

FL-4

Fuel System

General Information

Specifications

Fuel Delivery System

Items	Specification	
Fuel Tank	Capacity	73 lit. (77.1 U.S.qt., 64.2 Imp.qt.)
Fuel Filter	Type	High pressure type
Fuel Pressure Regulator	Regulated Fuel Pressure	379.5kPa (3.87kgf/cm ² , 55.0psi)
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	2,617
18.0	2,958
23.4	3,241
32.4	3,653
43.2	4,024
57.6	4,399
72.0	4,704
108.0	5,329
144.0	5,897
198.0	6,553
270.0	7,240
360.0	7,957
486.0	8,738
666.0	9,644
900.0	10,590

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 sensor

▷ Specification

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

General Information

FL-5

Engine Coolant Temperature Sensor (ECTS)

▷ Type: Thermistor type

▷ Specification

Temperature		Resistance (k Ω)
$^{\circ}\text{C}$	$^{\circ}\text{F}$	
-40	-40	48.14
-20	-4	14.13 ~ 16.83
0	32	5.79
20	68	2.31 ~ 2.59
40	104	1.15
60	140	0.59
80	176	0.32

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

▷ Type: Variable resistor type

▷ Specification

Throttle Angle($^{\circ}$)	Output Voltage(V)	
	TPS1	TPS2
0	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 $^{\circ}\text{C}$ (68 $^{\circ}\text{F}$)]
TPS2	2.7 ~ 4.1 [20 $^{\circ}\text{C}$ (68 $^{\circ}\text{F}$)]

Crankshaft Position Sensor (CKPS)

▷ Type: Magnetic field sensitive sensor

▷ Specification

Item	Specification
Coil Resistance (Ω)	630 ~ 770 Ω [25 $^{\circ}\text{C}$ (77 $^{\circ}\text{F}$)]
Air Gap (mm)	0.5 ~ 1.5

Camshaft Position Sensor (CMPS)

▷ Type: Hall effect type

▷ Specification

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

Knock Sensor (KS)

▷ Type: Piezo-electricity type

▷ Specification

Item	Specification
Capacitance (pF)	1,480 ~ 2,220

Heated Oxygen Sensor (HO2S)

▷ Type: Zirconia (ZrO₂) Type

▷ Specification

A/F Ratio (λ)	Output Voltage(V)
RICH	0.75 ~ 0.92
LEAN	0.04 ~ 0.1

Item	Specification
Heater Resistance (Ω)	8.1 ~ 11.1 Ω [21 $^{\circ}\text{C}$ (69.8 $^{\circ}\text{F}$)]

FL-6

Fuel System

CVVT Oil Temperature Sensor (OTS)

▷ Type: Thermistor type

▷ Specification

Temperature		Resistance (k Ω)
$^{\circ}\text{C}$	$^{\circ}\text{F}$	
-40	-40	52.15
-20	-4	16.52
0	32	6.0
20	68	2.45
40	104	1.11
60	140	0.54
80	176	0.29

Accelerator Position Sensor (APS)

▷ Type: Magnetic field sensitive sensor

▷ Specification

Accelerator Position	Output Voltage (V)	
	APS1	APS2
C.T	0.58 ~ 0.93	0.29 ~ 0.46
W.O.T	3.85 ~ 4.35	1.93 ~ 2.18

Actuators

Injector

▷ Specification

Item	Specification
Coil Resistance (Ω)	11.4 ~ 12.6 [20 $^{\circ}\text{C}$ (68 $^{\circ}\text{F}$)]

ETC Motor [integrated into ETC Module]

▷ Specification

Item	Specification
Coil Resistance (Ω)	1.275 ~ 1.725 [20 $^{\circ}\text{C}$ (68 $^{\circ}\text{F}$)]

Purge Control Solenoid Valve (PCSV)

▷ Specification

Item	Specification
Coil Resistance (Ω)	19.0 ~ 22.0 [20 $^{\circ}\text{C}$ (68 $^{\circ}\text{F}$)]

CVVT Oil Control Valve (OCV)

▷ Specification

Item	Specification
Coil Resistance (Ω)	6.7 ~ 7.7 [20 $^{\circ}\text{C}$ (68 $^{\circ}\text{F}$)]

Variable Intake Solenoid (VIS) Valve

▷ Specification

Item	Specification
Coil Resistance (Ω)	30.0 ~ 35.0 [20 $^{\circ}\text{C}$ (68 $^{\circ}\text{F}$)]

Ignition Coil

▷ Type: Stick type

▷ Specification

Item	Specification
1st Coil Resistance (Ω)	0.62 $\pm$ 10% [20 $^{\circ}\text{C}$ (68 $^{\circ}\text{F}$)]
2nd Coil Resistance (k Ω)	7.0 $\pm$ 15% [20 $^{\circ}\text{C}$ (68 $^{\circ}\text{F}$)]

General Information

FL-7

Service Standard

Item		Specification	
Ignition Timing (°)		BTDC 11 ± 5	
Idle Speed (rpm)	A/C OFF	Neutral, N, P-range	650 ± 100
		D-range	550 ± 100
	A/C ON	Neutral, N, P-range	650 ± 100
		D-range	550 ± 100

Tightening Torques

Engine Control System

Item	kgf.m	N.m	lb-ft
ECM installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Mass air flow sensor installation bolt	0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3
Engine coolant temperature sensor installation	2.0 ~ 4.0	19.6 ~ 39.2	14.5 ~ 28.9
Manifold absolute pressure sensor installation bolt	0.9 ~ 1.2	8.8 ~ 11.8	6.5 ~ 8.7
Crankshaft position sensor installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2
Camshaft position sensor (Bank 1/Intake) installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2
Camshaft position sensor (Bank 1/Exhaust) installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2
Camshaft position sensor (Bank 2/Intake) installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2
Camshaft position sensor (Bank 2/Exhaust) installation bolt	0.7 ~ 1.0	6.9 ~ 9.8	5.1 ~ 7.2
Knock sensor #1 (Bank 1) installation bolt	1.6 ~ 2.4	15.7 ~ 23.5	11.6 ~ 17.4
Knock sensor #2 (Bank 2) installation bolt	1.6 ~ 2.4	15.7 ~ 23.5	11.6 ~ 17.4
Heated oxygen sensor (Bank 1 / sensor 1) installation	4.0 ~ 5.0	39.2 ~ 49.1	28.9 ~ 36.2
Heated oxygen sensor (Bank 1 / sensor 2) installation	4.0 ~ 5.0	39.2 ~ 49.1	28.9 ~ 36.2
Heated oxygen sensor (Bank 2 / sensor 1) installation	4.0 ~ 5.0	39.2 ~ 49.1	28.9 ~ 36.2
Heated oxygen sensor (Bank 2 / sensor 2) installation	4.0 ~ 5.0	39.2 ~ 49.1	28.9 ~ 36.2
CVVT oil temperature sensor installation	2.0 ~ 4.0	19.6 ~ 39.2	14.5 ~ 28.9
Electronic throttle body installation bolt	0.9 ~ 1.2	8.8 ~ 11.8	6.5 ~ 8.7
Purge control solenoid valve bracket installation bolt	0.9 ~ 1.2	8.8 ~ 11.8	6.5 ~ 8.7
CVVT oil control valve (Bank 1 / Intake) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
CVVT oil control valve (Bank 1 / Exhaust) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
CVVT oil control valve (Bank 2 / Intake) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
CVVT oil control valve (Bank 2 / Exhaust) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Variable intake solenoid valve installation nut	0.9 ~ 1.2	8.8 ~ 11.8	6.5 ~ 8.7
Ignition coil installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Ignition coil condenser installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7

FL-8

Fuel System

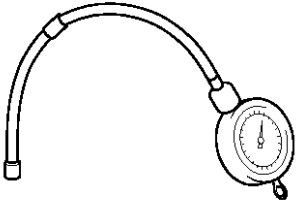
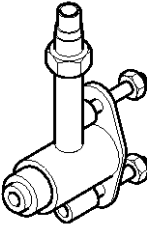
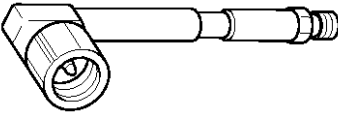
Fuel Delivery System

Item	kgf.m	N.m	lb-ft
Fuel tank band installation nut	4.0 ~ 5.5	39.2 ~ 54.0	28.9 ~ 39.8
Fuel pump installation bolt	0.2 ~ 0.3	2.0 ~ 2.9	1.4 ~ 2.2
Sub fuel sender installation bolt	0.2 ~ 0.3	2.0 ~ 2.9	1.4 ~ 2.2
Filler-neck assembly installation bolt	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
Filler-neck assembly installation nut	0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3
Accelerator pedal module installation bolt	0.9 ~ 1.4	8.8 ~ 13.7	6.5 ~ 10.1

General Information

FL-9

Special Service Tools

Tool (Number and Name)	Illustration	Application
Fuel Pressure Gauge (09353-24100)	 EFDA003A	Measuring the fuel line pressure
Fuel Pressure Gauge Adapter (09353-38000)	 BF1A025D	Connection between the delivery pipe and the fuel feed line
Fuel Pressure Gauge Connector (09353-24000)	 EFDA003C	Connection between the Fuel Pressure Gauge (09353-24100) and the Fuel Pressure Gauge Adapter (09353-38000)

FL-10

Fuel System

Basic Troubleshooting

Basic Troubleshooting Guide

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

LW8F1001

General Information

FL-11

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	CPF (Diesel Engine)	☐ With CPF ☐ Without CPF

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	

SFDF28233L

FL-12

Fuel System

Basic Inspection Procedure

Measuring Condition of Electronic Parts' Resistance

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

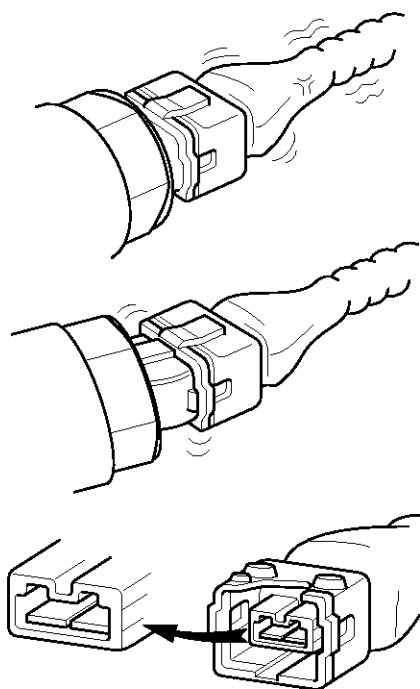
NOTICE

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

Intermittent Problem Inspection Procedure

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

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



BFGE321A

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

● Simulating Vibration

- a. Sensors and Actuators

: Slightly vibrate sensors, actuators or relays with finger.

⚠ WARNING

Strong vibration may break sensors, actuators or relays

- b. Connectors and Harness

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

● Simulating Heat

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

⚠ WARNING

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

● Simulating Water Sprinkling

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

⚠ WARNING

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

● Simulating Electrical Load

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

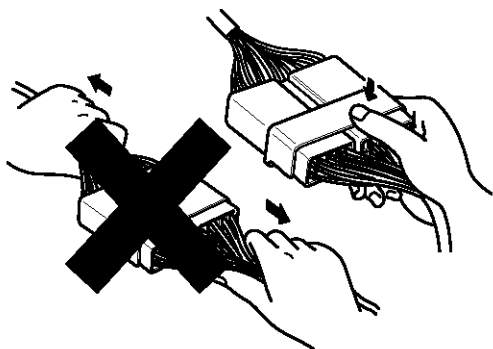
General Information

FL-13

Connector Inspection Procedure

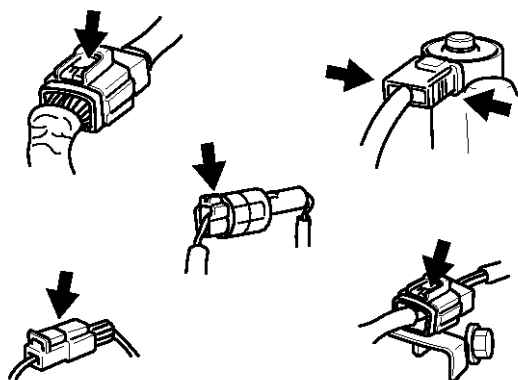
1. Handling of Connector

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



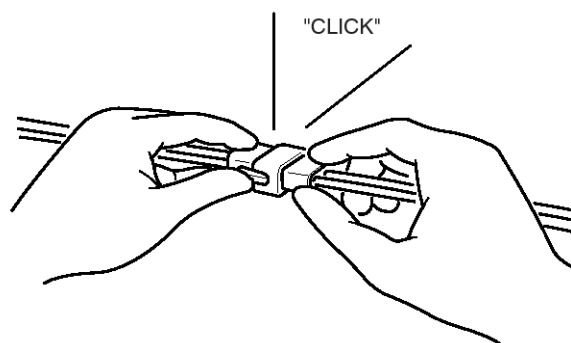
BFGE015F

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



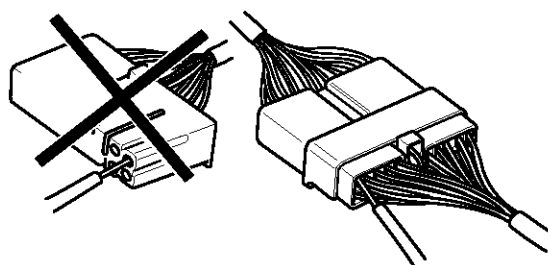
BFGE015G

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



BFGE015H

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

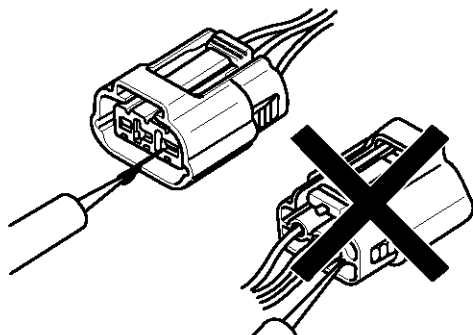


BFGE015I

FL-14

Fuel System

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



BFGE015J

NOTICE

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

2. Checking Point for Connector

- a. While the connector is connected:

Hold the connector, check connecting condition and locking efficiency.

- b. When the connector is disconnected:

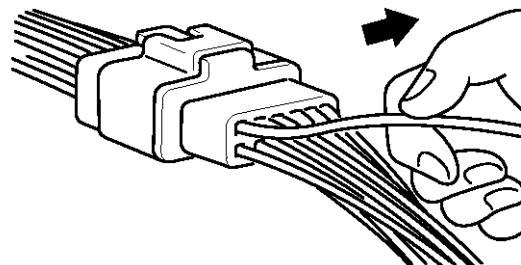
Check missed terminal, crimped terminal or broken core wire by slightly pulling the wire harness.

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.



BFGE015K

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.

General Information

FL-15

Electrical Circuit Inspection Procedure

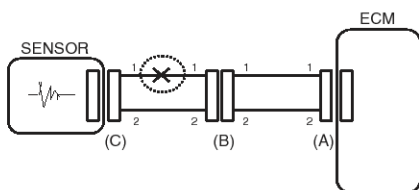
● Check Open Circuit

1. Procedures for Open Circuit

- Continuity Check
- Voltage Check

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

FIG 1



BFGE501A

2. Continuity Check Method

NOTICE

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

Specification (Resistance)

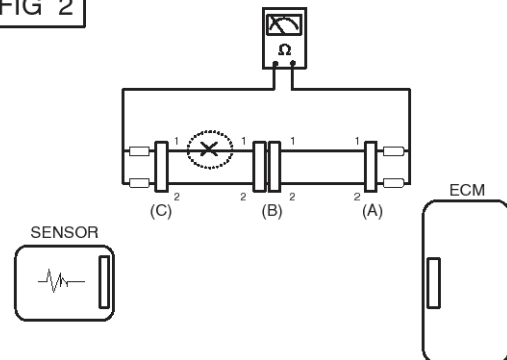
1Ω or less → Normal Circuit

1MΩ or Higher → Open Circuit

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

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

FIG 2

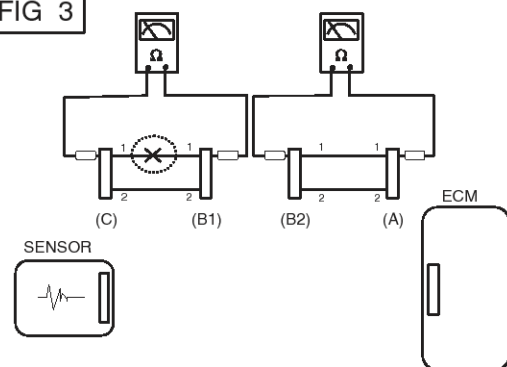


BFGE501B

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

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

FIG 3



BFGE501C

3. Voltage Check Method

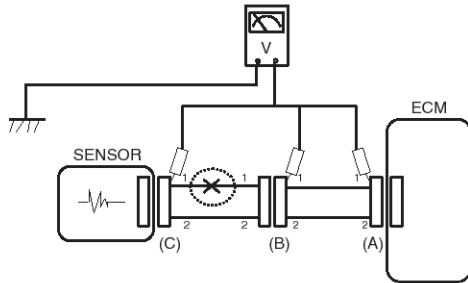
- With each connector still connected, measure the voltage between the chassis ground and terminal 1 of each connectors (A), (B) and (C) as shown in [FIG. 4].

FL-16

Fuel System

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

FIG 4



BFGE501D

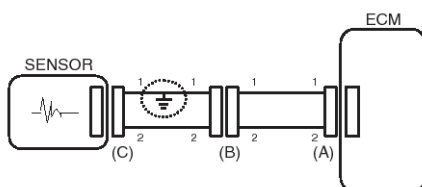
● Check Short Circuit

1. Test Method for Short to Ground Circuit

- Continuity Check with Chassis Ground

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

FIG 5



BFGE501E

2. Continuity Check Method (with Chassis Ground)

NOTICE

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

Specification (Resistance)

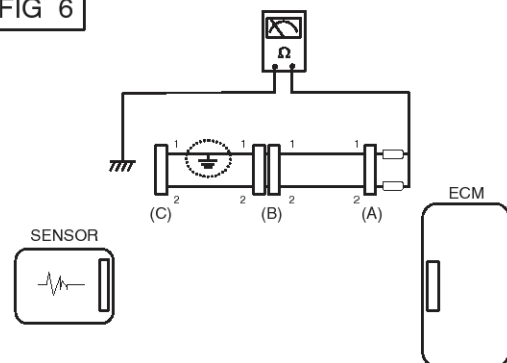
1Ω or less → Short to Ground Circuit

1MΩ or Higher → Normal Circuit

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

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

FIG 6

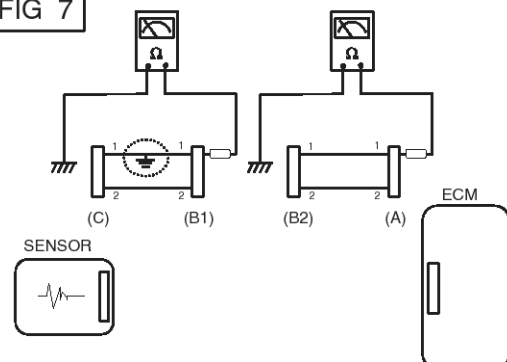


BFGE501F

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

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

FIG 7



BFGE501G

General Information

FL-17

Symptom Troubleshooting Guide Chart

Main symptom	Diagnostic procedure	Also check for
Unable to start (Engine does not turn over)	1. Test the battery 2. Test the starter 3. Inhibitor switch (A/T) or clutch start switch (M/T)	
Unable to start (Incomplete combustion)	1. Test the battery 2. Check the fuel pressure 3. Check the ignition circuit 4. Troubleshooting the immobilizer system (In case of immobilizer lamp flashing)	• DTC • Low compression • Intake air leaks • Slipped or broken timing belt • Contaminated fuel
Difficult to start	1. Test the battery 2. Check the fuel pressure 3. Check the ECT sensor and circuit (Check DTC) 4. Check the ignition circuit	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Poor idling (Rough, unstable or incorrect Idle)	1. Check the fuel pressure 2. Check the Injector 3. Check the long term fuel trim and short term fuel trim (Refer to CUSTOMER DATASTREAM) 4. Check the idle speed control circuit (Check DTC) 5. Inspect and test the Throttle Body 6. Check the ECT sensor and circuit (Check DTC)	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Engine stall	1. Test the Battery 2. Check the fuel pressure 3. Check the idle speed control circuit (Check DTC) 4. Check the ignition circuit 5. Check the CKPS Circuit (Check DTC)	• DTC • Intake air leaks • Contaminated fuel • Weak ignition spark
Poor driving (Surge)	1. Check the fuel pressure 2. Inspect and test Throttle Body 3. Check the ignition circuit 4. Check the ECT Sensor and Circuit (Check DTC) 5. Test the exhaust system for a possible restriction 6. Check the long term fuel trim and short term fuel trim (Refer to CUSTOMER DATASTREAM)	• 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 · A/C on full time or the defroster mode on? · Are tires at correct pressure? · Is excessively heavy load being carried? · Is acceleration too much, too often? 2. Check the fuel pressure 3. Check the injector 4. Test the exhaust system for a possible restriction 5. Check the ECT sensor and circuit	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark

FL-18

Fuel System

Main symptom	Diagnostic procedure	Also check for
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)

Engine Control System

FL-19

Engine Control System

Description

If the Gasoline Engine Control system components (sensors, ECM, injector, etc.) fail, interruption to the fuel supply or failure to supply the proper amount of fuel for various engine operating conditions will result. The following situations may be encountered.

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)

[EOBD]

A malfunction indicator lamp illuminates to notify the driver that there is a problem with the vehicle. However, the MIL will go off automatically after 3 subsequent sequential driving cycles without the same malfunction. Immediately after the ignition switch is turned on (ON position - do not start), the MIL will illuminate continuously to indicate that the MIL operates normally.

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.

FL-20

Fuel System

[NON-EOBD]

A malfunction indicator lamp illuminates to notify the driver that there is a problem with the vehicle. However, the MIL will go off automatically after 3 subsequent sequential driving cycles without the same malfunction. Immediately after the ignition switch is turned on (ON position - do not start), the MIL will illuminate continuously to indicate that the MIL operates normally.

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.

[INSPECTION]

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.

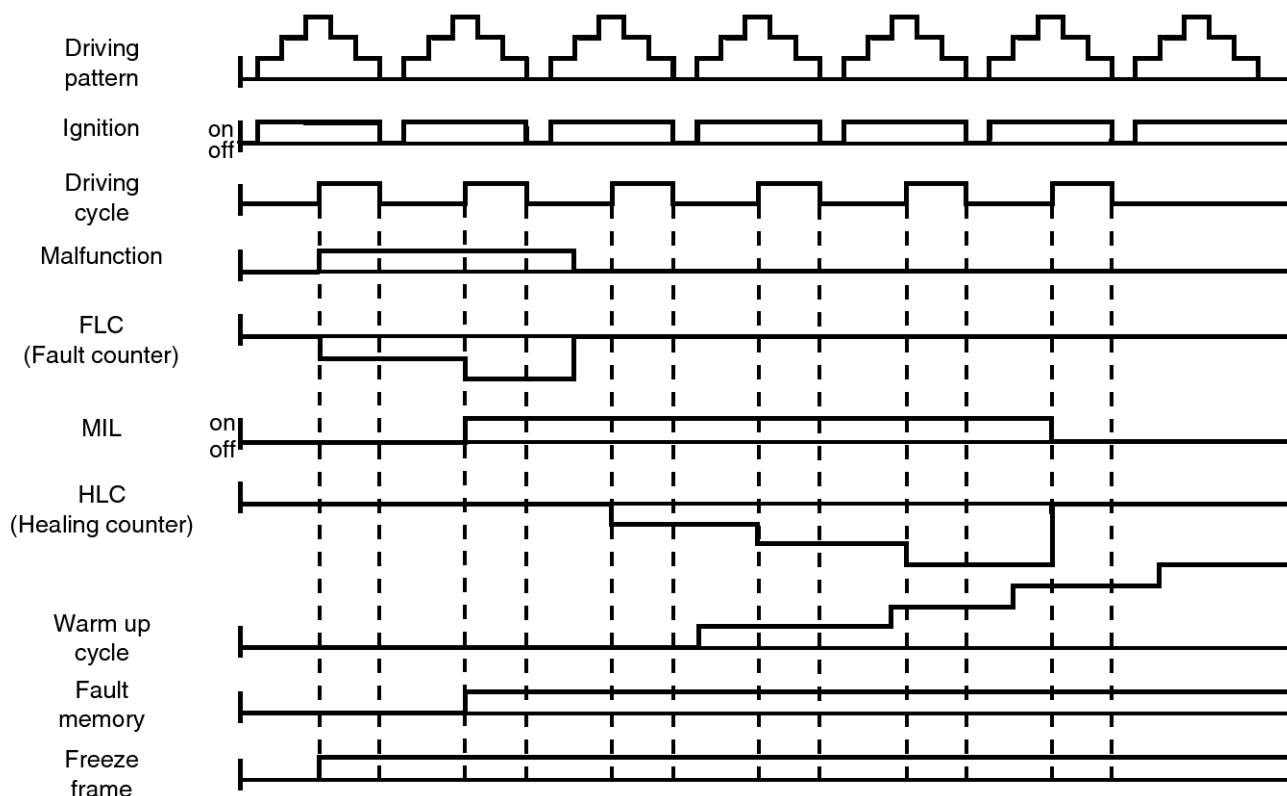
Self-Diagnosis

The ECM monitors the input/output signals (some signals at all times and the others under specified conditions). When the ECM detects an irregularity, it records the diagnostic trouble code, and outputs the signal to the Data Link connector. The diagnosis results can be read with the MIL or HI-SCAN (Pro). Diagnostic Trouble Codes (DTC) will remain in the ECM as long as battery power is maintained. The diagnostic trouble codes will, however, be erased when the battery terminal or ECM connector is disconnected, or by the HI-SCAN (Pro).

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



LGIF601Q

Engine Control System

FL-21

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.

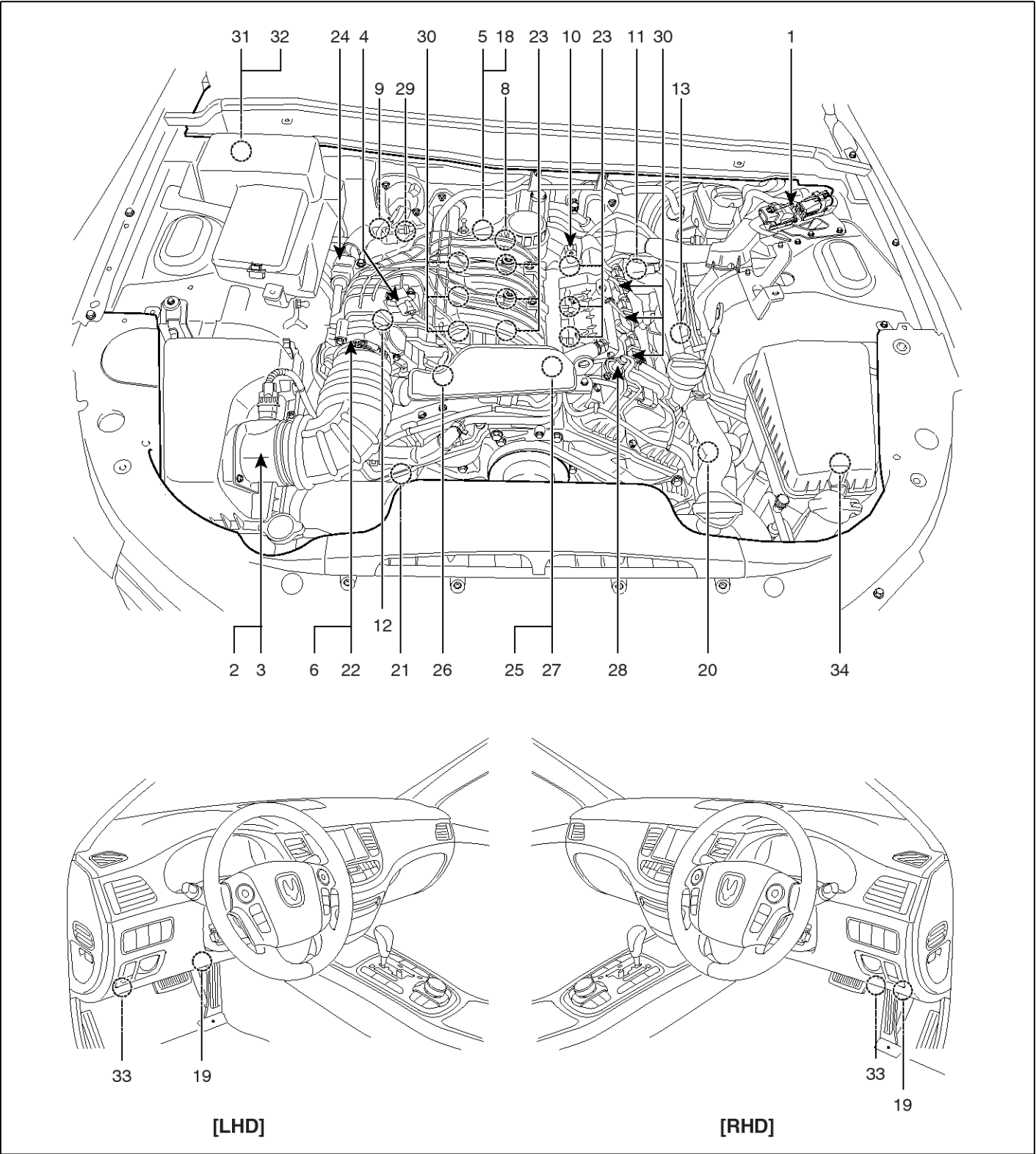
If a misfire is detected, a DTC will be recorded, and the MIL will illuminate, immediately after a fault is first detected.

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.

Components Location

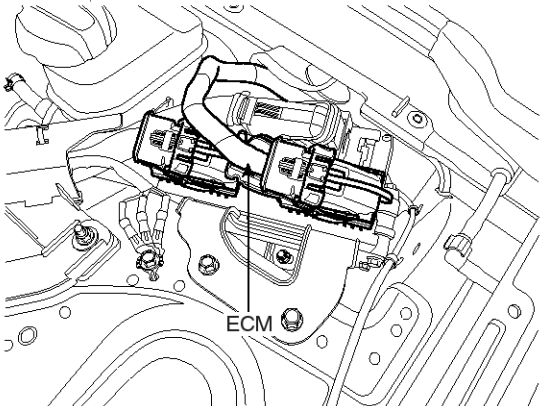
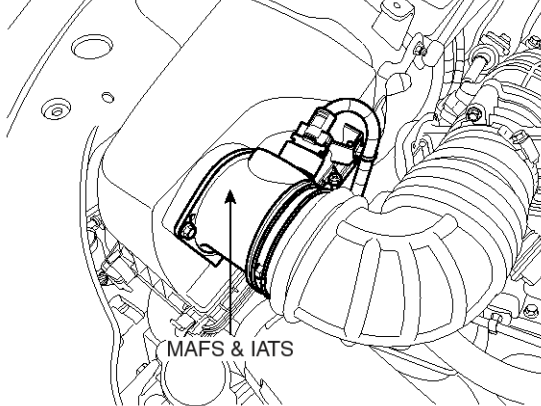
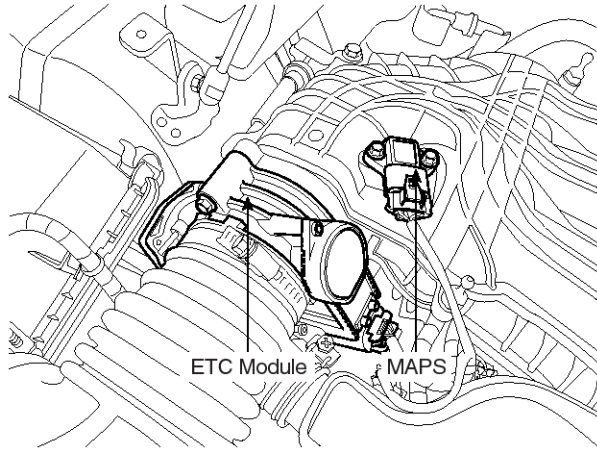
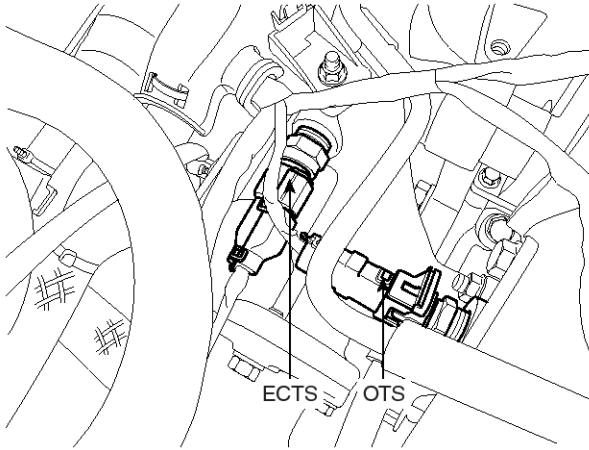


SBHFL9100L

Engine Control System

FL-23

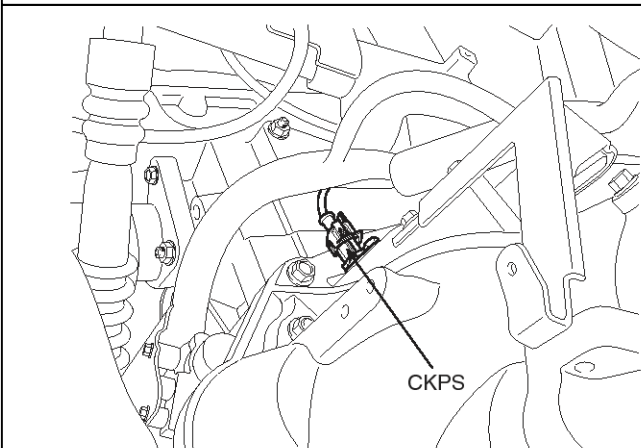
1. ECM (Engine Control Module)
2. Mass Air Flow Sensor (MAFS)
3. Intake Air Temperature Sensor (IATS)
4. Manifold Absolute Pressure Sensor (MAPS)
5. Engine Coolant Temperature Sensor (ECTS)
6. Throttle Position Sensor (TPS) [integrated into ETC Module]
7. Crankshaft Position Sensor (CKPS)
8. Camshaft Position Sensor (CMPS) [Bank 1 / Intake]
9. Camshaft Position Sensor (CMPS) [Bank 1 / Exhaust]
10. Camshaft Position Sensor (CMPS) [Bank 2 / Intake]
11. Camshaft Position Sensor (CMPS) [Bank 2 / Exhaust]
12. Knock Sensor (KS) [Bank 1]
13. Knock Sensor (KS) [Bank 2]
14. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 1]
15. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 2]
16. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 1]
17. Heated Oxygen Sensor (HO2S) [Bank 2 / Sensor 2]
18. CVVT Oil Temperature Sensor (OTS)
19. Accelerator Position Sensor (APS)
20. A/C Pressure Transducer (APT)
21. Power Steering Pressure Sensor (PSPS) [Without EHPS]
22. ETC Motor [integrated into ETC Module]
23. Injector
24. Purge Control Solenoid Valve (PCSV)
25. CVVT Oil Control Valve (OCV) [Bank 1 / Intake]
26. CVVT Oil Control Valve (OCV) [Bank 1 / Exhaust]
27. CVVT Oil Control Valve (OCV) [Bank 2 / Intake]
28. CVVT Oil Control Valve (OCV) [Bank 2 / Exhaust]
29. Variable Intake Solenoid (VIS) Valve
30. Ignition Coil
31. Main Relay
32. Fuel Pump Relay
33. Data Link Connector (DLC) [16 Pin]
34. Multi-Purpose Check Connector [20 Pin]

1. ECM (Engine Control Module)	2. Mass Air Flow Sensor (MAFS) 3. Intake Air Temperature Sensor (IATS)
 ECM SBHFL8101D	 MAFS & IATS SBHFL8102D
4. Manifold Absolute Pressure Sensor (MAPS) 6. Throttle Position Sensor (TPS) [integrated into ETC Module] 22. ETC Motor [integrated into ETC Module]	5. Engine Coolant Temperature Sensor (ECTS) 18. CVVT Oil Temperature Sensor (OTS)
 ETC Module MAPS SBHFL9101L	 ECTS OTS SBHFL8104D

Engine Control System

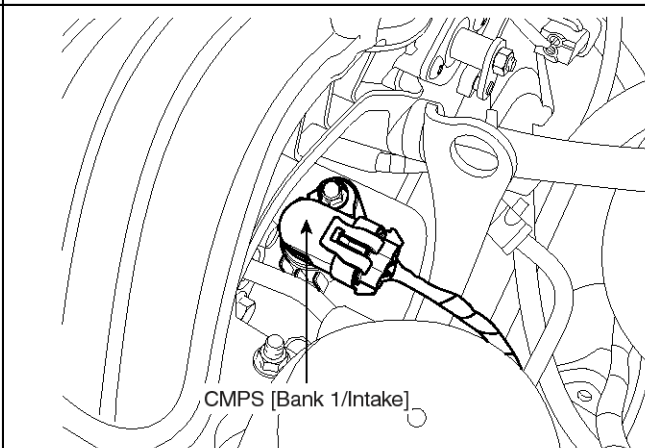
FL-25

7. Crankshaft Position Sensor (CKPS)



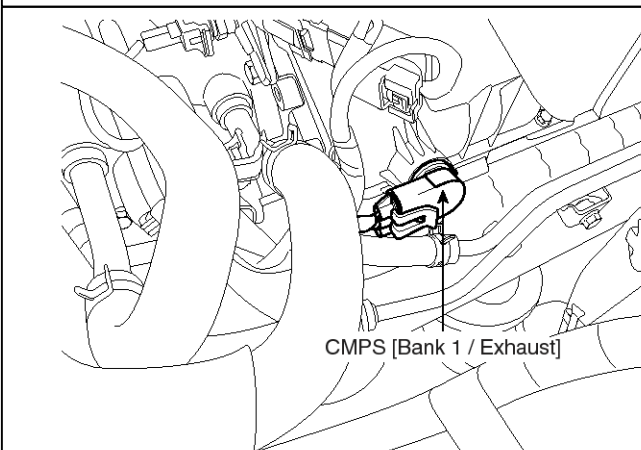
SBHFL8105D

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



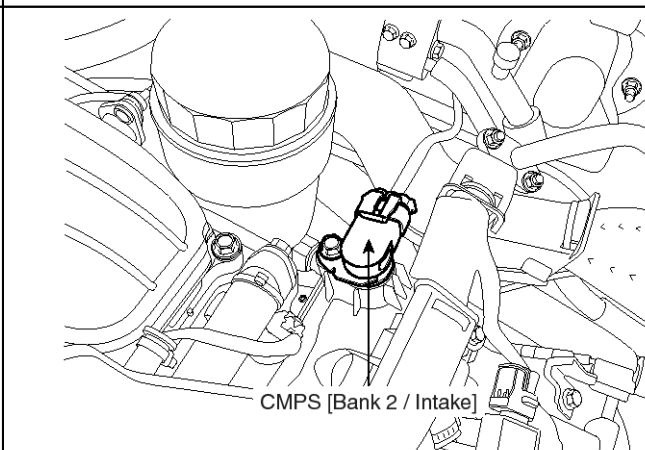
SBHFL9102L

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



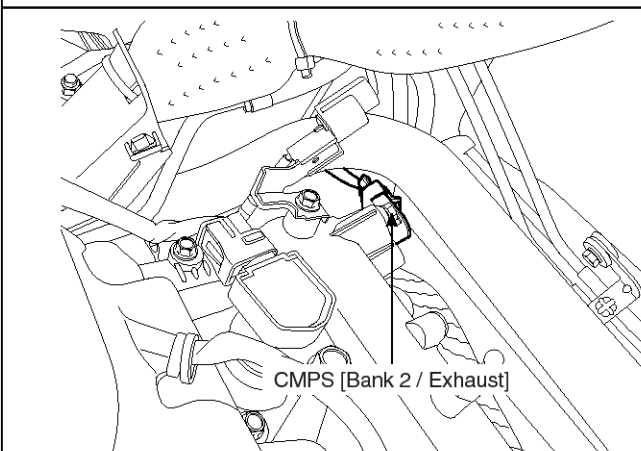
SBHFL9103L

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



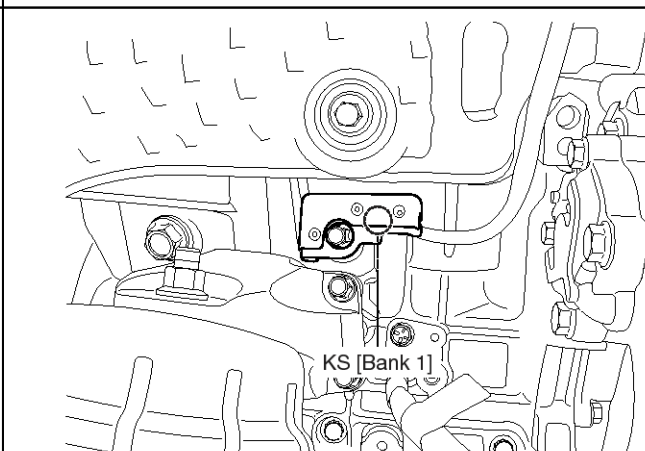
SBHFL9104L

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



SBHFL9105L

12. Knock Sensor (KS) [Bank 1]

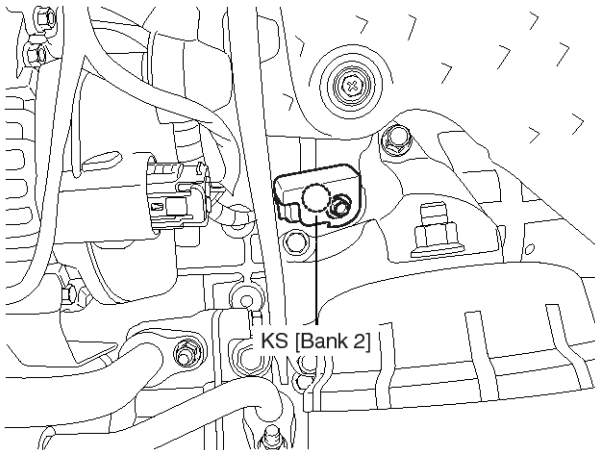


SBHFL9106L

FL-26

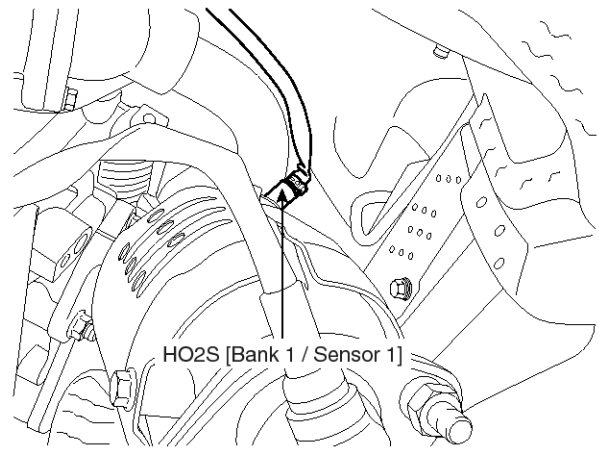
Fuel System

13. Knock Sensor (KS) [Bank 2]



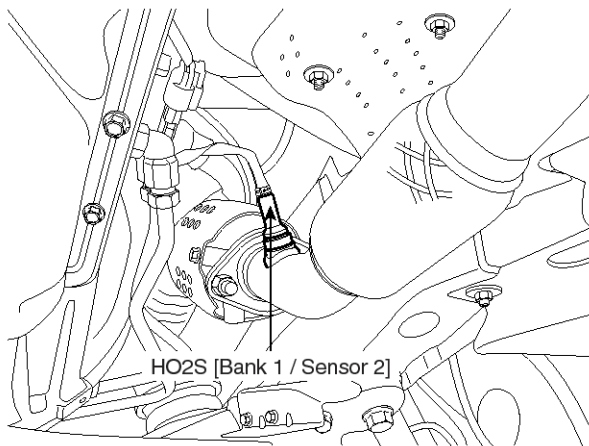
SBHFL9107L

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



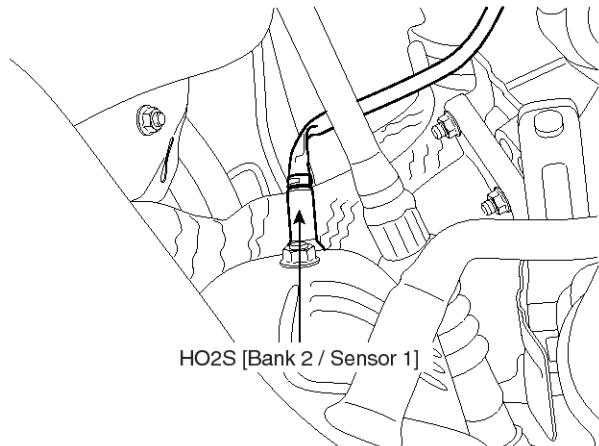
SBHFL9108L

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



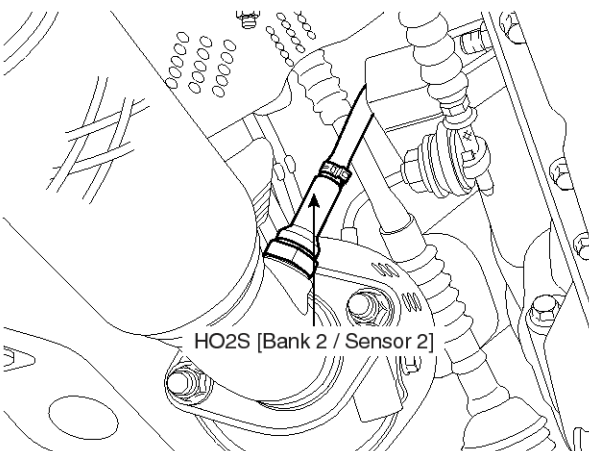
SBHFL9109L

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



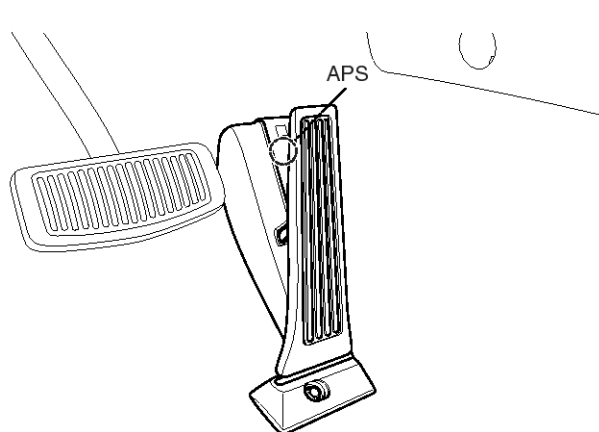
SBHFL9110L

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



SBHFL9111L

19. Accelerator Position Sensor (APS)

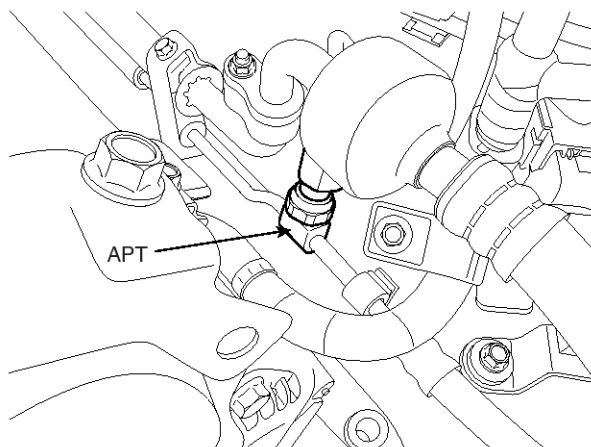


SBHFL8116D

Engine Control System

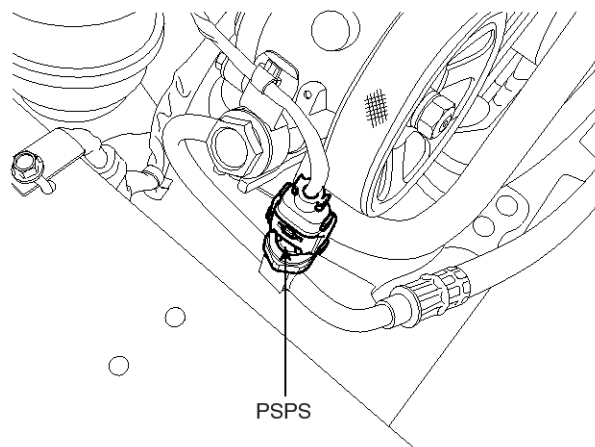
FL-27

20. A/C Pressure Transducer (APT)



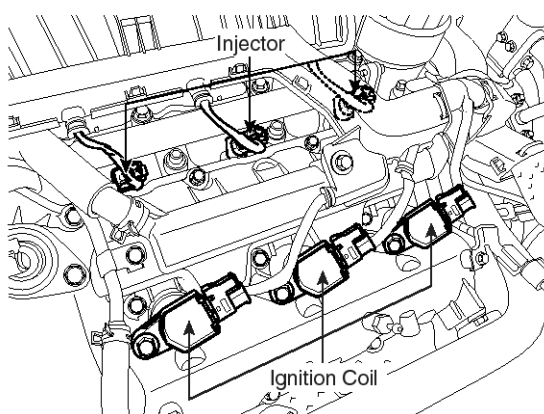
SBHFL8117D

21. Power Steering Pressure Sensor (PSPS)



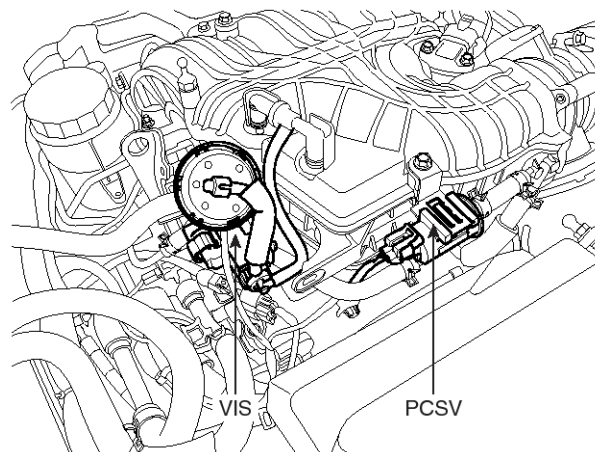
SBHFL8118D

23. Injector
30. Ignition Coil



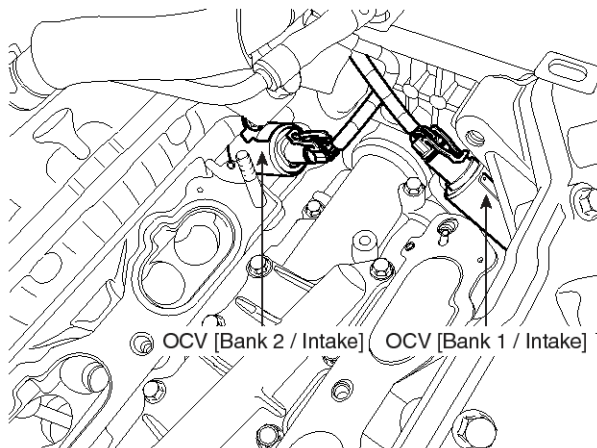
SBHFL9112L

24. Purge Control Solenoid Valve (PCSV)
29. Variable Intake Solenoid (VIS) Valve



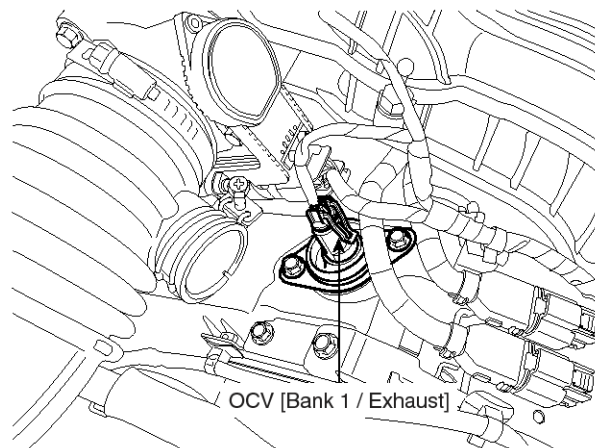
SBHFL8122D

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



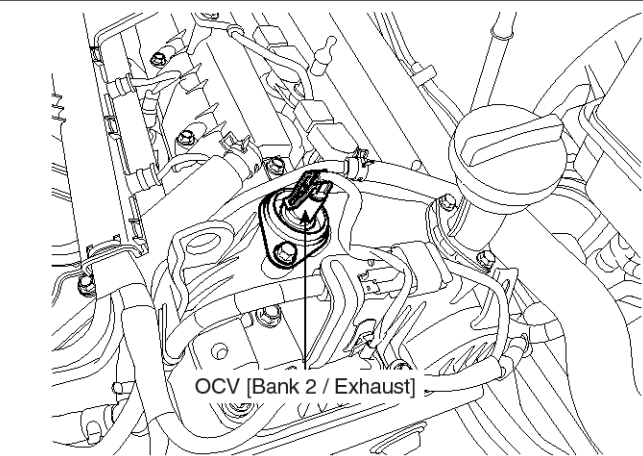
SBHFL9113L

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



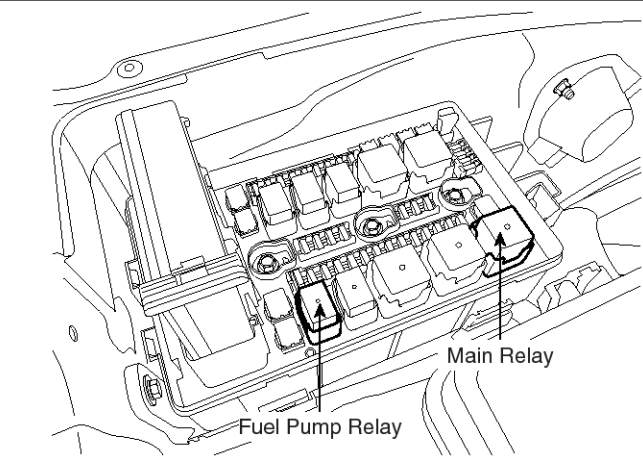
SBHFL9114L

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



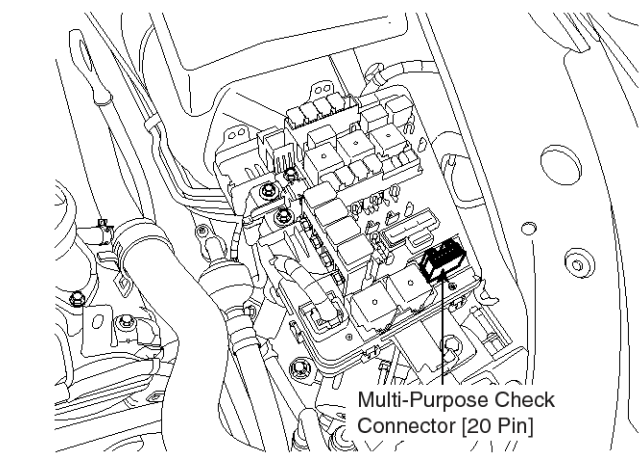
SBHFL9115L

31. Main Relay
32. Fuel Pump Relay



SBHFL9116L

34. Multi-Purpose Check Connector [20 Pin]



SBHFL9117L

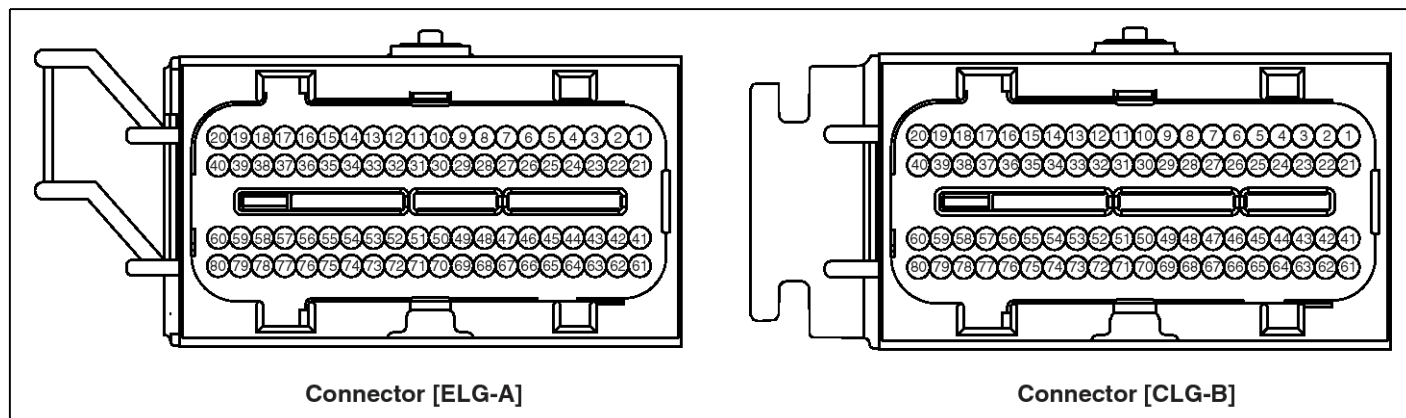
Engine Control System

FL-29

Engine Control Module (ECM)

ECM Terminal And Input/Output signal

ECM Harness Connector



SBHFL9118L

ECM Terminal Function

Connector [ELG-A]

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	-	
11	-	
12	-	
13	-	
14	-	
15	Alternator "FR" PWM signal input	Alternator
16	Ground	Cruise Control Switch
17	-	
18	A/C Switch "ON" signal input	A/C Control Module
19	-	
20	-	

FL-30

Fuel System

Pin No.	Description	Connected to
21	Brake Switch 2 signal input	Brake Switch
22	-	
23	Brake Switch 1 signal input	Brake Switch
24	-	
25	Cruise Control Switch signal input	Cruise Control Switch
26	-	
27	Immobilizer communication line	Immobilizer Control Unit [Without Button Engine Start System]
		Instrument Panel Module [With Button Engine Start System]
28	-	
29	-	
30	-	
31	Electrical Load signal input	Head Lamp Relay
32	A/C Pressure Transducer (APT) signal input	A/C Pressure Transducer (APT)
33	Sensor ground	A/C Pressure Transducer (APT)
		Power Steering Pressure Sensor (PSPS) [Without EHPS]
34	-	
35	-	
36	Alternator "C" PWM signal output	Alternator
37	-	
38	Batterypower (B+)	Main Relay
39	Batterypower (B+)	Main Relay
40	Batterypower (B+)	Main Relay
41	CAN [High]	Other control module, Data Link Connector (DLC), Multi-Purpose Check Connector
42	CAN [Low]	Other control module, Data Link Connector (DLC), Multi-Purpose Check Connector
43	Main Relaycontrol output	Main Relay
44	Intake Air Temperature Sensor (IATS) signal input	Intake Air Temperature Sensor (IATS)
45	LIN (Local Interconnect Network) Serial Bus Line	Battery Sensor
46	Power Steering Pressure Sensor (PSPS) signal input	Power Steering Pressure Sensor (PSPS) [Without EHPS]
47	Mass Air Flow Sensor (MAFS) signal input	Mass Air Flow Sensor (MAFS)
48	Sensor ground	Accelerator Position Sensor (APS) 2
49	Accelerator Position Sensor (APS) 2 signal input	Accelerator Position Sensor (APS) 2

Engine Control System

FL-31

Pin No.	Description	Connected to
50	-	
51	-	
52	Vehicle speed signal input	ESP Control Module
53	Sensor ground	Intake Air Temperature Sensor (IATS)
54	Accelerator Position Sensor (APS) 1 signal input	Accelerator Position Sensor (APS) 1
55	Sensor ground	Accelerator Position Sensor (APS) 1
56	-	
57	Sensor power (+5V)	Accelerator Position Sensor (APS) 2
58	Sensor power (+5V)	A/C Pressure Transducer (APT)
		Power Steering Pressure Sensor (PSPS) [Without EHPS]
59	Sensor power (+5V)	Accelerator Position Sensor (APS) 1
60	-	
61	Engine speed signal output	Power Distribution Module (PDM)
62	-	
63	Malfunction Indicator Lamp (MIL) control output	Malfunction Indicator Lamp (MIL)
64	A/C Compressor "CUT" signal output	A/C Control Module
65	-	
66	Cooling Fan control signal (PWM) control output	Cooling Fan Control Module
67	-	
68	-	
69	-	
70	Fuel Pump Relay control output	Fuel Pump Relay
71	Variable Intake Solenoid (VIS) Valve control output	Variable Intake Solenoid (VIS) Valve
72	Immobilizer Lamp control output	Immobilizer Lamp
73	-	
74	-	
75	-	
76	-	
77	-	
78	Purge Control Solenoid Valve (PCSV) control output	Purge Control Solenoid Valve (PCSV)
79	-	
80	-	

FL-32

Fuel System

Connector [CLG-B]

Pin No.	Description	Connected to
1	ETC Motor [-] control output	ETC Motor
2	ETC Motor [+] control output	ETC Motor
3	-	
4	CVVT Oil Temperature Sensor (OTS) signal input	CVVT Oil Temperature Sensor (OTS)
5	-	
6	-	
7	Engine Coolant Temperature Sensor (ECTS) signal input	Engine Coolant Temperature Sensor (ECTS)
8	Manifold Absolute Pressure Sensor (MAPS) signal input	Manifold Absolute Pressure Sensor (MAPS)
9	-	
10	-	
11	Sensor power (+5V)	Manifold Absolute Pressure Sensor (MAPS)
12	Battery power (B+)	Ignition Switch
13	Sensor power (+5V)	Throttle Position Sensor (TPS) 2
14	Sensor ground	Throttle Position Sensor (TPS) 1
15	Sensor power (+5V)	Camshaft Position Sensor (CMPS) [Bank 2/Intake]
		Camshaft Position Sensor (CMPS) [Bank 2/Exhaust]
16	Sensor power (+5V)	Throttle Position Sensor (TPS) 1
17	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 2/Intake]
		Camshaft Position Sensor (CMPS) [Bank 2/Exhaust]
18	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 1/Intake]
		Camshaft Position Sensor (CMPS) [Bank 1/Exhaust]
19	Ignition Coil (Cylinder #6) control output	Ignition Coil (Cylinder #6)
20	-	
21	Crankshaft Position Sensor (CKPS) [High] signal input	Crankshaft Position Sensor (CKPS)
22	-	
23	Sensor Shield	Knock Sensor (KS) #1 [Bank 1]
		Knock Sensor (KS) #2 [Bank 2]
24	Camshaft Position Sensor (CMPS)[Bank 2/Intake] signal input	Camshaft Position Sensor (CMPS) [Bank 2/Intake]
25	Camshaft Position Sensor (CMPS)[Bank 1/Intake] signal input	Camshaft Position Sensor (CMPS) [Bank 1/Intake]
26	Camshaft Position Sensor (CMPS)[Bank 2/Exhaust] signal input	Camshaft Position Sensor (CMPS) [Bank 2/Exhaust]

Engine Control System

FL-33

Pin No.	Description	Connected to
27	Camshaft Position Sensor (CMPS)[Bank 1/Exhaust] signal input	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust]
28	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1]
29	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2]
30	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
31	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
32	Sensor power (+5V)	Camshaft Position Sensor (CMPS) [Bank 1/Intake]
		Camshaft Position Sensor (CMPS) [Bank 1/Exhaust]
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 (CKPS) [Low] signal input	Crankshaft Position Sensor (CKPS)
42	-	
43	-	
44	-	
45	-	
46	-	
47	-	
48	Throttle Position Sensor (TPS) 1 signal input	Throttle Position Sensor (TPS) 1
49	Heated Oxygen Sensor (HO2S)[Bank 1/Sensor 1] signal input	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
50	Heated Oxygen Sensor (HO2S)[Bank 1/Sensor 2] signal input	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
51	Heated Oxygen Sensor (HO2S)[Bank 2/Sensor 1] signal input	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1]
52	Heated Oxygen Sensor (HO2S)[Bank 2/Sensor 2] signal input	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2]
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]

FL-34

Fuel System

Pin No.	Description	Connected to
56	Knock Sensor (KS) [Bank 1] [High] signal input	Knock Sensor (KS) [Bank 1]
57	Throttle Position Sensor (TPS) 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 (OCV)[Bank 2/Intake] control output	CVVT Oil Control Valve (OCV) [Bank 2/Intake]
62	CVVT Oil Control Valve (OCV)[Bank 1/Intake] control output	CVVT Oil Control Valve (OCV) [Bank 1/Intake]
63	Injector (Cylinder #2) control output	Injector (Cylinder #2)
64	Injector (Cylinder #3) control output	Injector (Cylinder #3)
65	CVVT Oil Control Valve (OCV)[Bank 1/Exhaust] control output	CVVT Oil Control Valve (OCV) [Bank 1/Exhaust]
66	CVVT Oil Control Valve (OCV)[Bank 2/Exhaust] control output	CVVT Oil Control Valve (OCV) [Bank 2/Exhaust]
67	Heated Oxygen Sensor (HO2S)[Bank 2/Sensor 1] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1]
68	Injector (Cylinder #4) control output	Injector (Cylinder #4)
69	Injector (Cylinder #5) control output	Injector (Cylinder #5)
70	Heated Oxygen Sensor (HO2S)[Bank 1/Sensor 1] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
71	Injector (Cylinder #6) control output	Injector (Cylinder #6)
72	Injector (Cylinder #1) control output	Injector (Cylinder #1)
73	Heated Oxygen Sensor (HO2S)[Bank 2/Sensor 2] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2]
74	Heated Oxygen Sensor (HO2S)[Bank 1/Sensor 2] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
75	-	
76	Batterypower (B+)	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	-	

Engine Control System

FL-35

ECM Terminal Input/Output Signal Connector [ELG-A]

Pin No.	Description	Condition	Type	Level
1	2nd CAN [High]	RECESSIVE	Pulse	2.0 ~ 3.0V
		DOMINANT		2.75 ~ 4.5V
2	2nd CAN [Low]	RECESSIVE	Pulse	2.0 ~ 3.0V
		DOMINANT		0.5 ~ 2.25V
3	-			
4	-			
5	-			
6	-			
7	-			
8	-			
9	-			
10	-			
11	-			
12	-			
13	-			
14	-			
15	Alternator "FR" PWM signal input	Idle	PWM	High: Battery voltage
				Low: Max. 1.5V
				133 <Frequency< 200Hz
				5 <Duty< 95%
16	Ground	Idle	DC	Max. 150mV
17	-			
18	A/C Switch "ON" signal input	S/W ON	DC	Min. 5.7V
		S/W OFF	DC	Max. 1.0V
19	-			
20	-			
21	Brake Switch 2 signal input	Brake ON	DC	Max. 0.5V
		Brake OFF		Battery Voltage
22	-			
23	Brake Switch 1 signal input	Brake ON	DC	Battery Voltage
		Brake OFF		Max. 0.5V
24	-			

FL-36

Fuel System

Pin No.	Description	Condition	Type	Level
25	Cruise Control Switch signal input	MAIN	DC	11.1 ~ 12.1V
		SET		1.0 ~ 1.8V
		CANCEL		-0.5 ~ 0.5V
		RESUME		2.5 ~ 3.5V
26	-			
27	Immobilizer communication line	When transmitting	DC	Hi: Min. Vbatt X 80%
				Lo: Max. Vbatt X 20%
		When receiving		Hi: Min. Vbatt X 70%
				Lo: Max. Vbatt X 30%
28	-			
29	-			
30	-			
31	Electrical Load signal input			
32	A/C Pressure Transducer (APT) signal input	A/C ON	DC	0.5 ~ 4.5V
33	Sensor ground	Idle	DC	Max. 150mV
34	-			
35	-			
36	Alternator "C" PWM control output	Idle	PWM	High: Min. 4.0V
				Low: Max. 2.0V
37	-			
38	Batterypower (B+)	Idle	DC	Battery Voltage
39	Batterypower (B+)	Idle	DC	Battery Voltage
40	Batterypower (B+)	Idle	DC	Battery Voltage
41	CAN [High]	RECESSIVE	Pulse	2.0 ~ 3.0V
		DOMINANT		2.75 ~ 4.5V
42	CAN [Low]	RECESSIVE	Pulse	2.0 ~ 3.0V
		DOMINANT		0.5 ~ 2.25V
43	Main Relay control output	Relay ON	DC	Max. 1.7V
		Relay OFF		Battery Voltage
44	Intake Air Temperature Sensor (IATS)signal input	Idle	DC	4.85V (-40℃)
				0.07V (150℃)

Engine Control System

FL-37

Pin No.	Description	Condition	Type	Level
45	LIN (Local Interconnect Network) Serial Bus Line	When transmitting	DC	Hi: Min. Vbatt X 80%
		When receiving		Lo: Max. Vbatt X 20%
				Hi: Min. Vbatt X 70%
				Lo: Max. Vbatt X 30%
46	Power Steering Pressure Sensor (PSPS) signal input	Idle	DC	0.3 ~ 4.53V
47	Mass Air Flow Sensor (MAFS) signal input	Idle	Pulse	High: Min.4.5V
				Low: Max. 0.6V
				768 <Frequency< 12,032Hz
				Duty= 50%
48	Sensor ground	Idle	DC	Max. 150mV
49	Accelerator Position Sensor (APS) 2 signal input	C.T	DC	0.29 ~ 0.46V
		W.O.T		1.93 ~ 2.18V
50	-			
51	-			
52	Vehicle speed signal input	Vehicle Run	Pulse	High: Min. 4.0V
				Low: Max. 1.1V
				6.4 <Frequency< 1,534Hz
				Duty= 50%
53	Sensor ground	Idle	DC	Max. 150mV
54	Accelerator Position Sensor (APS) 1 signal input	C.T	DC	0.58 ~ 0.93V
		W.O.T		3.85 ~ 4.35V
55	Sensor ground	Idle	DC	Max. 150mV
56	-			
57	Sensor power (+5V)	Idle	DC	4.9 ~ 5.1V
58	Sensor power (+5V)	Idle	DC	4.9 ~ 5.1V
59	Sensor power (+5V)	Idle	DC	4.9 ~ 5.1V
60	-			
61	Engine speed signal output	Idle	Pulse	High: Battery Voltage
				Low: Max. 1.1V
				0 <Frequency< 350Hz
				47.5 <Duty< 52.5%
62	-			
63	Malfunction Indicator Lamp (MIL) control output	MIL ON	DC	Max. 0.5V
		MIL OFF		Battery Voltage

FL-38

Fuel System

Pin No.	Description	Condition	Type	Level
64	A/C Compressor "CUT" signal output			
65	-			
66	Cooling Fan control signal (PWM) control output	Idle	Pulse	High: Battery Voltage
				Low: Max. 0.5V
				Frequency= 300Hz
				0 <Duty< 100%
67	-			
68	-			
69	-			
70	Fuel Pump Relay control output	Relay ON	DC	Max. 1.1V
		Relay OFF		Battery Voltage
71	Variable Intake Solenoid (VIS) Valve control output	Valve Open	DC	Battery Voltage
		Valve Close		Max. 1.1V
72	Immobilizer Lamp control output	Lamp ON	DC	Max. 1.1V
		Lamp OFF		Battery Voltage
73	-			
74	-			
75	-			
76	-			
77	-			
78	Purge Control Solenoid Valve (PCSV) control output	Idle	Pulse	High: Battery Voltage
				Low: Max. 1.0V
				Frequency= 30Hz
				0 <Duty< 100%
79	-			
80	-			

Engine Control System

FL-39**Connector [CLG-B]**

Pin No	Description	Condition	Type	Level
1	ETC Motor [-] control output	Idle	PWM	Battery Voltage
2	ETC Motor [+] control output	Idle	Pulse	High: Battery Voltage
				Low: Max.1.0V
				1,500 <Frequency< 2,400Hz
				0 <Duty< 98%
3	-			
4	CVVT Oil Temperature Sensor (OTS) signal input	Idle	DC	0.15(150℃) ~ 4.85V(-40℃)
5	-			
6	-			
7	Engine Coolant Temperature Sensor (ECTS) signal input	Idle	DC	0 ~ 5.0V
8	Manifold Absolute Pressure Sensor (MAPS) signal input	Idle	DC	4.43V (107kPa)
				0.75V (20kPa)
9	-			
10	-			
11	Sensor power (+5V)	Idle	DC	4.9 ~ 5.1V
12	Battery power (B+)	Idle	DC	Battery Voltage
13	Sensor power (+5V)	Idle	DC	4.9 ~ 5.1V
14	Sensor ground	Idle	DC	Max. 150mV
15	Sensor power (+5V)	Idle	DC	4.9 ~ 5.1V
16	Sensor power (+5V)	Idle	DC	4.9 ~ 5.1V
17	Sensor ground	Idle	DC	Max. 150mV
18	Sensor ground	Idle	DC	Max. 150mV
19	Ignition Coil (Cylinder #6) control output	Idle	Pulse	V _{peak} = 400V
				0 <Frequency< 58.3Hz
20	-			
21	Crankshaft Position Sensor (CKPS) [High] signal input	Idle	SINE Wave	0.4 < V _{p_p} < 200V
				55 <Frequency< 7,000Hz
22	-			
23	Sensor Shield	Idle	DC	Max. 150mV
24	Camshaft Position Sensor (CMPS) [Bank 2/Intake] signal input	Idle	Pulse	High: 3.2 ~ V _{cc}
				Low: Max. 0.7V
				0 <Frequency< 350Hz

FL-40

Fuel System

Pin No	Description	Condition	Type	Level
25	Camshaft Position Sensor (CMPS) [Bank 1/Intake] signal input	Idle	Pulse	High: 3.2 ~ Vcc
				Low: Max. 0.7V
				0 <Frequency< 350Hz
26	Camshaft Position Sensor (CMPS) [Bank 2/Exhaust] signal input	Idle	Pulse	High: 3.2 ~ Vcc
				Low: Max. 0.7V
				0 <Frequency< 350Hz
27	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust] signal input	Idle	Pulse	High: 3.2 ~ Vcc
				Low: Max. 0.7V
				0 <Frequency< 350Hz
28	Sensor ground	Idle	DC	Max. 150mV
29	Sensor ground	Idle	DC	Max. 150mV
30	Sensor ground	Idle	DC	Max. 150mV
31	Sensor ground	Idle	DC	Max. 150mV
32	Sensor power (+5V)	Idle	DC	4.9 ~ 5.1V
33	Sensor ground	Idle	DC	Max. 150mV
34	Sensor ground	Idle	DC	Max. 150mV
35	Power ground	Idle	DC	Max. 150mV
36	Power ground	Idle	DC	Max. 150mV
37	Power ground	Idle	DC	Max. 150mV
38	Power ground	Idle	DC	Max. 150mV
39	Power ground	Idle	DC	Max. 150mV
40	Ignition Coil (Cylinder #4) control output	Idle	Pulse	Vpeak = 400V
				0 <Frequency< 58.3Hz
41	Crankshaft Position Sensor (CKPS) [Low] signal input	Idle	SINE Wave	0.4 < Vp_p < 200V
				55 <Frequency< 7,000Hz
42	-			
43	-			
44	-			
45	-			
46	-			
47	-			
48	Throttle Position Sensor (TPS) 1 signal input	C.T	DC	0.25 ~ 0.9V
		W.O.T		Min. 4.0V

Engine Control System

FL-41

Pin No	Description	Condition	Type	Level
49	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] signal input	RICH	DC	0.75 ~ 0.92V
		LEAN		0.04 ~ 0.1V
50	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] signal input	RICH	DC	0.75 ~ 0.92V
		LEAN		0.04 ~ 0.1V
51	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1] signal input	RICH	DC	0.75 ~ 0.92V
		LEAN		0.04 ~ 0.1V
52	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 2] signal input	RICH	DC	0.75 ~ 0.92V
		LEAN		0.04 ~ 0.1V
53	Knock Sensor (KS) [Bank 2] [High] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3V
		Normal		0V
54	Knock Sensor (KS) [Bank 2] [Low] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3V
		Normal		0V
55	Knock Sensor (KS) [Bank 1] [Low] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3V
		Normal		0V
56	Knock Sensor (KS) [Bank 1] [High] signal input	Knocking	Variable Frequency	-0.3 ~ 0.3V
		Normal		0V
57	Throttle Position Sensor (TPS) 2 signal input	C.T	DC	Min. 4.0V
		W.O.T		0.25 ~ 0.9V
58	Sensor ground	Idle	DC	Max. 150mV
59	-			
60	Ignition Coil (Cylinder #2) control output	Idle	Pulse	Vpeak = 400V
				0 <Frequency< 58.3Hz
61	CVVT Oil Control Valve (OCV)[Bank 2/Intake] control output	Idle	PWM	High: Battery Voltage
				Low: Max. 1.0V
				Frequency= 128Hz
				0 <Duty< 100%
62	CVVT Oil Control Valve (OCV)[Bank 1/Intake] control output	Idle	PWM	High: Battery Voltage
				Low: Max. 1.0V
				Frequency= 128Hz
				0 <Duty< 100%
63	Injector (Cylinder #2) control output	Idle	PWM	High: Battery Voltage
				Low: Max. 1.0V
				0 <Frequency< 58.3Hz
				47 < Vpeak < 64V

FL-42

Fuel System

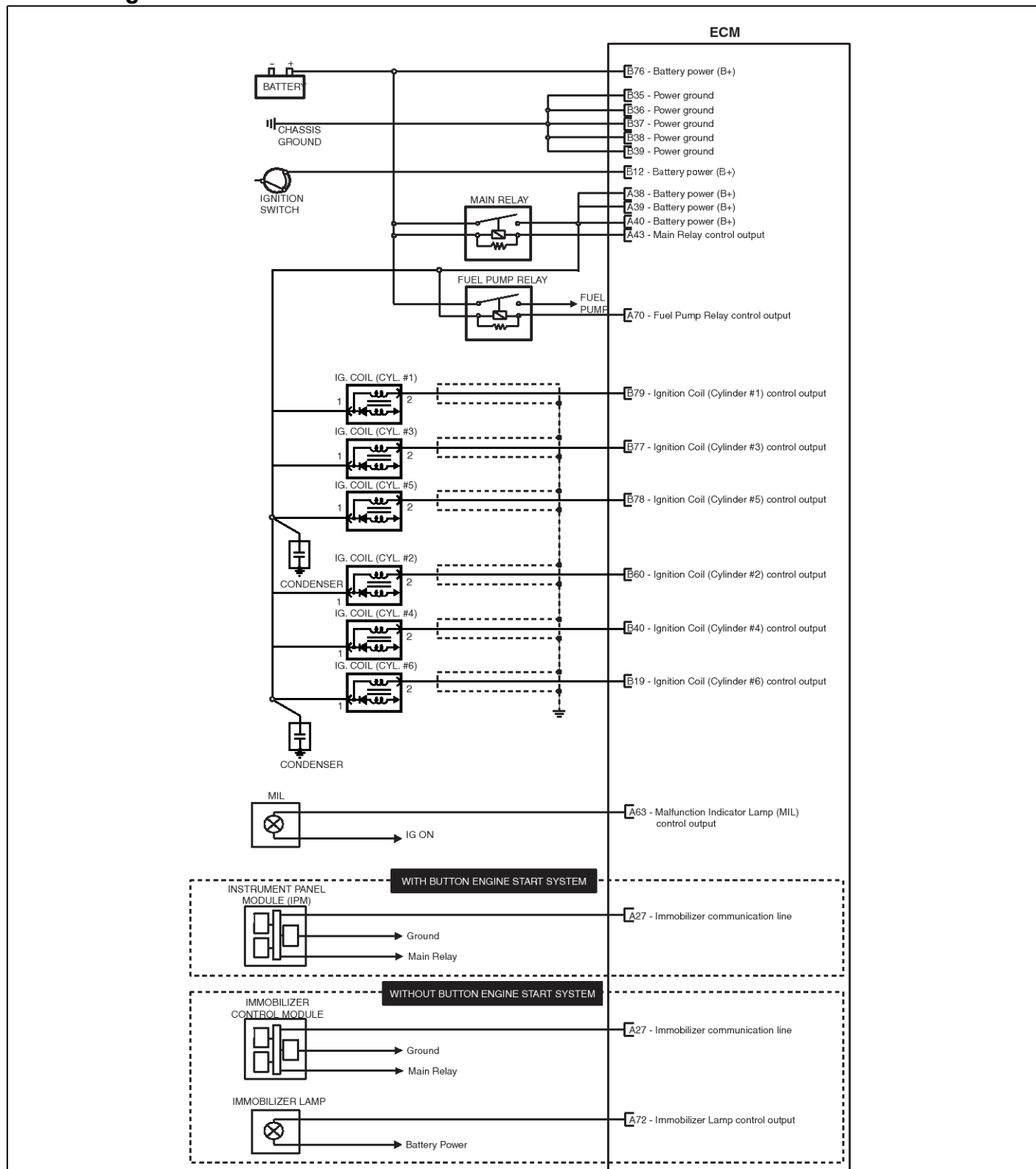
Pin No	Description	Condition	Type	Level
64	Injector (Cylinder #3) control output	Idle	PWM	High: Battery Voltage
				Low: Max. 1.0V
				0 <Frequency< 58.3Hz
				47 < Vpeak < 64V
65	CVVT Oil Control Valve (OCV) [Bank 1/Exhaust] control output	Idle	PWM	High: Battery Voltage
				Low: Max. 1.0V
				Frequency= 128Hz
				0 <Duty< 100%
66	CVVT Oil Control Valve (OCV) [Bank 2/Exhaust] control output	Idle	PWM	High: Battery Voltage
				Low: Max. 1.0V
				Frequency= 128Hz
				0 <Duty< 100%
67	Heated Oxygen Sensor (HO2S) [Bank 2/Sensor 1] Heater control output	Idle	PWM	High: Battery Voltage
				Low: Max. 1.15V
				0 <Duty<100%
68	Injector (Cylinder #4) control output	Idle	PWM	High: Battery Voltage
				Low: Max. 1.0V
				0 <Frequency< 58.3Hz
				47 < Vpeak < 64V
69	Injector (Cylinder #5) control output	Idle	PWM	High: Battery Voltage
				Low: Max. 1.0V
				0 <Frequency< 58.3Hz
				47 < Vpeak < 64V
70	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] Heater control output	Idle	PWM	High: Battery Voltage
				Low: Max. 1.15V
				0 <Duty<100%
71	Injector (Cylinder #6) control output	Idle	PWM	High: Battery Voltage
				Low: Max. 1.0V
				0 <Frequency< 58.3Hz
				47 < Vpeak < 64V
72	Injector (Cylinder #1) control output	Idle	PWM	High: Battery Voltage
				Low: Max. 1.0V
				0 <Frequency< 58.3Hz
				47 < Vpeak < 64V

Engine Control System

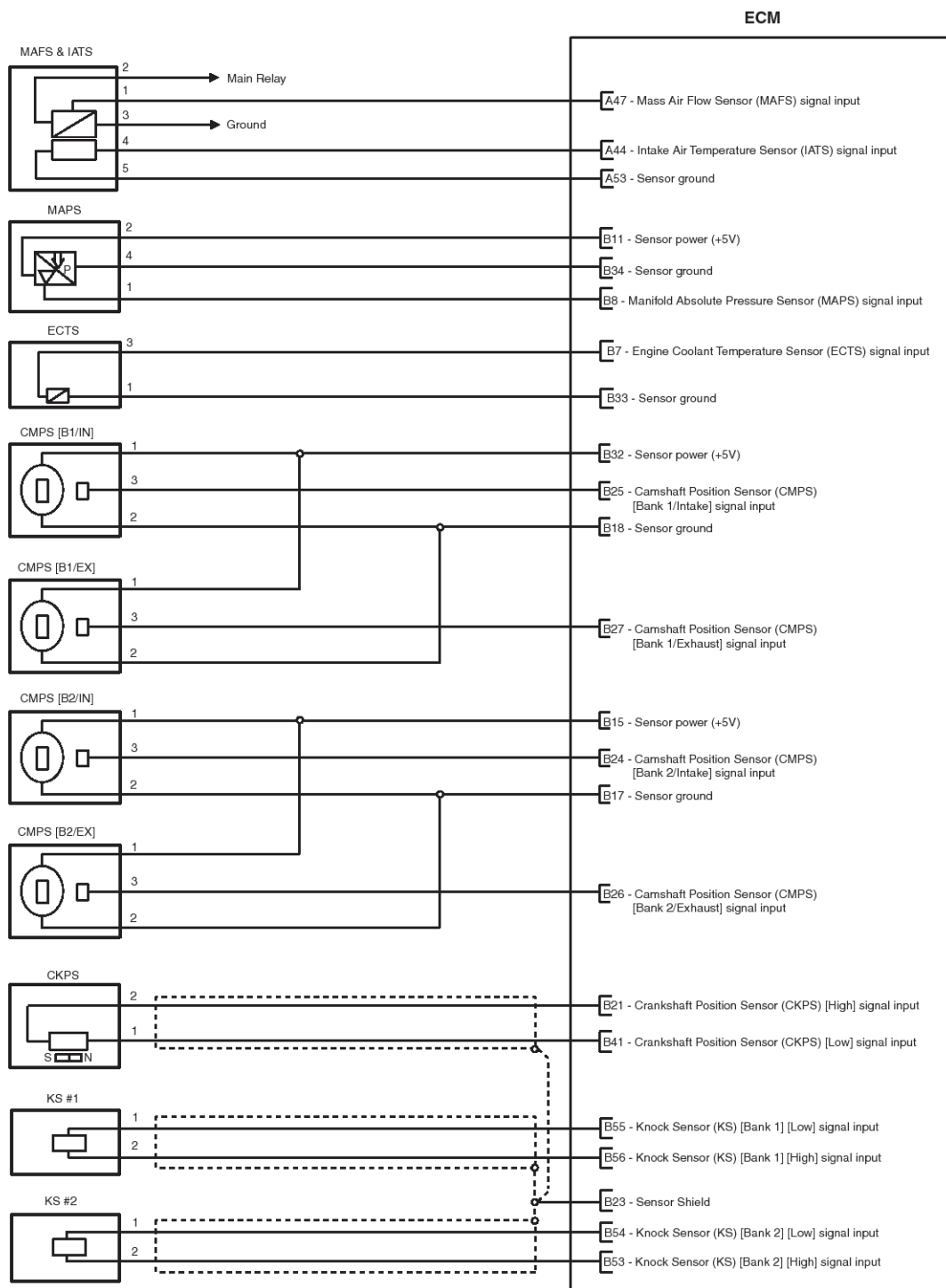
FL-43

Pin No	Description	Condition	Type	Level
73	Heated Oxygen Sensor (HO2S)[Bank 2/Sensor 2] Heater control output	Idle	PWM	High: Battery Voltage
				Low: Max. 1.15V
				0 <Duty<100%
74	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] Heater control output	Idle	PWM	High: Battery Voltage
				Low: Max. 1.15V
				0 <Duty<100%
75	-			
76	Battery power (B+)	Idle	DC	Battery Voltage
77	Ignition Coil (Cylinder #3) control output	Idle	Pulse	Vpeak = 400V
				0 <Frequency< 58.3Hz
78	Ignition Coil (Cylinder #5) control output	Idle	Pulse	Vpeak = 400V
				0 <Frequency< 58.3Hz
79	Ignition Coil (Cylinder #1) control output	Idle	Pulse	Vpeak = 400V
				0 <Frequency< 58.3Hz
80	-			

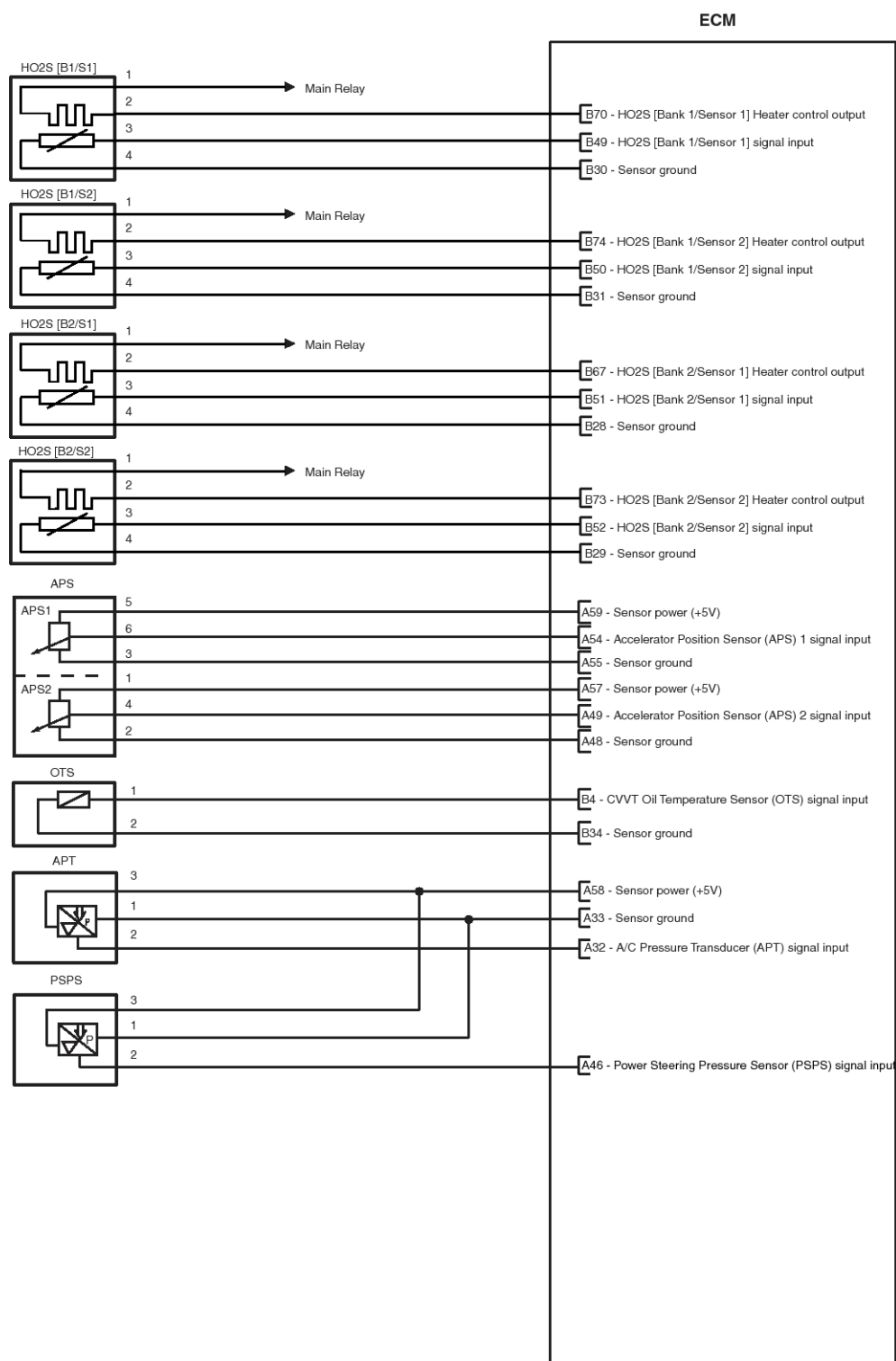
Circuit Diagram



SBHFL9119L



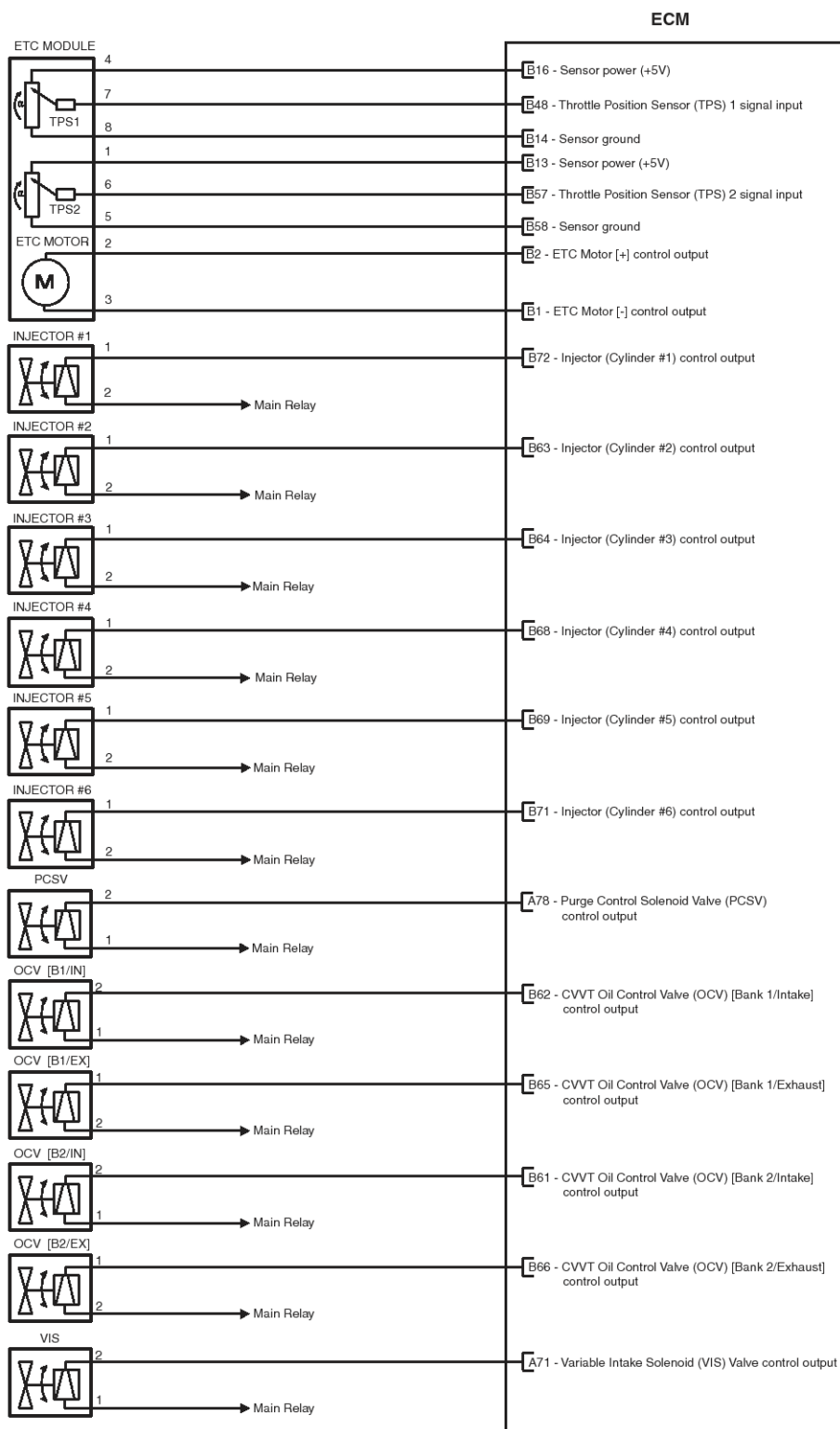
SBHFL9120L



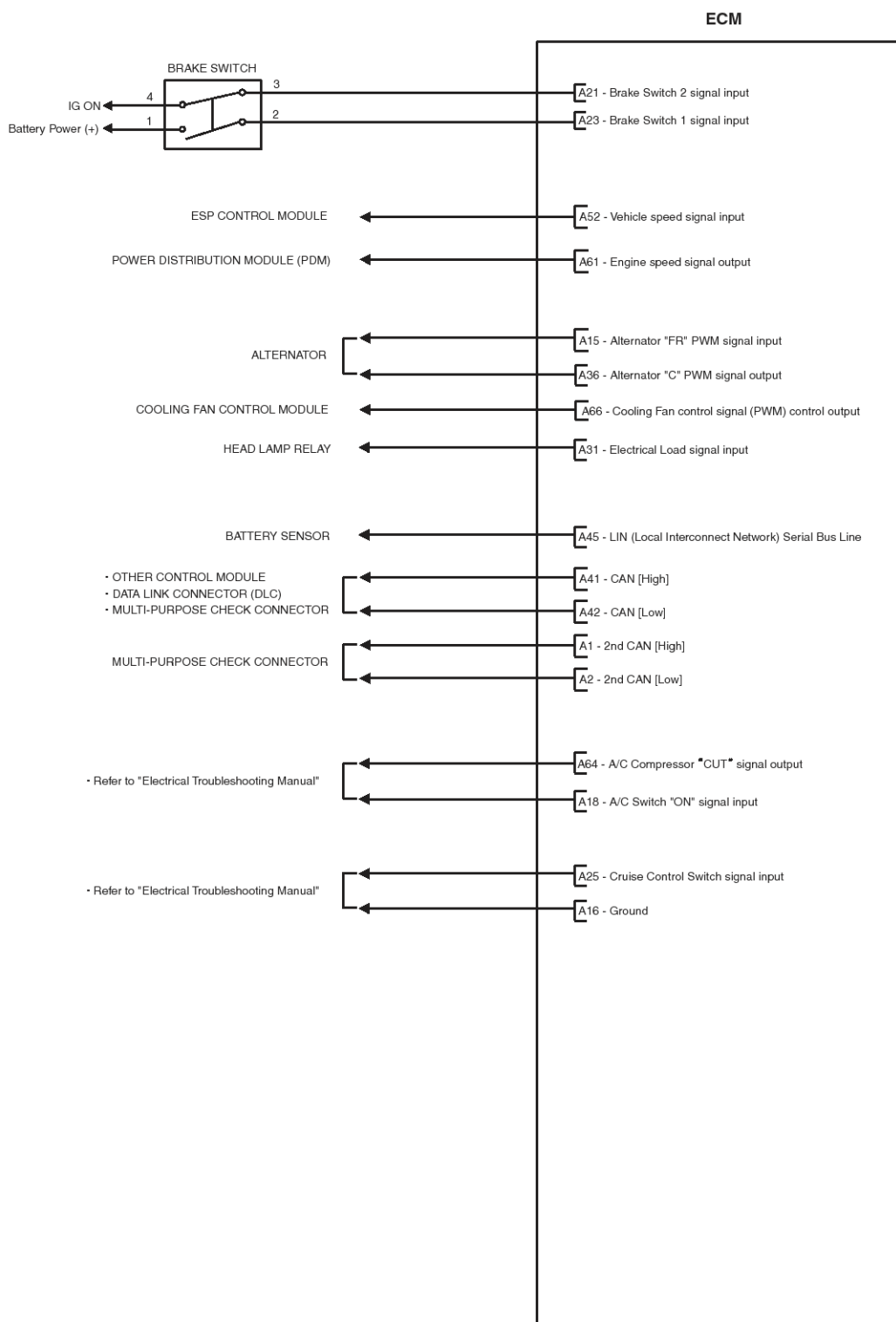
SBHFL9121L

Engine Control System

FL-47



SBHFL9122L



SBHFL9123L

Engine Control System

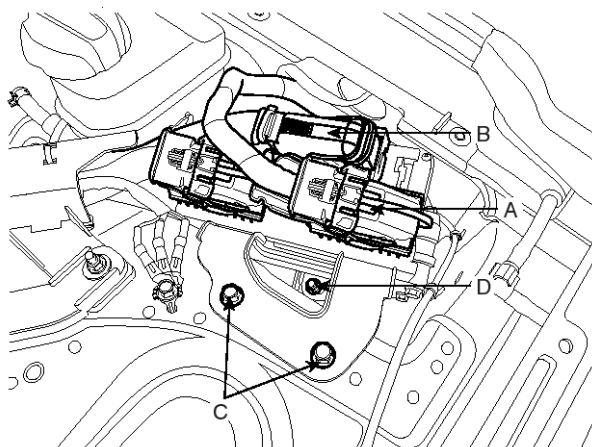
FL-49

Removal

NOTICE

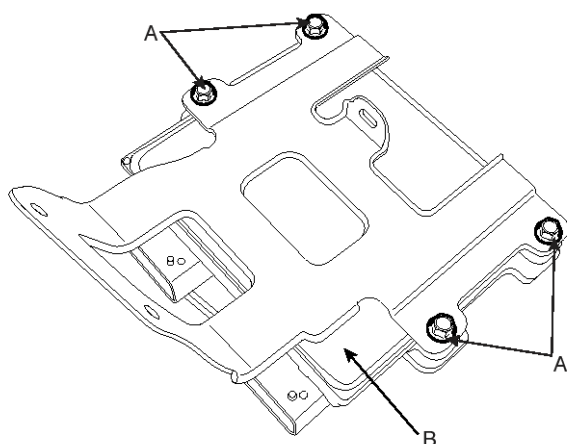
In the case of the vehicle equipped with immobilizer, perform "Key Teaching" procedure together (Refer to "Immobilizer" in BE group).

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



SBHFL8134D

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



SBHFL8135D

Installation

NOTICE

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

1. Installation is reverse of removal.

ECM installation bolt:

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

ECM Problem Inspection Procedure

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

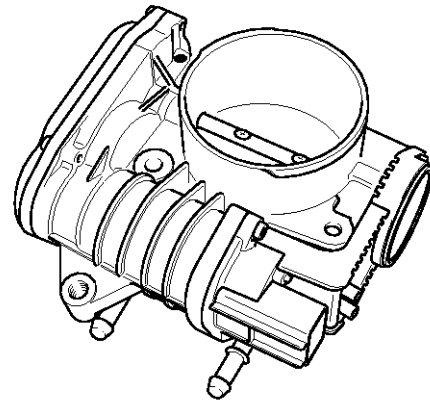
Specification: Below 1Ω

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

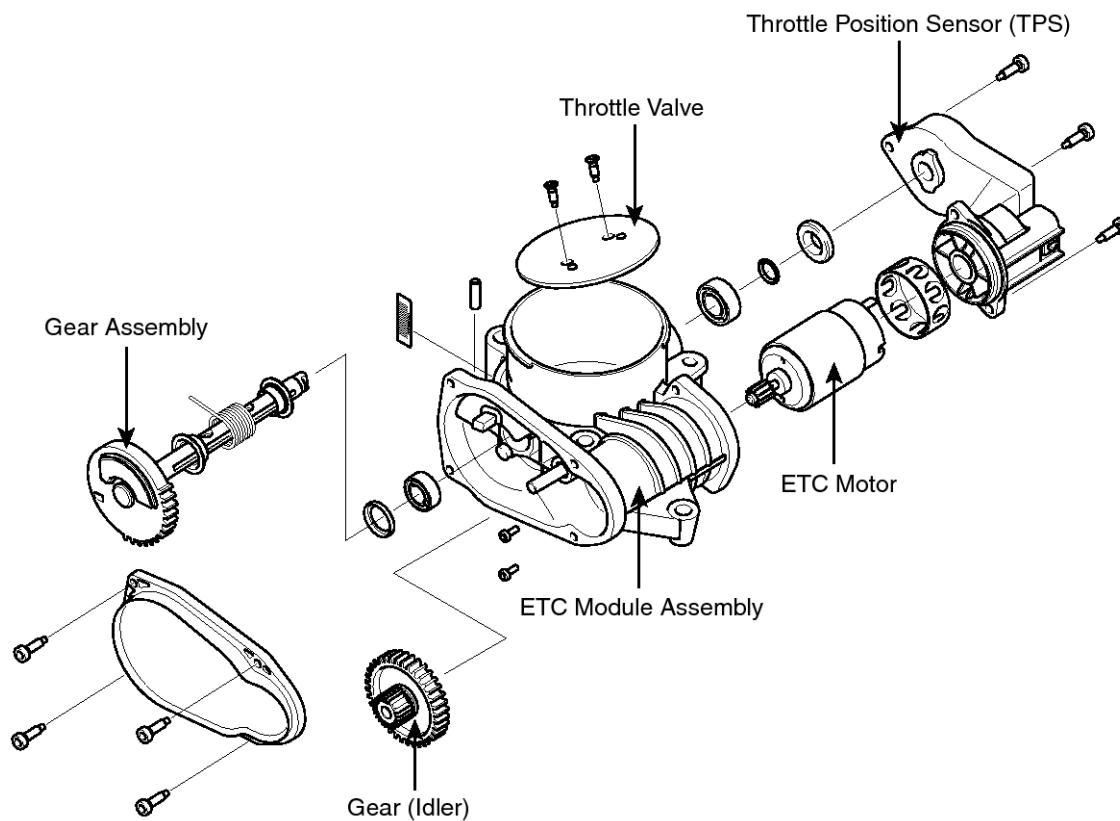
ETC (Electronic Throttle Control) System

Description

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



KFCF1020

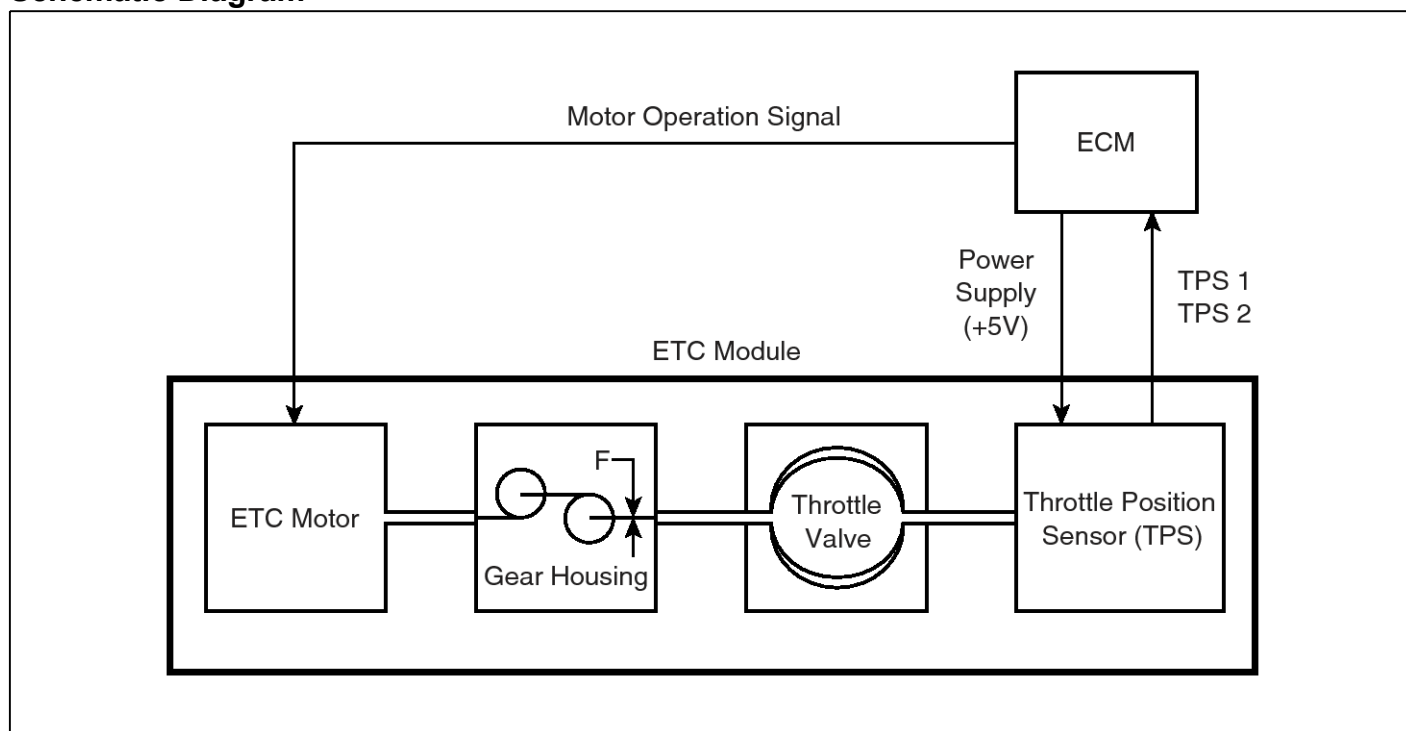


EGRF233A

Engine Control System

FL-51

Schematic Diagram



EGRF234A

Fail-Safe Mode

Mode	Symptom	Possible Cause
[MODE 1] FORCED ENGINE SHUTDOWN	Engine stop	- ETC system can't proceed reliable algorithm procedure - Fatal ECM 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	- No response for accelerator activation - Forced idle state	- No information about the accelerator position - Broken 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	- Engine power varies with accelerator position - Driver perceives lack of engine power. - 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	

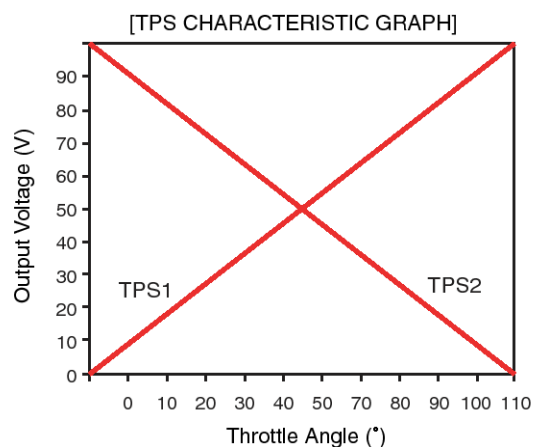
FL-52

Fuel System

Specification

[Throttle Position Sensor (TPS)]

Throttle Angle(°)	Output Voltage(V)	
	TPS1	TPS2
0	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



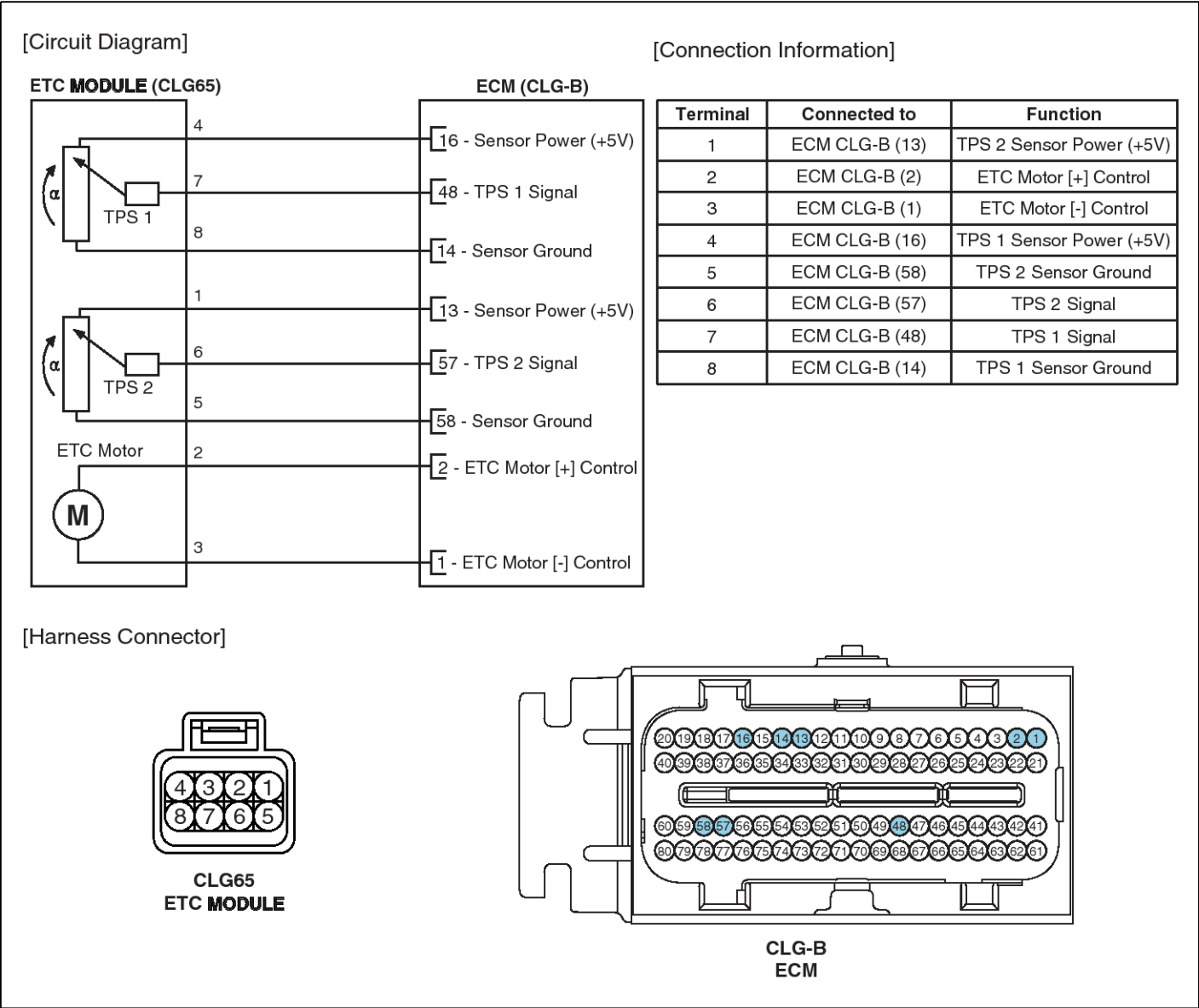
EGRF235A

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

[ETC Motor]

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

Circuit Diagram



SBHFL9200L

FL-54

Fuel System

Inspection

Throttle Position Sensor (TPS)

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

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

3. Turn the ignition switch OFF and disconnect the scantool from the DLC.
4. Disconnect the ETC module connector and measure the resistance between the ETC module terminals 4 and 8 (TPS 1).

Specification: Refer to "Specification"

5. Measure resistance between the ETC module terminals 1 and 5 (TPS 2).

Specification: Refer to "Specification"

ETC Motor

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

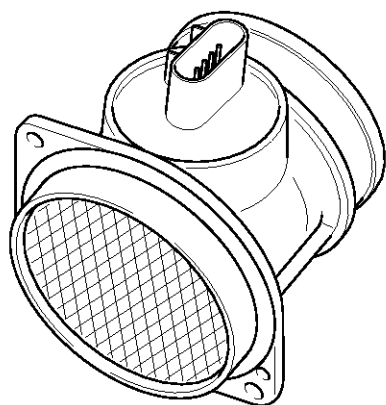
Specification: Refer to "Specification"

Mass Air Flow Sensor (MAFS)

Description

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 a honey cell and detects the intake air quantity flowing into the intake manifold.

While the intake air coming out of the air cleaner flows by the honey cell, it becomes laminar flow, and then it passes the hot-film. 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 ECM by frequency. By using this signal, the ECM can calculate fuel quantity and ignition timing.



KFCF1021

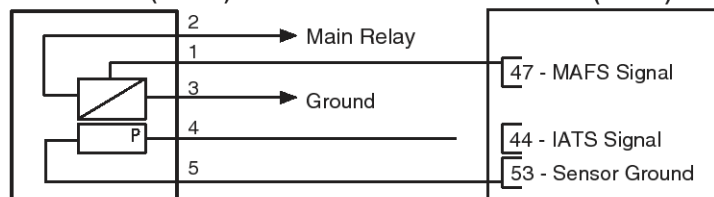
Specification

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

Circuit Diagram

[Circuit Diagram]

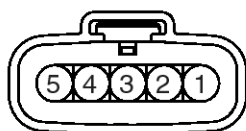
MAFS & IATS (CLG27)



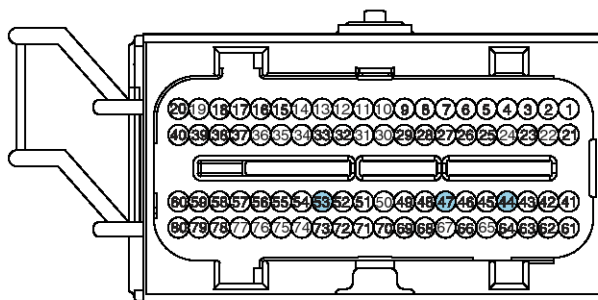
[Connection Information]

Terminal	Connected to	Function
1	ECM ELG-A (47)	MAFS Signal
2	Main Relay	Sensor Power (B+)
3	Chassis Ground	Power Ground
4	ECM ELG-A (44)	IATS Signal
5	ECM ELG-A (53)	Sensor Ground

[Harness Connector]



CLG27
MAFS & IATS



ELG-A
ECM

SBHFL9201L

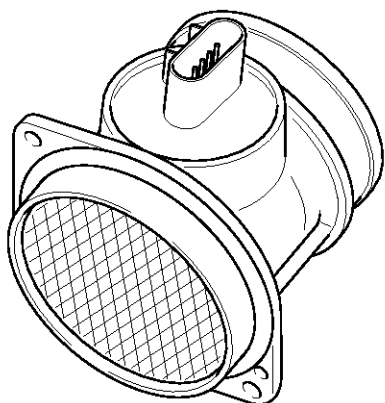
Inspection

- Check the mass air flow sensor visually.
 - Mounting direction of the sensor
 - Any contamination, corrosion or damage of connector
 - Air cleaner's clogging or wet
 - Sensor cylinder's deforming or blocking by any foreign material
- Check any leakage on intake system.

Intake Air Temperature Sensor (IATS)

Description

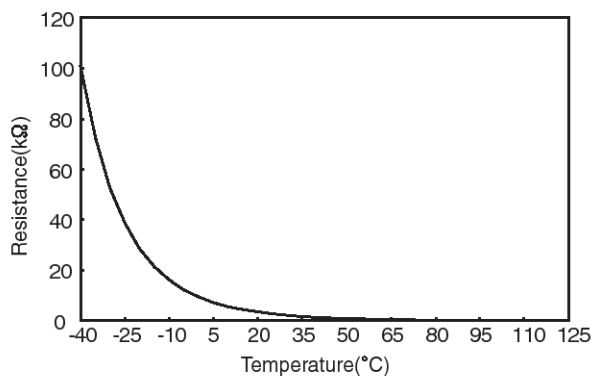
Intake Air Temperature Sensor (IATS) is installed inside the Mass Air Flow Sensor (MAFS) and detects the intake air temperature. To calculate precise air quantity, correction of the air temperature is needed because air density varies according to the temperature. So the ECM uses not only MAFS signal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



KFCF1021

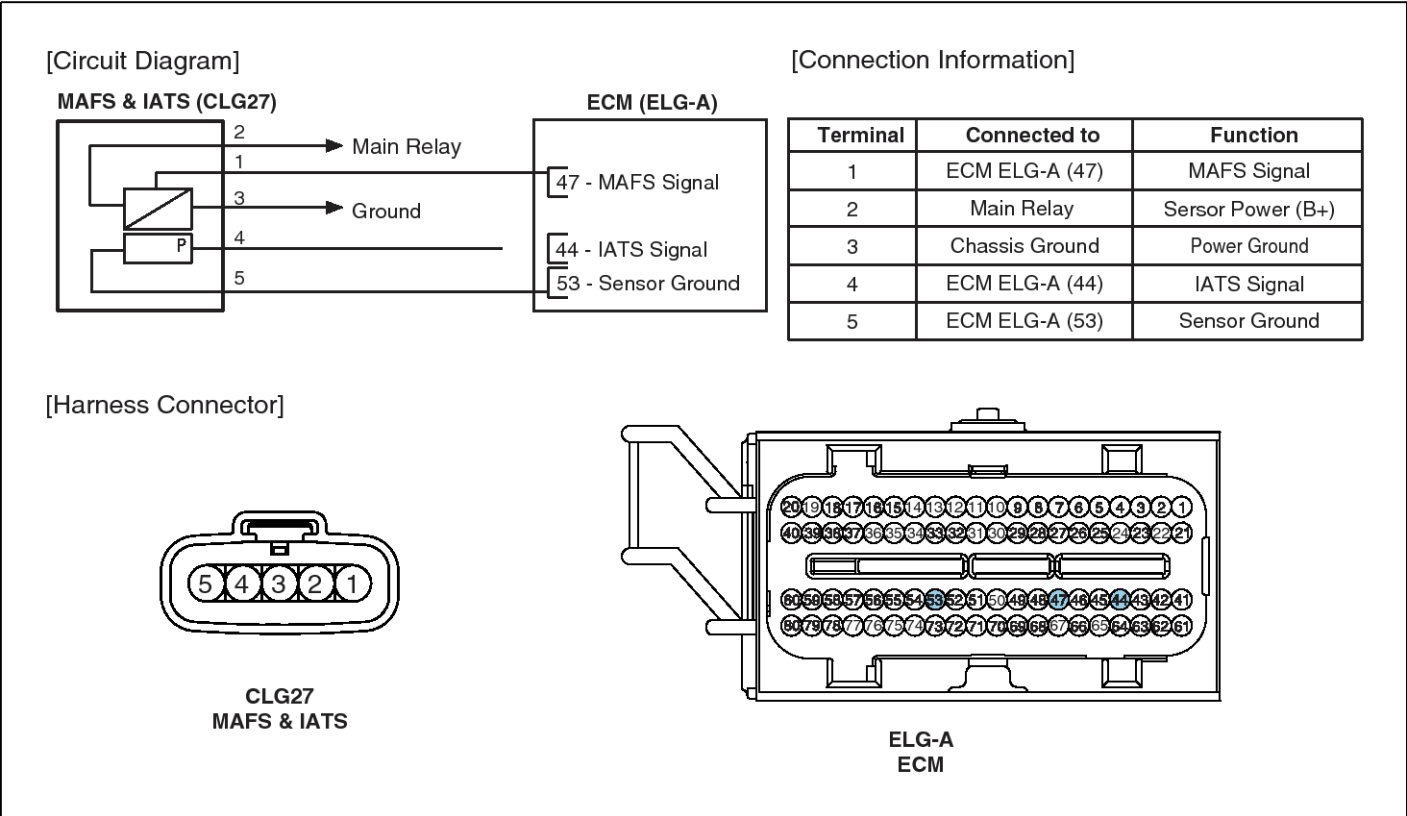
Specification

Temperature		Resistance (k Ω)
$^{\circ}\text{C}$	$^{\circ}\text{F}$	
-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



SBHFL9135L

Circuit Diagram



SBHFL9201L

Inspection

1. Turn the ignition switch OFF.
2. Disconnect the IATS connector.
3. Measure resistance between the IATS terminals 4 and 5.
4. Check that the resistance is within the specification.

Specification: Refer to "Specification"

Engine Control System

FL-59

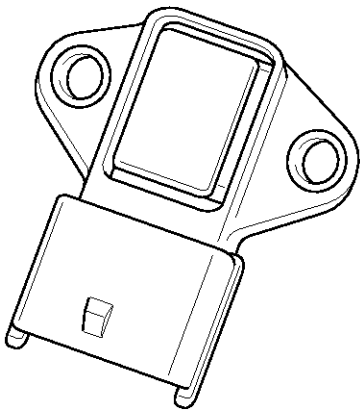
Manifold Absolute Pressure Sensor (MAPS)

Description

Manifold Absolute Pressure Sensor (MAPS) is a speed-density type sensor and is installed on the surge tank.

The MAPS senses absolute pressure in surge tank and transfers this analog signal proportional to the pressure to the ECM. The ECM calculates the intake air quantity and engine speed based on this signal.

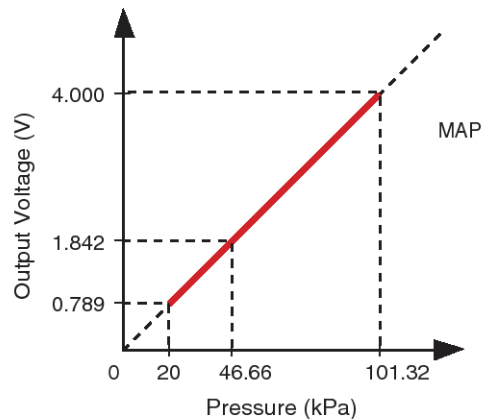
This MAPS consists of a piezo-electric element and a hybrid IC that amplifies the element output signal. The element is silicon diaphragm type and adapts pressure sensitive variable resistor effect of semi-conductor. 100% vacuum and the manifold pressure apply to the both sides of it respectively. That is, this sensor outputs the silicon variation proportional to pressure change by voltage.



SBHFL8133D

Specification

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



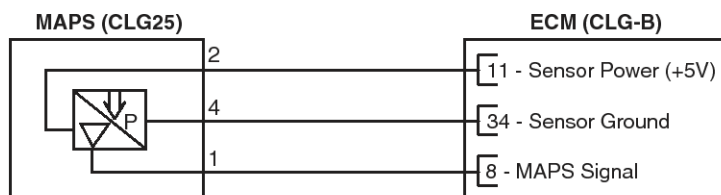
SBHFL9136L

FL-60

Fuel System

Circuit Diagram

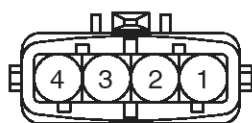
[Circuit Diagram]



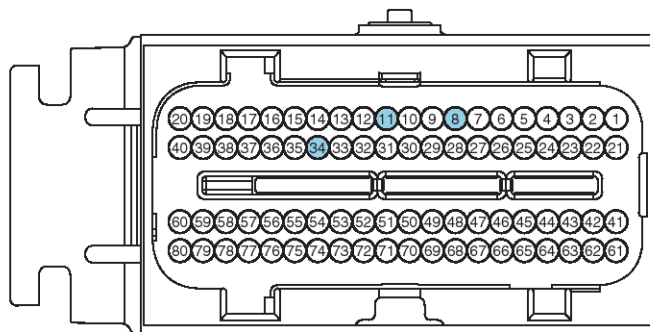
[Connection Information]

Terminal	Connected to	Function
1	ECM CLG-B (8)	MAPS Signal
2	ECM CLG-B (11)	Sensor Power (+5V)
3	-	-
4	ECM CLG-B (34)	Sensor Ground

[Harness Connector]



CLG25
MAPS



CLG-B
ECM

SBHFL9202L

Inspection

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

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

Engine Control System

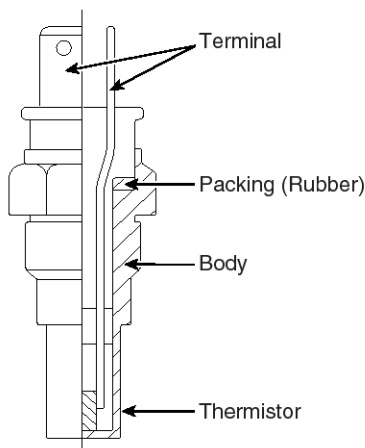
FL-61

Engine Coolant Temperature Sensor (ECTS)

Description

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

During cold engine operation the ECM increases the fuel injection duration and controls the ignition timing using the information of engine coolant temperature to avoid engine stalling and improve drivability.



SBHFL9140L

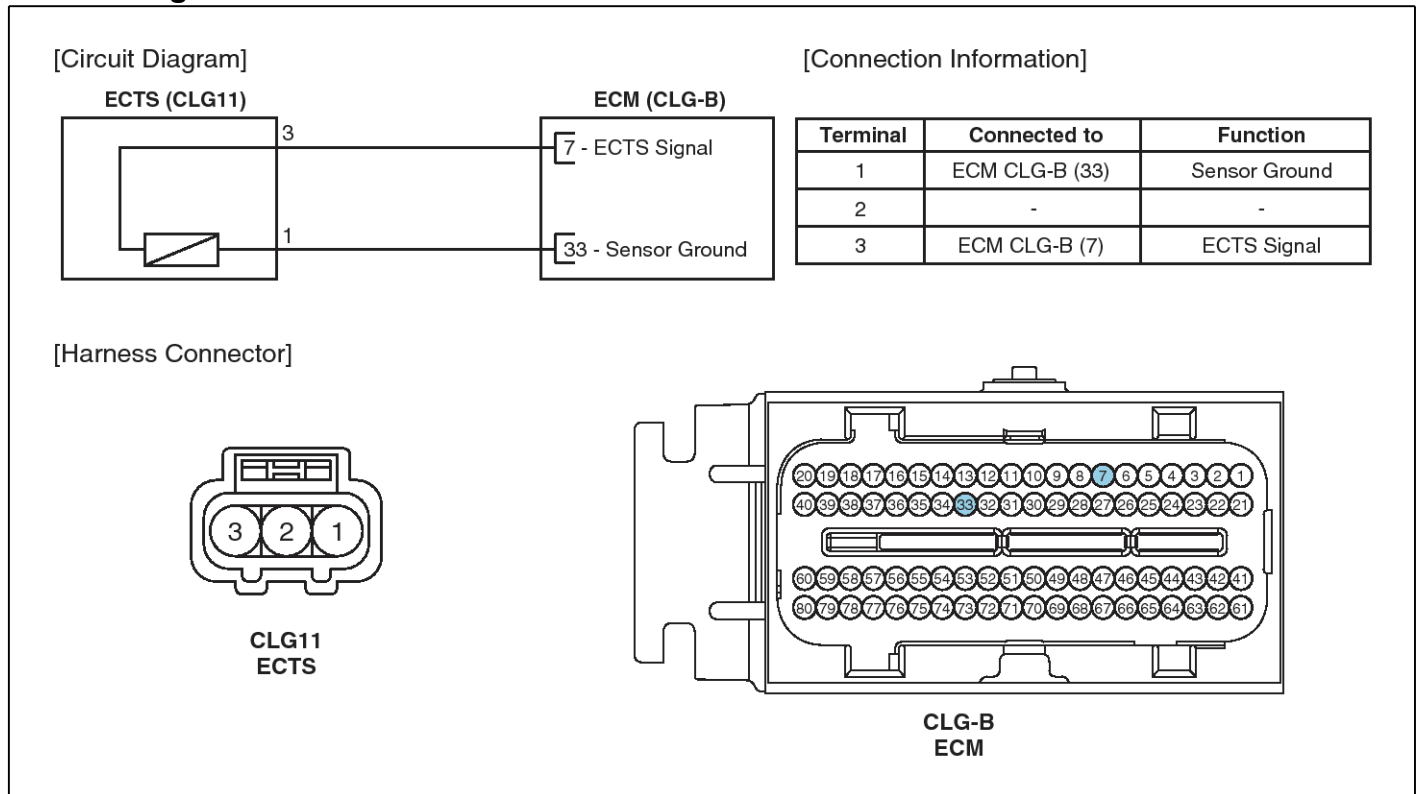
Specification

Temperature		Resistance (k Ω)
$^{\circ}\text{C}$	$^{\circ}\text{F}$	
-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

FL-62

Fuel System

Circuit Diagram



SBHFL9203L

Inspection

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

Specification: Refer to "Specification"

Engine Control System

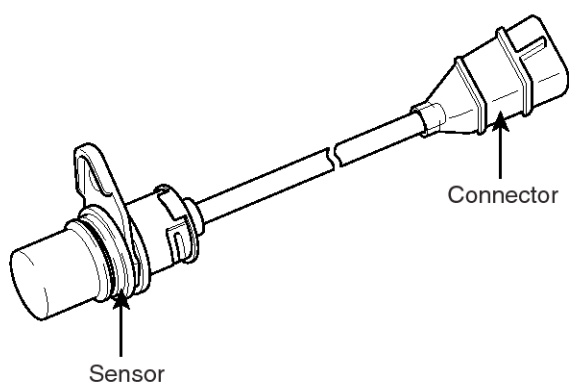
FL-63

Crankshaft Position Sensor (CKPS)

Description

Crankshaft Position Sensor (CKPS) detects the crankshaft position and is one of the most important sensors of the engine control system. If there is no CKPS signal input, fuel is not supplied and the main relay does not operates. That is, vehicle can't run without CKPS signal.

This sensor is installed on transaxle housing or the cylinder block and generates alternating current by magnetic flux field which is made by the sensor and the target wheel when the engine rotates. The target wheel consists of 58 slots and 2 missing slots on 360 CA (Crank Angle).

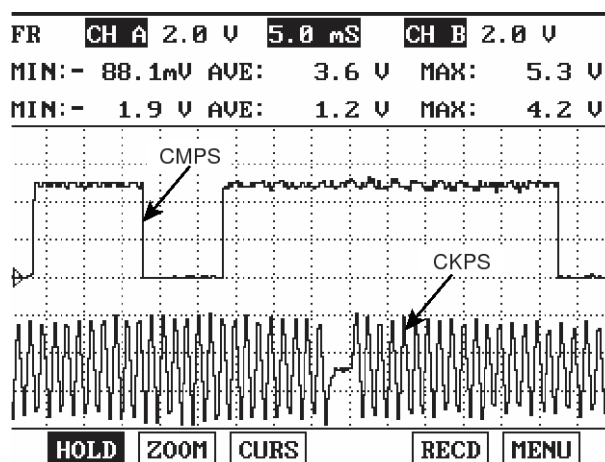
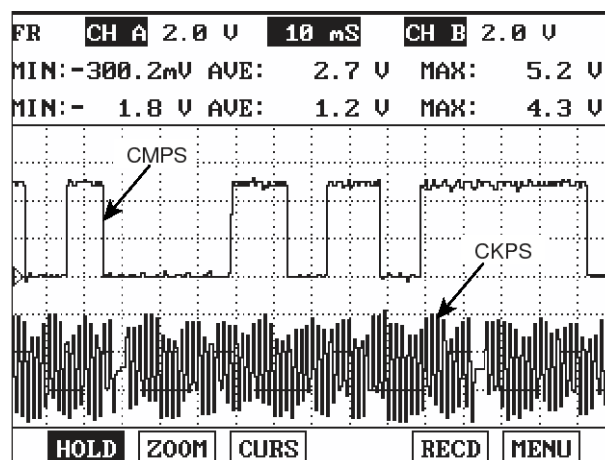


EGRF245A

Specification

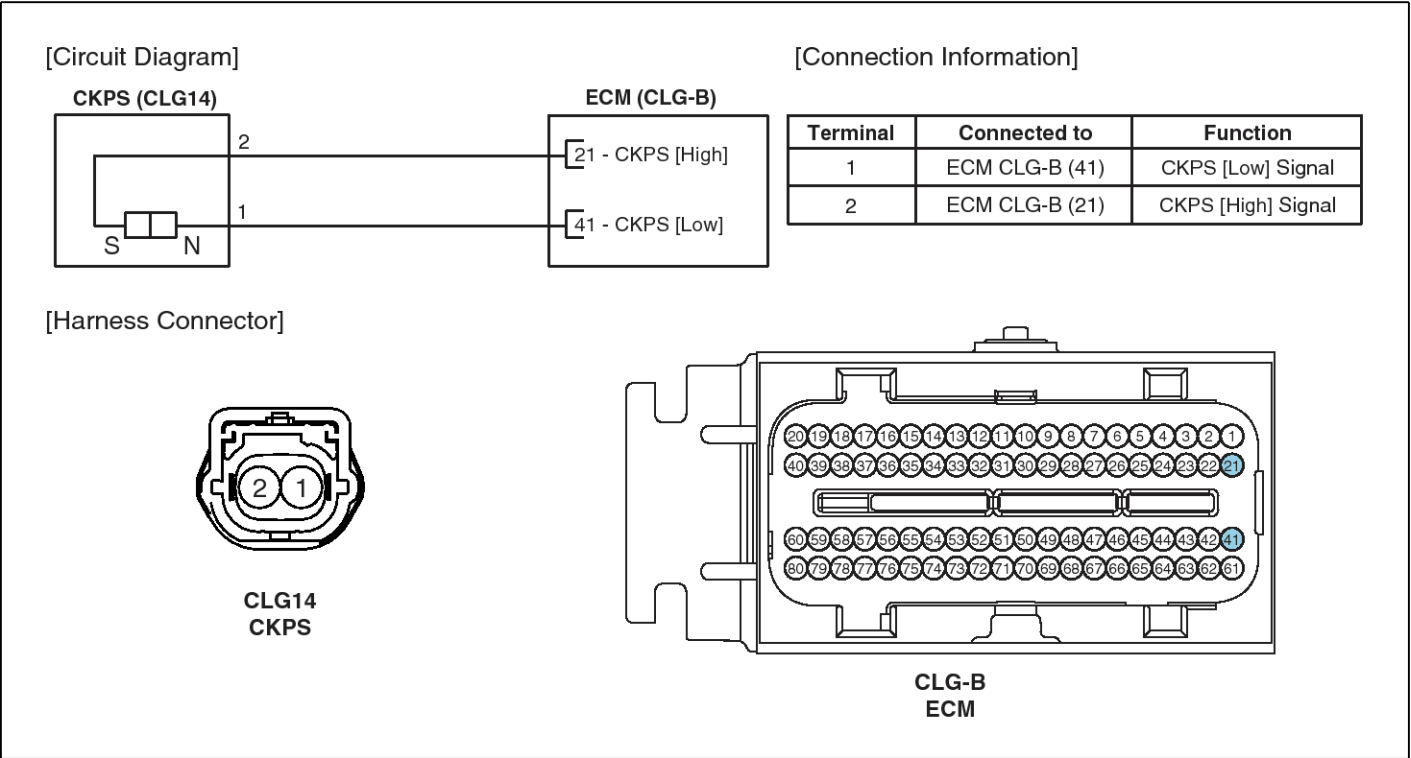
Item	Specification
Coil Resistance (Ω)	630 ~ 770 Ω [25°C (77°F)]
Air Gap (mm)	0.5 ~ 1.5

Wave Form



SBHFL9214L

Circuit Diagram



SBHFL9204L

Inspection

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

Specification: Refer to “Wave Form”

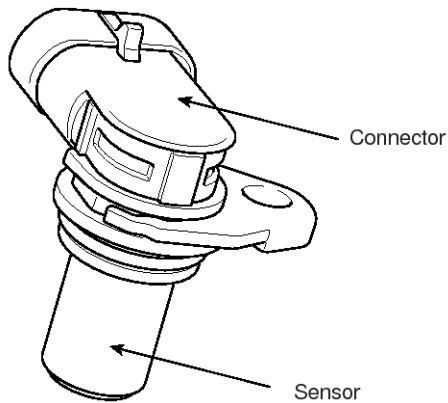
Engine Control System

FL-65

Camshaft Position Sensor (CMPS)

Description

Camshaft Position Sensor (CMPS) is a hall sensor and detects the camshaft position by using a hall element. It is related with Crankshaft Position Sensor (CKPS) and detects the piston position of each cylinder which the CKPS can't detect. The two CMPS are installed on engine head cover of bank 1 and 2 respectively and use a target wheel installed on the camshaft. This sensor has a hall-effect IC which output voltage changes when magnetic field is made on the IC with current flow. So the sequential injection of the 6 cylinders is impossible without CMPS signal.

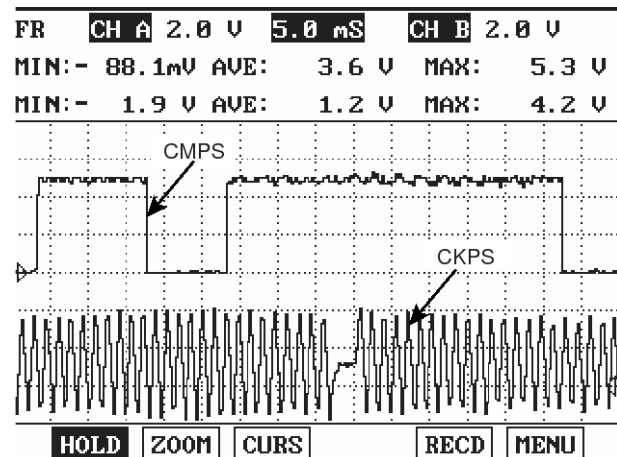
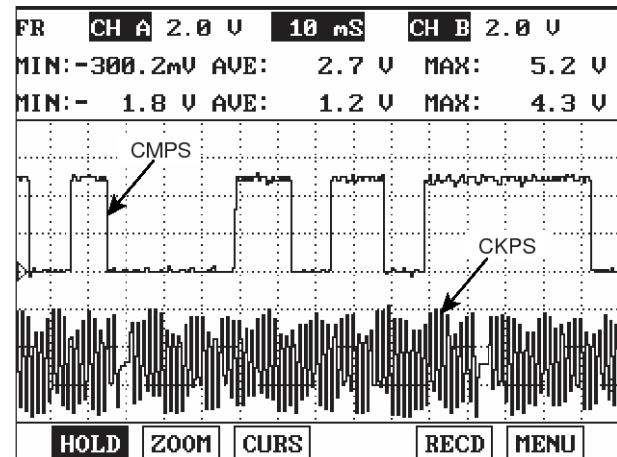


SBHFL9138L

Specification

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

Wave Form



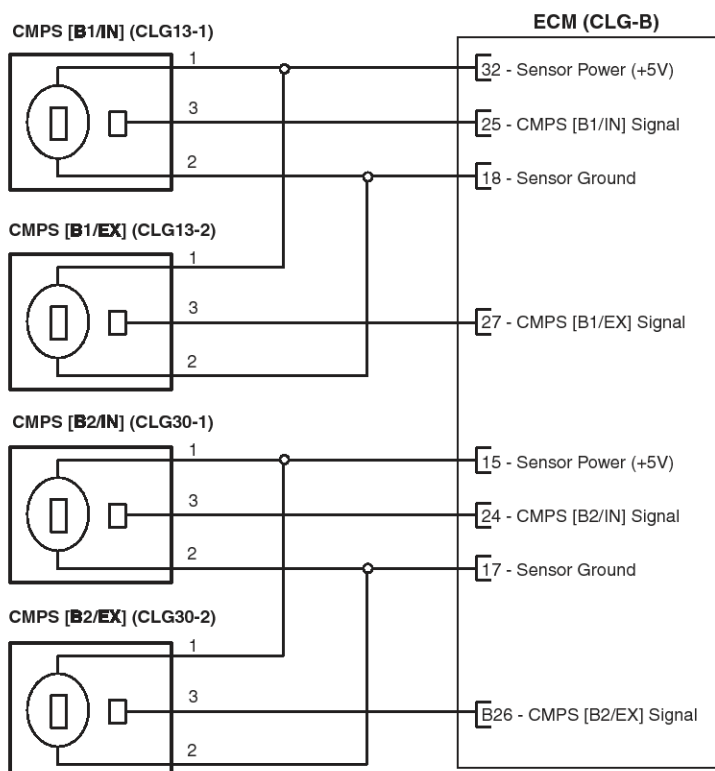
SBHFL9214L

FL-66

Fuel System

Circuit Diagram

[Circuit Diagram]



[Connection Information]

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

Terminal	Connected to	Function
1	ECM CLG-B (32)	Sensor Power (+5V)
2	ECM CLG-B (18)	Sensor Ground
3	ECM CLG-B (25)	CMPS [B1/IN] Signal

CMPS [BANK 1/EXHAUST] (CLG13-2)

Terminal	Connected to	Function
1	ECM CLG-B (32)	Sensor Power (+5V)
2	ECM CLG-B (18)	Sensor Ground
3	ECM CLG-B (27)	CMPS [B1/EX] Signal

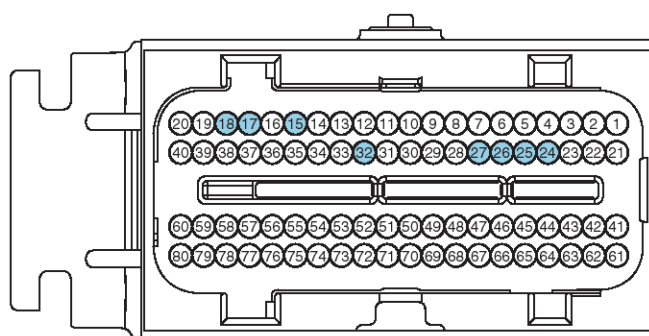
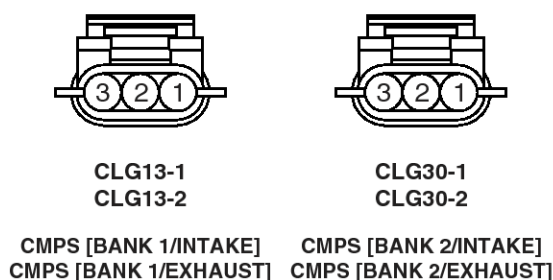
CMPS [BANK 2/INTAKE] (CLG30-1)

Terminal	Connected to	Function
1	ECM CLG-B (15)	Sensor Power (+5V)
2	ECM CLG-B (17)	Sensor Ground
3	ECM CLG-B (24)	CMPS [B2/IN] Signal

CMPS [BANK 2/EXHAUST] (CLG30-2)

Terminal	Connected to	Function
1	ECM CLG-B (15)	Sensor Power (+5V)
2	ECM CLG-B (17)	Sensor Ground
3	ECM CLG-B (26)	CMPS [B2/EX] Signal

[Harness Connector]



SBHFL9205L

Inspection

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

Specification: Refer to "Wave Form"

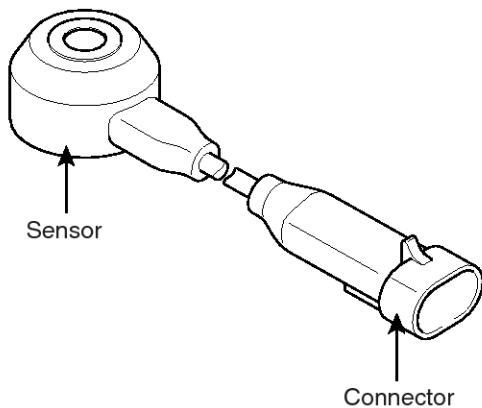
Engine Control System

FL-67

Knock Sensor (KS)

Description

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 ECM and the ECM retards the ignition timing. If the knocking disappears after retarding the ignition timing, the ECM will advance the ignition timing. This sequential control can improve engine power, torque and fuel economy.

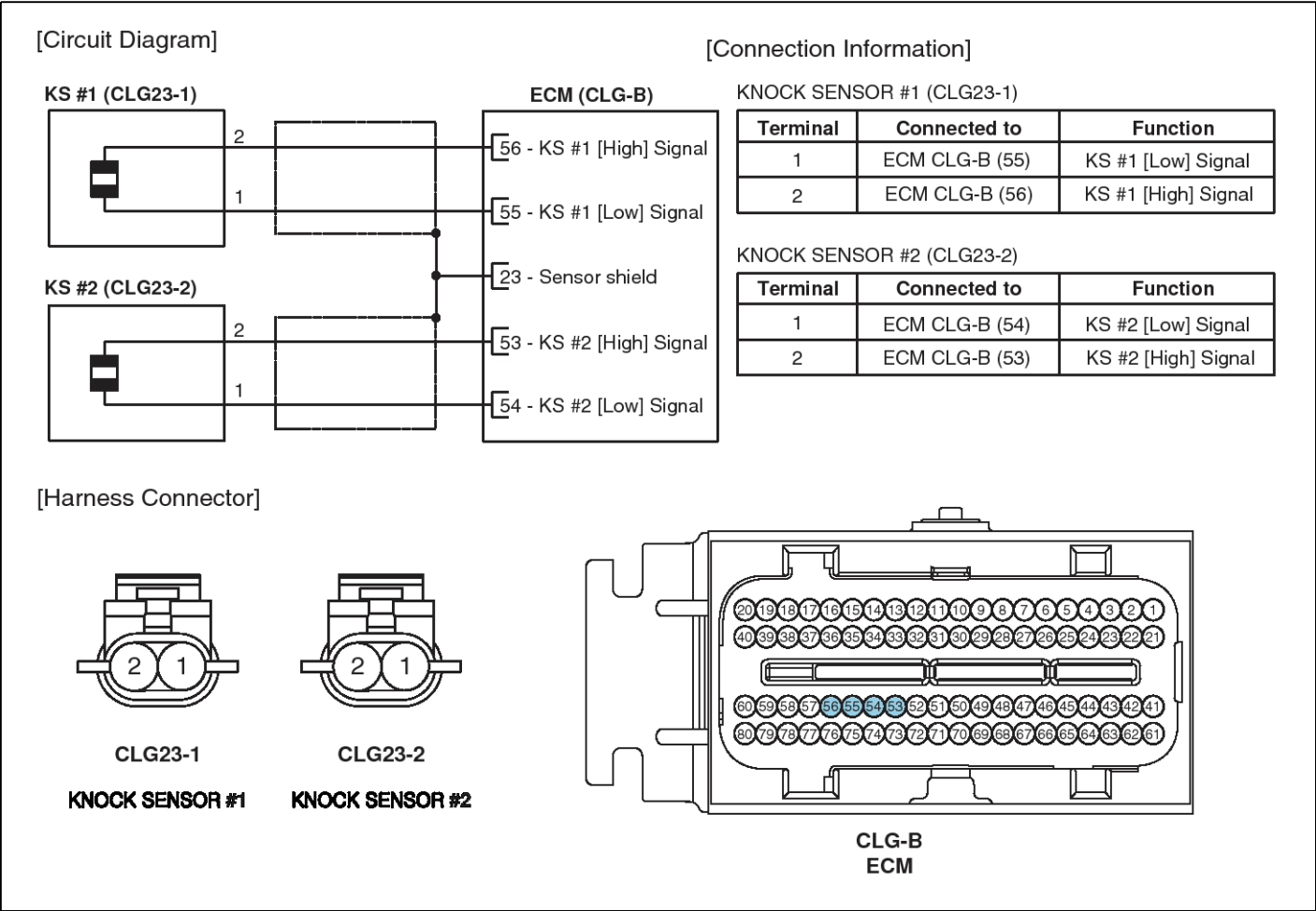


EGRF251A

Specification

Item	Specification
Capacitance (pF)	1,480 ~ 2,220

Circuit Diagram



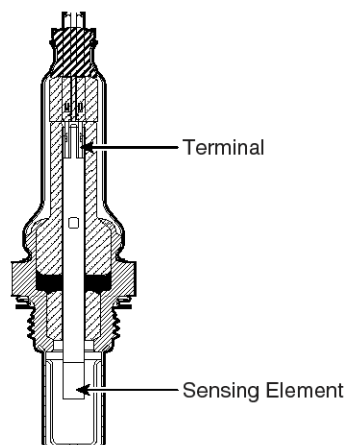
Heated Oxygen Sensor (HO2S)

Description

Heated Oxygen Sensor (HO2S) consists of the zirconium and the alumina and is installed on upstream and downstream of the Manifold Catalyst Converter (MCC).

After it compares oxygen consistency of the atmosphere with the exhaust gas, it transfers the oxygen consistency of the exhaust gas to the ECM. When A/F ratio is rich or lean, it generates approximately 1V or 0V respectively. In order that this sensor normally operates, the temperature of the sensor tip is higher than 370°C (698°F). So it has a heater which is controlled by the ECM duty signal.

When the exhaust gas temperature is lower than the specified value, the heater warms the sensor tip.



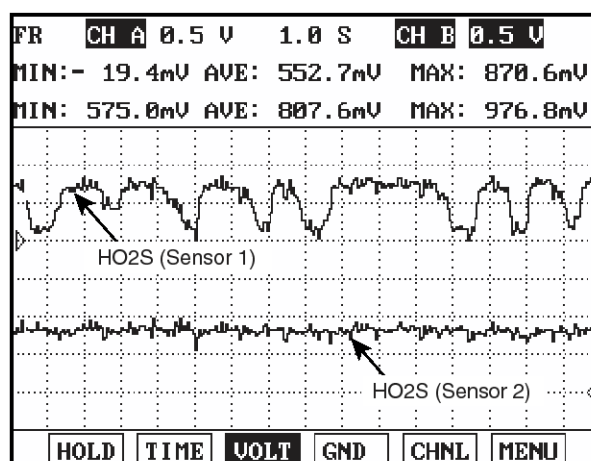
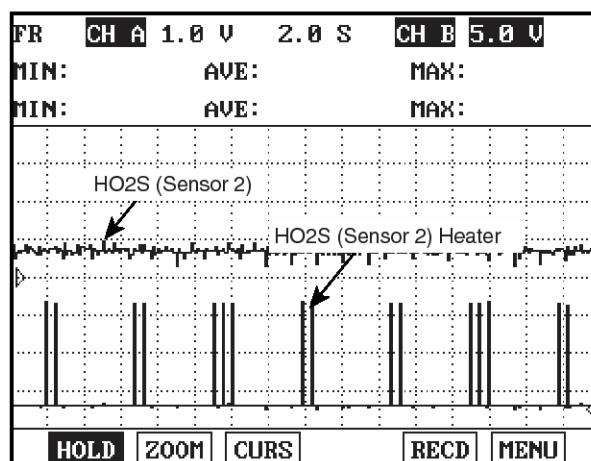
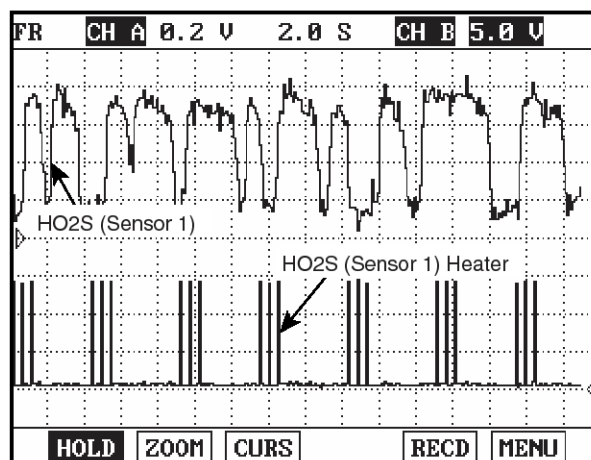
EGRF247A

Specification

A/F Ratio (λ)	Output Voltage(V)
RICH	0.75 ~ 0.92
LEAN	0.04 ~ 0.1

Item	Specification
Heater Resistance (Ω)	8.1 ~ 11.1 Ω [21°C (69.8°F)]

Wave Form



SBHFL9139L

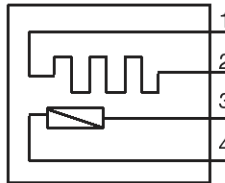
FL-70

Fuel System

Circuit Diagram

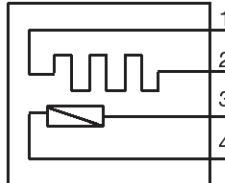
[Circuit Diagram]

HO2S [B1/S1] (CLG93)



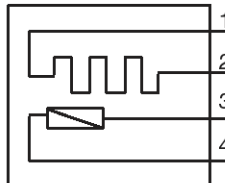
Main Relay

HO2S [B1/S2] (CLG95)



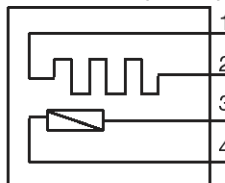
Main Relay

HO2S [B2/S1] (CLG94)



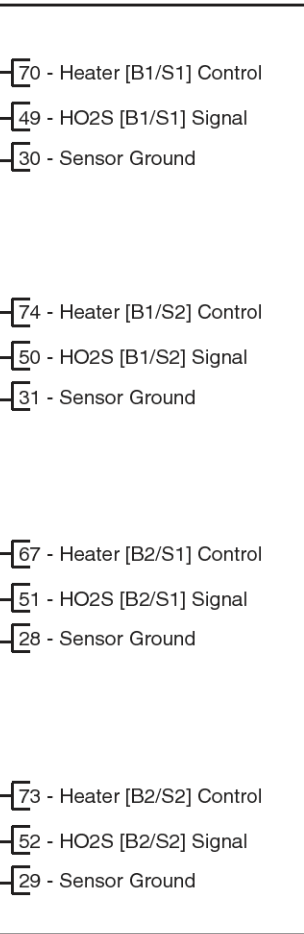
Main Relay

HO2S [B2/S2] (CLG96)



Main Relay

ECM (CLG-B)



[Connection Information]

HO2S [BANK 1/SENSOR 1] (CLG93)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CLG-B (70)	Heater [B1/S1] Control
3	ECM CLG-B (49)	HO2S [B1/S1] Signal
4	ECM CLG-B (30)	Sensor Ground

HO2S [BANK 1/SENSOR 2] (CLG95)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CLG-B (74)	Heater [B1/S2] Control
3	ECM CLG-B (50)	HO2S [B1/S2] Signal
4	ECM CLG-B (31)	Sensor Ground

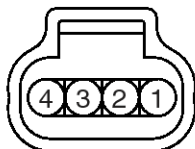
HO2S [BANK 2/SENSOR 1] (CLG94)

Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CLG-B (67)	Heater [B2/S1] Control
3	ECM CLG-B (51)	HO2S [B2/S1] Signal
4	ECM CLG-B (28)	Sensor Ground

HO2S [BANK 2/SENSOR 2] (CLG96)

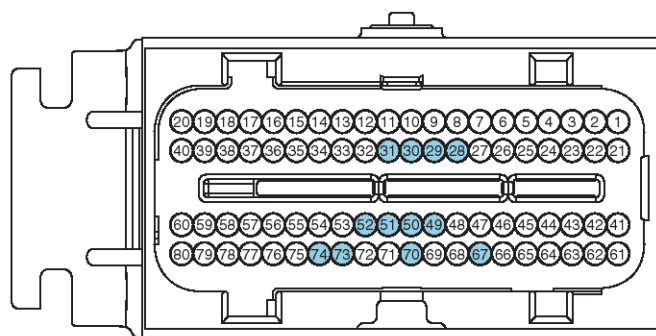
Terminal	Connected to	Function
1	Main Relay	Battery Power (B+)
2	ECM CLG-B (73)	Heater [B2/S2] Control
3	ECM CLG-B (52)	HO2S [B2/S2] Signal
4	ECM CLG-B (29)	Sensor Ground

[Harness Connector]



CLG93, CLG95, CLG94, CLG96

HO2S [BANK 1/SENSOR 1]
HO2S [BANK 1/SENSOR 2]
HO2S [BANK 2/SENSOR 1]
HO2S [BANK 2/SENSOR 2]



CLG-B ECM

SBHFL9207L

Inspection

1. Turn the ignition switch OFF.
2. Disconnect the HO2S connector.
3. Measure resistance between the HO2S terminals 1 and 2.

4. Check that the resistance is within the specification.

Specification: Refer to "Specification"

CVT Oil Temperature Sensor (OTS)

Description

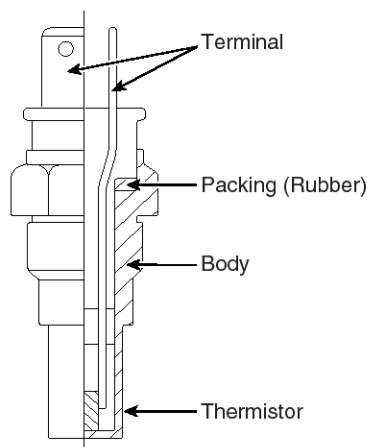
Continuous Variable Valve Timing (CVVT) system advances or retards the valve timing of the intake and exhaust valve in accordance with the ECM control signal which is calculated by the engine speed and load.

By controlling CVVT, the valve over-lap or under-lap occurs, which makes better fuel economy and reduces exhaust gases (NOx, HC) and improves engine performance through reduction of pumping loss, internal EGR effect, improvement of combustion stability, improvement of volumetric efficiency, and increase of expansion work.

This system consist of

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

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



SBHFL9140L

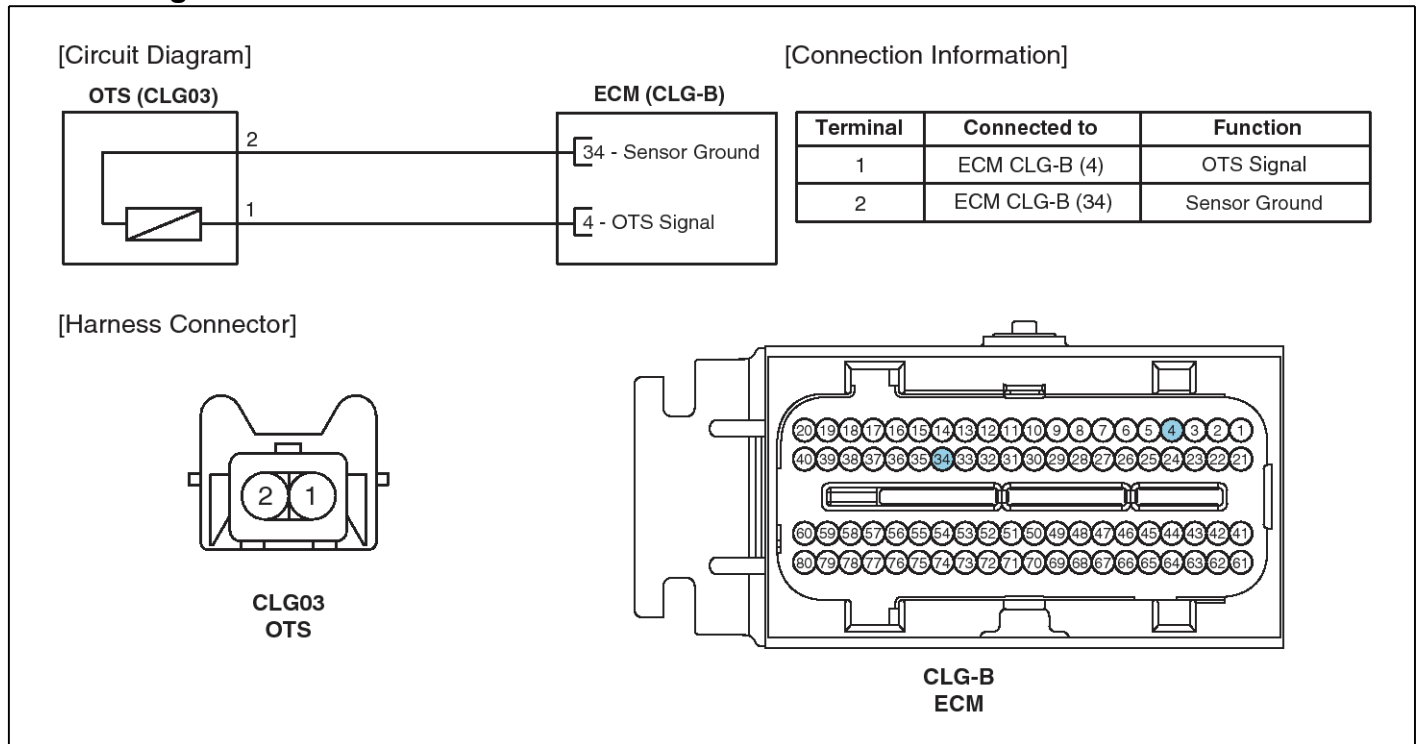
Specification

Temperature		Resistance (k Ω)
$^{\circ}\text{C}$	$^{\circ}\text{F}$	
-40	-40	52.15
-20	-4	16.52
0	32	6.0
20	68	2.45
40	104	1.11
60	140	0.54
80	176	0.29

FL-72

Fuel System

Circuit Diagram



SBHFL9208L

Inspection

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

Specification: Refer to "Specification"

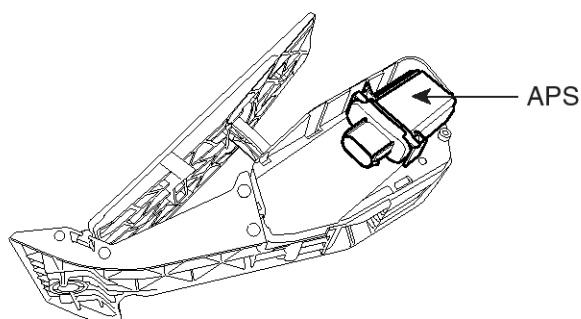
Engine Control System

FL-73

Accelerator Position Sensor (APS)

Description

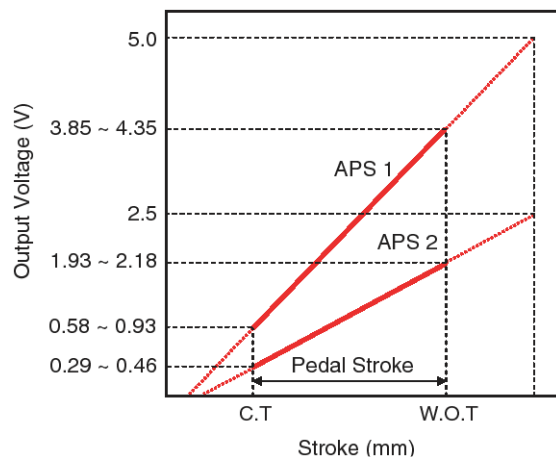
Accelerator Position Sensor (APS) is installed on the accelerator pedal module and detects the rotation angle of the accelerator pedal. The APS is one of the most important sensors in engine control system, so it consists of the two sensors which adapt individual sensor power and ground line. The second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



SBHFL9141L

Specification

Accelerator Position	Output Voltage (V)	
	APS1	APS2
C.T	0.58 ~ 0.93	0.29 ~ 0.46
W.O.T	3.85 ~ 4.35	1.93 ~ 2.18



SBHFL9142L

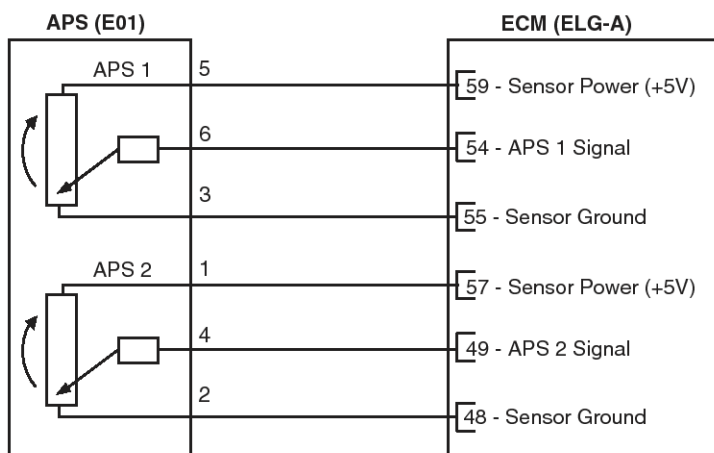
FL-74

Fuel System

Circuit Diagram

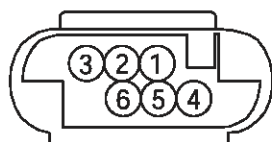
[Circuit Diagram]

[Connection Information]

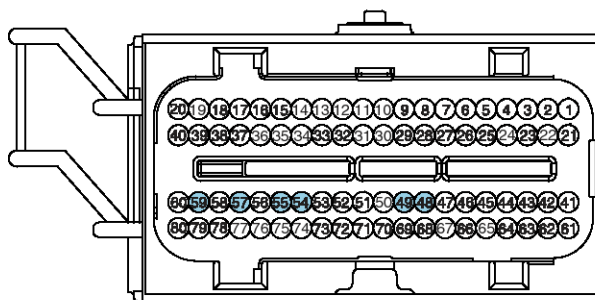


Terminal	Connected to	Function
1	ECM ELG-A (57)	APS 2 Sensor Power (+5V)
2	ECM ELG-A (48)	APS 2 Sensor Ground
3	ECM ELG-A (55)	APS 1 Sensor Ground
4	ECM ELG-A (49)	APS 2 Signal
5	ECM ELG-A (59)	APS 1 Sensor Power (+5V)
6	ECM ELG-A (54)	APS 1 Signal

[Harness Connector]



E01
APS



ELG-A
ECM

SBHFL9209L

Inspection

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

Specification: Refer to "Specification"

Engine Control System

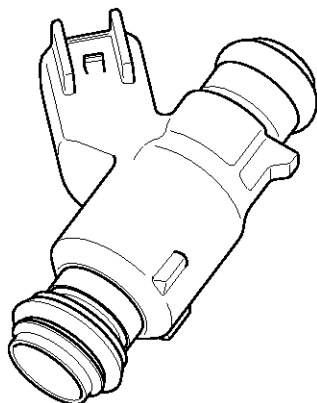
FL-75

Injector

Description

Based on information from various sensors, the ECM determines 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 ECM controls each injector by grounding the control circuit. When the ECM energizes the injector by grounding the control circuit, the circuit voltage should be low (theoretically 0V) and the fuel is injected. When the ECM de-energizes the injector by opening control circuit, the fuel injector is closed and circuit voltage should be peak for a moment.



KFCF1026

⚠ CAUTION

- If an injector connector is disconnected for more than **46 seconds** while the engine runs, the ECM 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

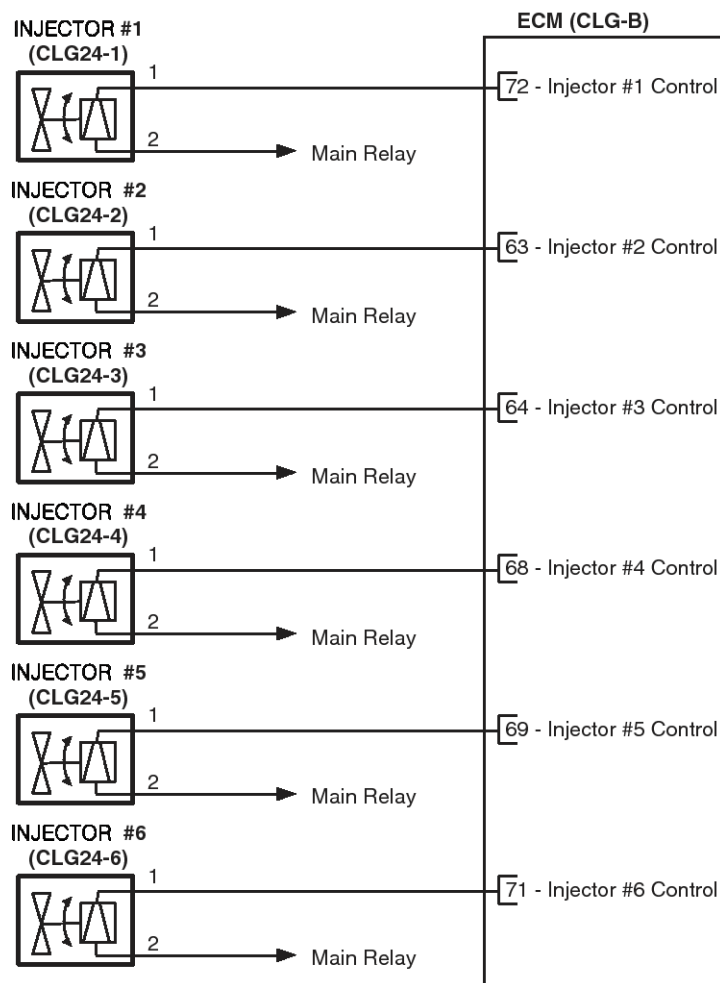
Item	Specification
Coil Resistance (Ω)	11.4 ~ 12.6 [20°C (68°F)]

FL-76

Fuel System

Circuit Diagram

[Circuit Diagram]



[Connection Information]

INJECTOR #1 (CLG24-1)

Terminal	Connected to	Function
1	ECM CLG-B (72)	Injector #1 Control
2	Main Relay	Battery Power (B+)

INJECTOR #2 (CLG24-2)

Terminal	Connected to	Function
1	ECM CLG-B (63)	Injector #2 Control
2	Main Relay	Battery Power (B+)

INJECTOR #3 (CLG24-3)

Terminal	Connected to	Function
1	ECM CLG-B (64)	Injector #3 Control
2	Main Relay	Battery Power (B+)

INJECTOR #4 (CLG24-4)

Terminal	Connected to	Function
1	ECM CLG-B (68)	Injector #4 Control
2	Main Relay	Battery Power (B+)

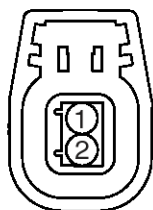
INJECTOR #5 (CLG24-5)

Terminal	Connected to	Function
1	ECM CLG-B (69)	Injector #5 Control
2	Main Relay	Battery Power (B+)

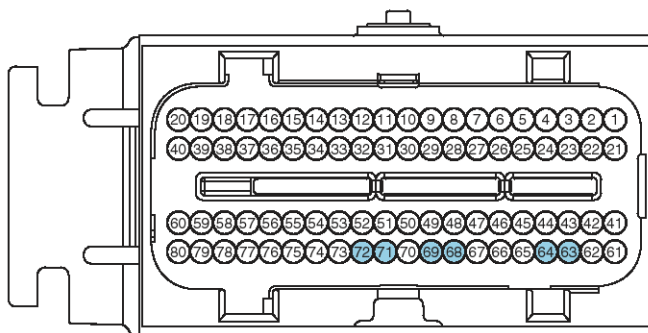
INJECTOR #6 (CLG24-6)

Terminal	Connected to	Function
1	ECM CLG-B (71)	Injector #6 Control
2	Main Relay	Battery Power (B+)

[Harness Connector]



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



CLG-B
ECM

SBHFL9210L

Engine Control System

FL-77

Inspection

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

Specification: Refer to "Specification"

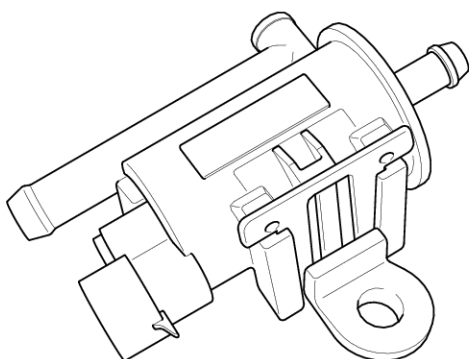
FL-78

Fuel System

Purge Control Solenoid Valve (PCSV)

Description

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

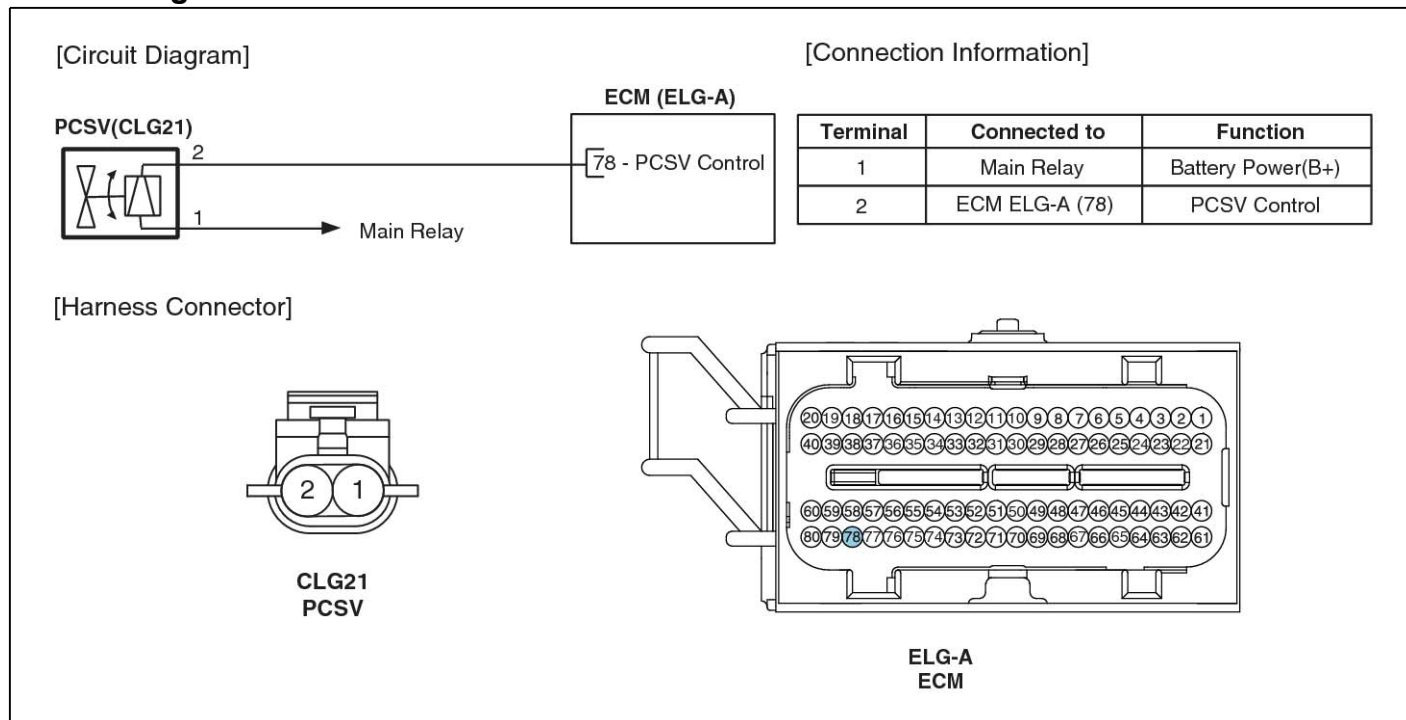


KFCF1028

Specification

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

Circuit Diagram



SBHFL9211L

Engine Control System

FL-79

Inspection

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

Specification: Refer to "Specification"

CVT Oil Control Valve (OCV)

Description

Continuous Variable Valve Timing (CVVT) system advances or retards the valve timing of the intake and exhaust valve in accordance with the ECM control signal which is calculated by the engine speed and load.

By controlling CVVT, the valve over-lap or under-lap occurs, which makes better fuel economy and reduces exhaust gases (NOx, HC) and improves engine performance through reduction of pumping loss, internal EGR effect, improvement of combustion stability, improvement of volumetric efficiency, and increase of expansion work.

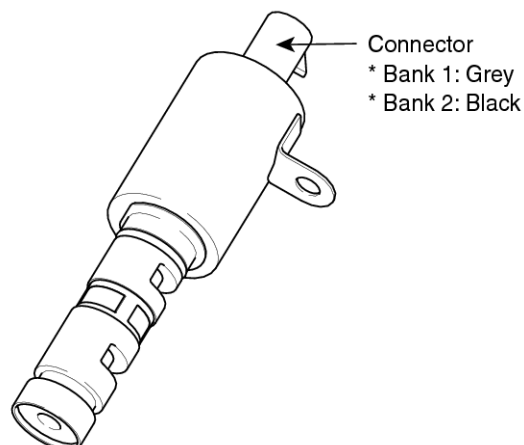
This system consist of

- the CVVT Oil Control Valve (OCV) which supplies the engine oil to the cam phaser or runs out the engine oil from the cam phaser in accordance with the ECM PWM (Pulse With Modulation) control signal,

- the CVVT Oil Temperature Sensor (OTS) which measures the engine oil temperature,

- and the Cam Phaser which varies the cam phase by using the hydraulic force of the engine oil.

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



SBHFL9143L

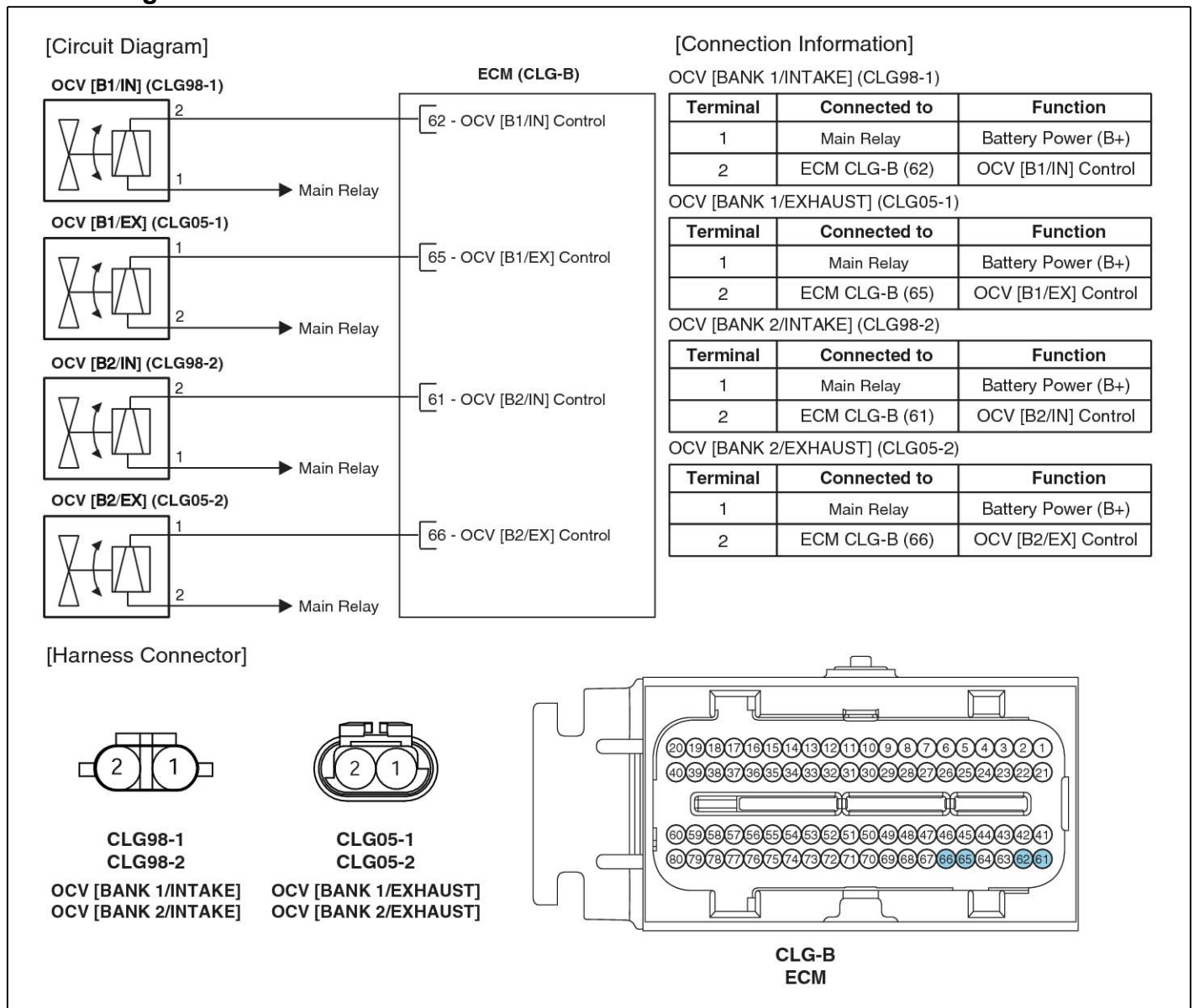
Specification

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

Engine Control System

FL-81

Circuit Diagram



SBHFL9212L

Inspection

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

Specification: Refer to "Specification"

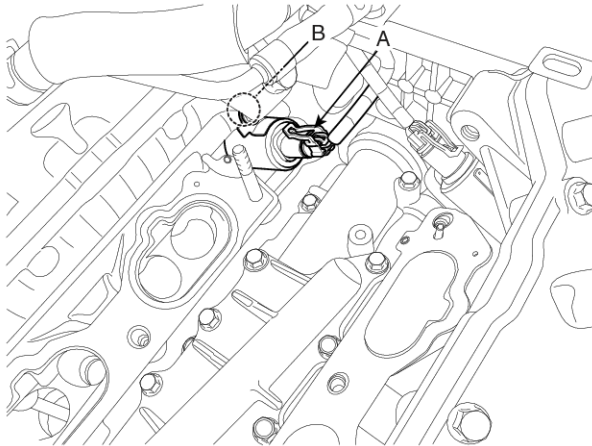
FL-82

Fuel System

Removal

[CVVT Oil Control Valve (Intake)]

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Remove the intake manifold (Refer to "Intake And Exhaust System" in EM group).
3. Disconnect the CVVT oil control valve connector (A).

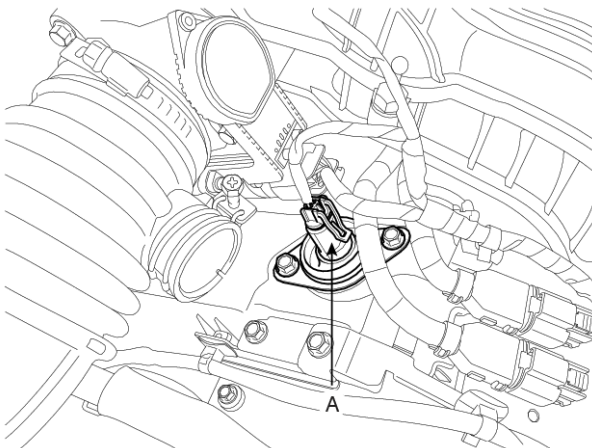


SBHFL8157D

4. Remove the mounting bolt (B), and then remove the valve from the engine.

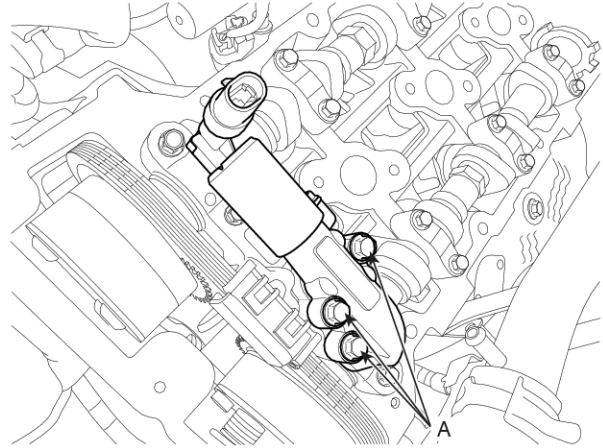
[CVVT Oil Control Valve (Exhaust)]

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



SBHFL8158D

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



SBHFL8159D

Installation

1. Installation is reverse of removal.

CVVT oil control valve installation bolt:

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

CAUTION

Pay attention to color of valve connector (Component and harness side) when installing. If an OCV is installed on opposite bank, the engine may be damaged.

[Connector Color]

Item	Component Side	Harness Side
Bank1 (RH)	Grey	
Bank 2(LH)	Black	

Engine Control System

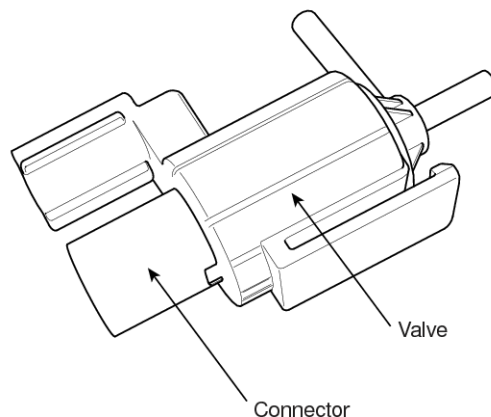
FL-83

Variable Intake Solenoid (VIS) Valve

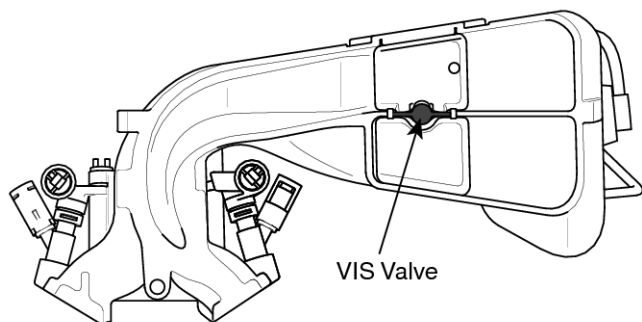
Description

Variable Intake Manifold (VIS) Valve is installed on the intake manifold. It combines or divides the two banks' intake air passages to improve intake efficiency in accordance with the ECM control signal calculated by engine operating condition.

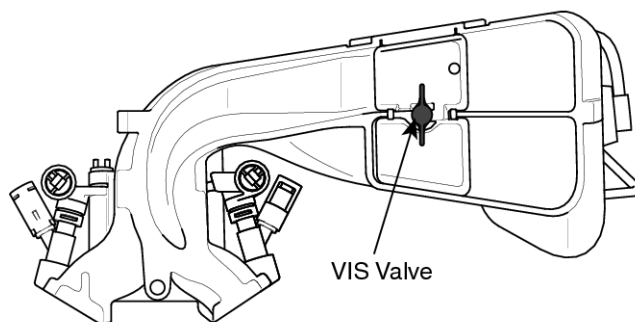
- Low/Middle Speed: Close VIS Valve → No Interference between LH & RH banks → Resonance Effect Maximized → Intake Efficiency Improved
- High Speed: Open VIS Valve → Intake Inertia Effect Maximized → Intake Efficiency Improved



SBHFL9215L



[When closing]



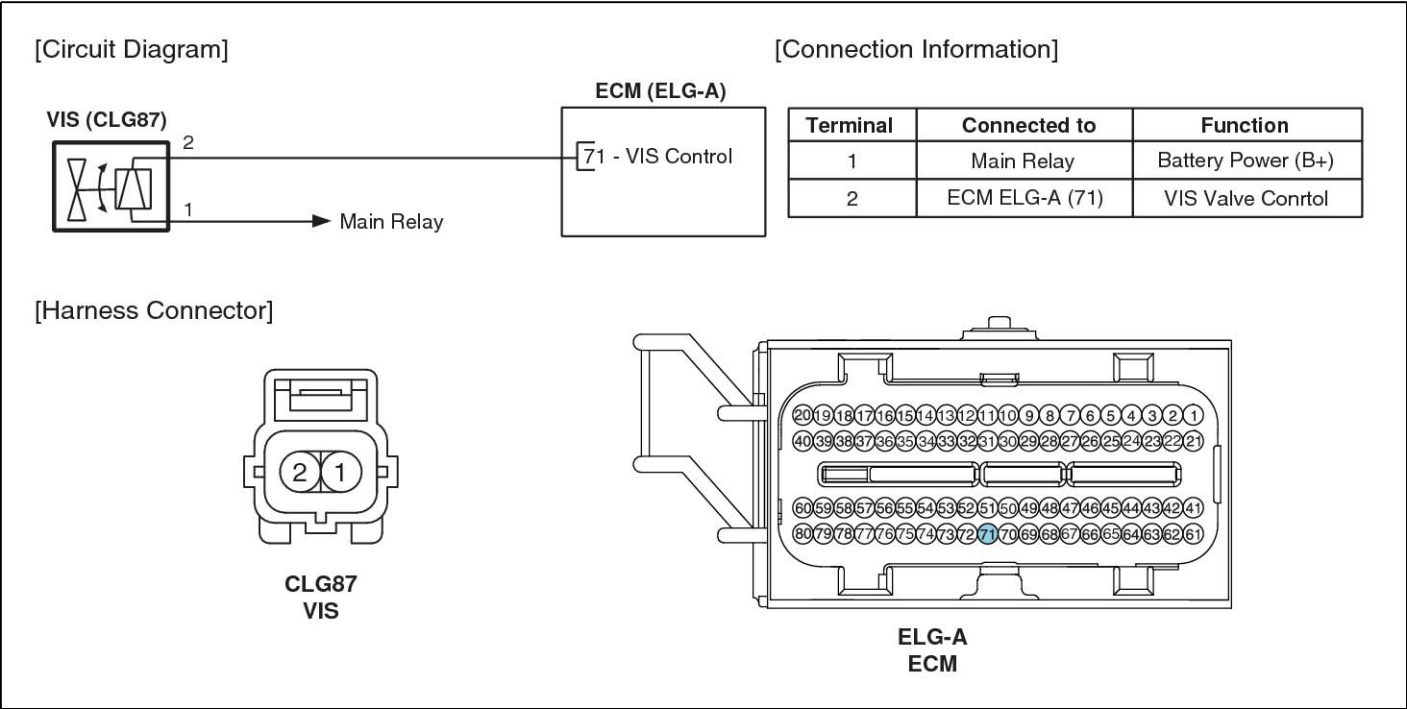
[When open]

EGRF258A

Specification

Item	Specification
Coil Resistance (Ω)	30.0 ~ 35.0 [20°C (68°F)]

Circuit Diagram



SBHFL9213L

Inspection

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

Specification: Refer to “Specification”

Engine Control System

FL-85

Inspection Chart For Diagnostic Trouble Codes (DTC)

DTC	Description	MIL		
		Euro-III/IV	BOBD-I	Leaded
P0012	"A" Camshaft Position-Timing Over-Retarded (Bank 1)	●	▲	▲
P0015	"B" Camshaft Position-Timing Over-Retarded (Bank 1)	●	▲	▲
P0016	Crankshaft Position-Camshaft Position Correlation (Bank 1 Sensor A)	●	▲	▲
P0017	Crankshaft Position-Camshaft Position Correlation (Bank 1 Sensor B)	●	▲	▲
P0018	Crankshaft Position-Camshaft Position Correlation (Bank 2 Sensor A)	●	▲	▲
P0019	Crankshaft Position-Camshaft Position Correlation (Bank 2 Sensor B)	●	▲	▲
P0022	"A" Camshaft Position-Timing Over-Retarded (Bank 2)	●	▲	▲
P0025	"B" Camshaft Position-Timing Over-Retarded (Bank 2)	●	▲	▲
P0026	Intake Valve Control Solenoid Circuit Range/Performance (Bank 1)	●	▲	▲
P0027	Exhaust Valve Control Solenoid Circuit Range/Performance (Bank 1)	●	▲	▲
P0028	Intake Valve Control Solenoid Circuit Range/Performance (Bank 2)	●	▲	▲
P0029	Exhaust Valve Control Solenoid Circuit Range/Performance (Bank 2)	●	▲	▲
P0030	HO2S Heater Control Circuit (Bank 1/Sensor 1)	●		
P0031	HO2S Heater Control Circuit Low (Bank 1/Sensor 1)	●	●	
P0032	HO2S Heater Control Circuit High (Bank 1/Sensor 1)	●	●	
P0036	HO2S Heater Control Circuit (Bank 1/Sensor 2)	●		
P0037	HO2S Heater Control Circuit Low (Bank 1/Sensor 2)	●		
P0038	HO2S Heater Control Circuit High (Bank 1/Sensor 2)	●		
P0050	HO2S Heater Control Circuit (Bank 2/Sensor 1)	●		
P0051	HO2S Heater Control Circuit Low (Bank 2/Sensor 1)	●	●	
P0052	HO2S Heater Control Circuit High (Bank 2/Sensor 1)	●	●	
P0056	HO2S Heater Control Circuit (Bank 2/Sensor 2)	●		
P0057	HO2S Heater Control Circuit Low (Bank 2/Sensor 2)	●		
P0058	HO2S Heater Control Circuit High (Bank 2/Sensor 2)	●		
P0076	Intake Valve Control Solenoid Circuit-Low (Bank 1)	●	●	▲
P0077	Intake Valve Control Solenoid Circuit-High (Bank 1)	●	●	▲
P0079	Exhaust Valve Control Solenoid Circuit Low (Bank 1)	●	●	▲
P0080	Exhaust Valve Control Solenoid Circuit High (Bank 1)	●	●	▲
P0082	Intake Valve Control Solenoid Circuit-Low (Bank 2)	●	●	▲
P0083	Intake Valve Control Solenoid Circuit-High (Bank 2)	●	●	▲
P0085	Exhaust Valve Control Solenoid Circuit Low (Bank 2)	●	●	▲
P0086	Exhaust Valve Control Solenoid Circuit High (Bank 2)	●	●	▲
P0101	Mass or Volume Air Flow "A" Circuit Range/Performance	●	▲	▲

FL-86

Fuel System

DTC	Description	MIL		
		Euro-III/IV	BOBD-I	Leaded
P0102	Mass or Volume Air Flow "A" Circuit Low Input	●	●	●
P0103	Mass or Volume Air Flow "A" Circuit High Input	●	●	●
P0105	Manifold Absolute Pressure/Barometric Pressure Circuit	▲	▲	▲
P0106	Manifold Absolute Pressure/Barometric Pressure Circuit Range/Performance	▲		
P0107	Manifold Absolute Pressure/Barometric Pressure Circuit Low Input	●	●	●
P0108	Manifold Absolute Pressure/Barometric Pressure Circuit High Input	●	●	●
P0109	Manifold Absolute Pressure/Barometric Pressure Circuit Intermittent	▲	▲	▲
P0110	Intake Air Temperature Sensor 1 Circuit	▲		
P0111	Intake Air Temperature Sensor 1 Circuit Range/Performance	▲		
P0112	Intake Air Temperature Sensor 1 Circuit Low Input	●	●	▲
P0113	Intake Air Temperature Sensor 1 Circuit High Input	●	●	▲
P0115	Engine Coolant Temperature Circuit	▲		
P0116	Engine Coolant Temperature Circuit Range/Performance	▲		
P0117	Engine Coolant Temperature Circuit Low Input	●	●	●
P0118	Engine Coolant Temperature Circuit High Input	●	●	●
P0122	Throttle/Pedal Position Sensor/Switch "A" Circuit Low Input	●	●	●
P0123	Throttle/Pedal Position Sensor/Switch "A" Circuit High Input	●	●	●
P0131	O2 Sensor Circuit Low Voltage(Bank 1/Sensor 1)	●	●	
P0132	O2 Sensor Circuit High Voltage(Bank 1/Sensor 1)	●	●	
P0133	O2 Sensor Circuit Slow Response (Bank 1/Sensor 1)	●		
P0134	O2 Sensor Circuit No Activity Detected (Bank 1 Sensor 1)	●	●	
P0137	O2 Sensor Circuit Low Voltage (Bank 1/Sensor 2)	●		
P0138	O2 Sensor Circuit High Voltage (Bank 1/Sensor 2)	●		
P0140	O2 Sensor Circuit No Activity Detected (Bank 1/Sensor 2)	●		
P0151	O2 Sensor Circuit Low Voltage (Bank 2/Sensor 1)	●	●	
P0152	O2 Sensor Circuit High Voltage (Bank 2/Sensor 1)	●	●	
P0153	O2 Sensor Circuit Slow Response (Bank 2/Sensor 1)	●		
P0154	O2 Sensor Circuit No Activity Detected (Bank 2/Sensor 1)	●	●	
P0157	O2 Sensor Circuit Low Voltage (Bank 2/Sensor 2)	●		
P0158	O2 Sensor Circuit High Voltage (Bank 2/Sensor 2)	●		
P0160	O2 Sensor Circuit No Activity Detected (Bank 2/Sensor 2)	●		
P0171	System too Lean (Bank 1)	●	▲	
P0172	System too Rich (Bank 1)	●	▲	

Engine Control System

FL-87

DTC	Description	MIL		
		Euro-III/IV	BOBD-I	Leaded
P0174	System too Lean (Bank 2)	●	▲	
P0175	System too Rich (Bank 2)	●	▲	
P0196	Engine Oil Temperature Sensor-Range/Performance	▲		
P0197	Engine Oil Temperature Sensor Low Input	●	●	▲
P0198	Engine Oil Temperature Sensor High Input	●	●	▲
P0217	Engine Coolant Over Temperature Condition	▲		
P0222	Throttle/Pedal Position Sensor/Switch "B" Circuit Low Input	●	●	●
P0223	Throttle/Pedal Position Sensor/Switch "B" Circuit High Input	●	●	●
P0230	Fuel Pump Primary Circuit	▲	▲	▲
P0261	Cylinder 1 Injector Circuit Low	●	●	●
P0262	Cylinder 1 Injector Circuit High	●	●	●
P0264	Cylinder 2 Injector Circuit Low	●	●	●
P0265	Cylinder 2 Injector Circuit High	●	●	●
P0267	Cylinder 3 Injector Circuit Low	●	●	●
P0268	Cylinder 3 Injector Circuit High	●	●	●
P0270	Cylinder 4 Injector Circuit Low	●	●	●
P0271	Cylinder 4 Injector Circuit High	●	●	●
P0273	Cylinder 5 Injector Circuit Low	●	●	●
P0274	Cylinder 5 Injector Circuit High	●	●	●
P0276	Cylinder 6 Injector Circuit Low	●	●	●
P0277	Cylinder 6 Injector Circuit High	●	●	●
P0300	Random/Multiple Cylinder Misfire Detected	●		
P0301	Cylinder 1-Misfire detected	●		
P0302	Cylinder 2-Misfire detected	●		
P0303	Cylinder 3-Misfire detected	●		
P0304	Cylinder 4-Misfire detected	●		
P0305	Cylinder 5-Misfire detected	●		
P0306	Cylinder 6-Misfire detected	●		
P0315	Crankshaft Position (CKP) Sensor Error	▲		
P0325	Knock Sensor 1 Circuit (Bank 1 or Single Sensor)	▲	●	▲
P0326	Knock Sensor 1 Circuit Range/Performance (Bank 1 or Single Sensor)	▲	●	▲
P0330	Knock Sensor 2 Circuit (Bank 2)	▲	●	▲
P0331	Knock Sensor 2 Circuit Range/Performance (Bank 2)	▲	●	▲
P0335	Crankshaft Position Sensor "A" Circuit	●	●	▲

FL-88

Fuel System

DTC	Description	MIL		
		Euro-III/IV	BOBD-I	Leaded
P0336	Crankshaft Position Sensor "A" Circuit Range/Performance	●	▲	▲
P0340	Camshaft Position Sensor "A" Circuit (Single Sensor)	●	●	▲
P0341	Camshaft Position Sensor "A" Circuit Range/Performance (Bank 1)	●	●	▲
P0346	Camshaft Position Sensor "A" Circuit Range/Performance (Bank 2)	●	●	▲
P0351	Ignition Coil 'A' Primary/Secondary Circuit	●	●	▲
P0352	Ignition Coil 'B' Primary/Secondary Circuit	●	●	▲
P0353	Ignition Coil 'C' Primary/Secondary Circuit	●	●	▲
P0354	Ignition Coil 'D' Primary/Secondary Circuit	●	●	▲
P0355	Ignition Coil 'E' Primary/Secondary Circuit	●	●	▲
P0356	Ignition Coil 'F' Primary/Secondary Circuit	●	●	▲
P0366	Camshaft Position Sensor "B" Circuit Range/Performance (Bank 1)	●	●	▲
P0391	Camshaft Position Sensor "B" Circuit Range/Performance (Bank 2)	●	●	▲
P0420	Catalyst System Efficiency below Threshold (Bank 1)	●		
P0430	Catalyst System Efficiency Below Threshold (Bank 2)	●		
P0444	Evaporative Emission System-Purge Control Valve Circuit Open	●		
P0445	Evaporative Emission System-Purge Control Valve Circuit Shorted	●		
P0501	Vehicle Speed Sensor "A" Range/Performance	●	●	●
P0504	Brake Switch "A"/"B" Correlation	▲	▲	▲
P0506	Idle Air Control System-RPM Lower than Expected	●		
P0507	Idle Air Control System-RPM Higher than Expected	●		
P0532	A/C Refrigerant Pressure Sensor "A" Circuit Low Input	▲	▲	▲
P0533	A/C Refrigerant Pressure Sensor "A" Circuit High Input	▲	▲	▲
P0552	Power Steering Pressure Sensor/Switch Circuit Low input	▲	▲	
P0553	Power Steering Pressure Sensor/Switch Circuit High input	▲	▲	
P0562	System Voltage Low	●	▲	▲
P0563	System Voltage High	●	▲	▲
P0571	Brake Switch "A" Circuit	▲	▲	▲
P0601	Internal Control Module Memory Check Sum Error	●	▲	▲
P0602	Control Module Programming Error	●	▲	▲
P0604	Internal Control Module Random Access Memory (RAM) Error	●	▲	▲
P0606	ECM/PCM Processor	●	●	▲
P0638	Throttle Actuator Control Range/Performance (Bank 1)	●	●	▲
P0641	Sensor Reference Voltage "A" Circuit/Open	●	●	▲
P0646	A/C Clutch Relay Control Circuit Low	▲	▲	▲

Engine Control System

FL-89

DTC	Description	MIL		
		Euro-III/IV	BOBD-I	Leaded
P0647	A/C Clutch Relay Control Circuit High	▲	▲	▲
P0650	Malfunction Indicator Lamp (MIL) Control Circuit	▲	▲	
P0651	Sensor Reference Voltage "B" Circuit Open	●	●	▲
P0660	Intake Manifold Tuning Valve Control Circuit/Open (Bank 1)	●	●	▲
P0685	ECM/PCM Power Relay Control Circuit /Open	▲	▲	▲
P0700	Transmission Control System (MIL Request)	●	●	●
P1106	Manifold Absolute Pressure Sensor Circuit Intermittent High	▲	▲	▲
P1107	Manifold Absolute Pressure Sensor Circuit Intermittent Low	▲	▲	▲
P1111	Intake Air Temperature Sensor Circuit Intermittent High	▲	▲	▲
P1112	Intake Air Temperature Sensor Circuit Intermittent Low	▲	▲	▲
P1114	Engine Coolant Temperature Sensor Circuit Intermittent Low	▲	▲	▲
P1115	Engine Coolant Temperature Sensor Circuit Intermittent High	▲	▲	▲
P1295	Throttle Actuator Control System-Power Management	●	●	●
P1501	Battery Temperature Too High Diagnostic	▲	▲	▲
P1502	Battery Not Charging Diagnostic	▲	▲	▲
P1523	Throttle Actuator Control System-Throttle Valve Stuck	▲	▲	▲
P2096	Post Catalyst Fuel Trim System Too Lean (Bank 1)	●	▲	
P2097	Post Catalyst Fuel Trim System Too Rich (Bank 1)	●	▲	
P2098	Post Catalyst Fuel Trim System Too Lean (Bank 2)	●	▲	
P2099	Post Catalyst Fuel Trim System Too Rich (Bank 2)	●	▲	
P2104	Throttle Actuator Control System-Forced Idle	●	●	●
P2105	Throttle Actuator Control System-Force Engine Shutdown	●	●	●
P2106	Throttle Actuator Control System-Force Limited Power	●	●	●
P2122	Throttle/Pedal Position Sensor/Switch "D" Circuit Low Input	●	●	▲
P2123	Throttle/Pedal Position Sensor /Switch "D" Circuit High Input	●	●	▲
P2127	Throttle/Pedal Position Sensor/Switch "E" Circuit Low Input	●	●	▲
P2128	Throttle/Pedal Position Sensor/Switch "E" Circuit-High Input	●	●	▲
P2135	Throttle/Pedal Position Sensor/Switch A/B Voltage Correlation	●	●	▲
P2138	Throttle/Pedal Position Sensor/Switch D/E Voltage Correlation	●	●	▲
P2173	Throttle Actuator Control System- High Air Flow Detected	●	●	▲
P2187	System too Lean at Idle (← Additive) (Bank 1)	●	▲	
P2188	System too Rich at Idle (Bank 1)	●	▲	
P2189	System too Lean at Idle (← Additive) (Bank 2)	●	▲	
P2190	System too Rich at Idle (Bank 2)	●	▲	

FL-90

Fuel System

DTC	Description	MIL		
		Euro-III/IV	BOBD-I	Leaded
P2195	O2 Sensor Signal Stuck Lean (Bank 1 Sensor 1)	●	▲	
P2196	O2 Sensor Signal Stuck Rich (Bank 1 Sensor 1)	●	▲	
P2197	O2 Sensor Signal Stuck Lean (Bank 2 Sensor 1)	●	▲	
P2198	O2 Sensor Signal Stuck Rich (Bank 2 Sensor 1)	●	▲	
P2270	O2 Sensor Signal Stuck Lean (Bank 1 Sensor 2)	●		
P2271	O2 Sensor Signal Stuck Rich (Bank 1 Sensor 2)	●		
P2272	O2 Sensor Signal Stuck Lean (Bank 2 Sensor 2)	●		
P2273	O2 Sensor Signal Stuck Rich (Bank 2 Sensor 2)	●		
P2502	Battery Voltage Rationality	▲	▲	▲
P2507	ECM/PCM power Input Signal Low	●	▲	▲
P2610	ECM/PCM-Engine Off Timer Performance	●	▲	▲
U0001	High Speed CAN Communication Bus off	●	●	▲
U0101	Lost Communication With TCM	●	●	▲
U1111	Battery Sensor fault detected by ECU	▲	▲	▲
U1112	LIN Communication Error	▲	▲	▲

NOTICE

●: MIL ON & Memory

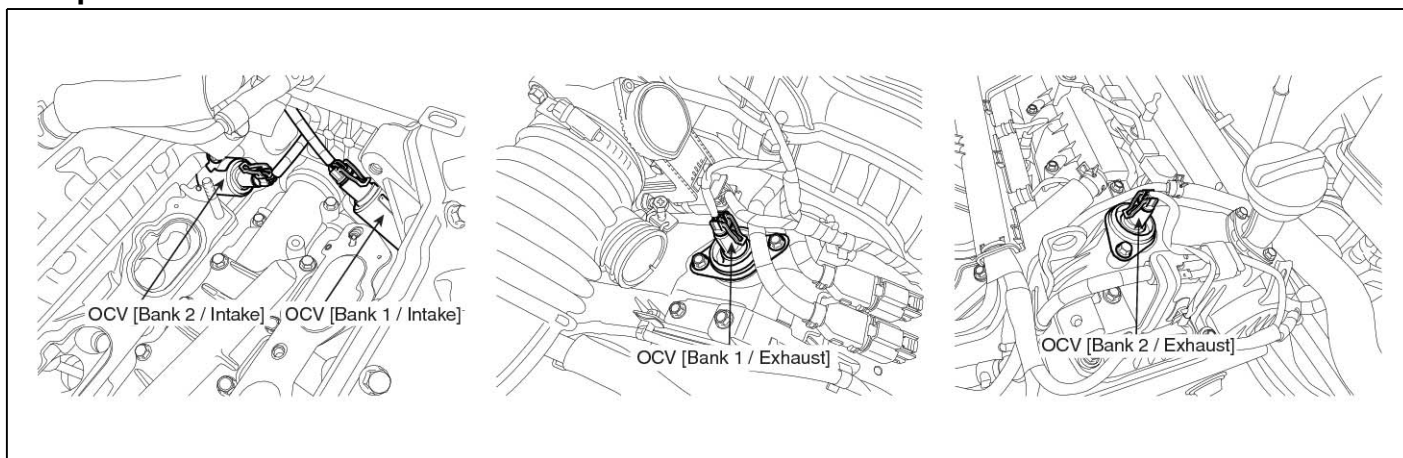
▲: MIL OFF & Memory

Engine Control System

FL-91

P0012 "A" Camshaft Position-Timing Over-Retarded (Bank 1)

Component Location



SBHFL9325L

General Description

The CVVT (Continuously Variable Valve Timing) system is installed to the chain sprocket of the intake camshaft. This system controls the intake camshaft to provide the optimal valve timing for every driving condition. The ECM controls the Oil Control Valve(OCV), based on the signals output from mass air flow, throttle position and engine coolant temperature. The CVVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft becomes optimal, and the engine torque improves, fuel economy improves, exhaust emissions decrease under overall driving conditions.

DTC Description

ECM monitors CAM phaser error while CMP signal is normally generating and vehicle is driving in 2000 ~ 3000rpm.

If the CAM phaser does not move although ECM commands OCV duty cycle ECM determines that a fault exists and a DTC is stored.

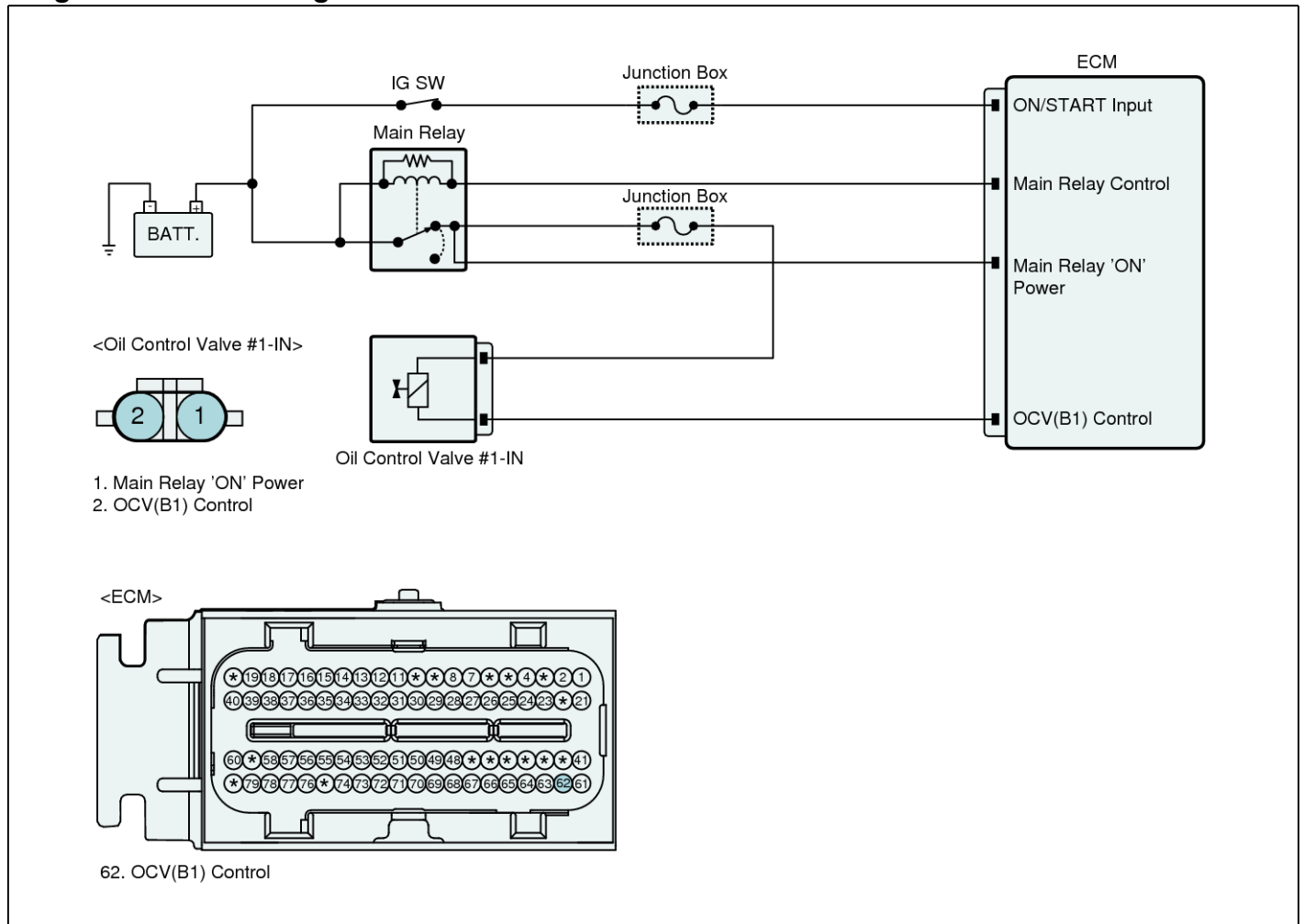
DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		Determines if the phaser is stuck or has steady-state error	- Engine Oil - OCV stuck - CVVT stuck
Enable Conditions		- CAM signal is normally generating - Vehicle is on driving (2000 ~ 3000RPM) for 5 minutes	
Threshold value	Case 1	5 CAD < Cam Actual Position < 50 CAD - Duty Cycle > 90% or Duty Cycle < 10%	
	Case 2	- Cam Position error > 15 CAD (Difference between Actual Position and Desire Position is more than 15°) - Timing Counter > 80	
Diagnosis Time		Continuous (within 5min.)	
MIL On Condition		2 Driving Cycles	

FL-92

Fuel System

Diagnostic Circuit Diagram



SBHFL9500L

Signal Waveform & Data

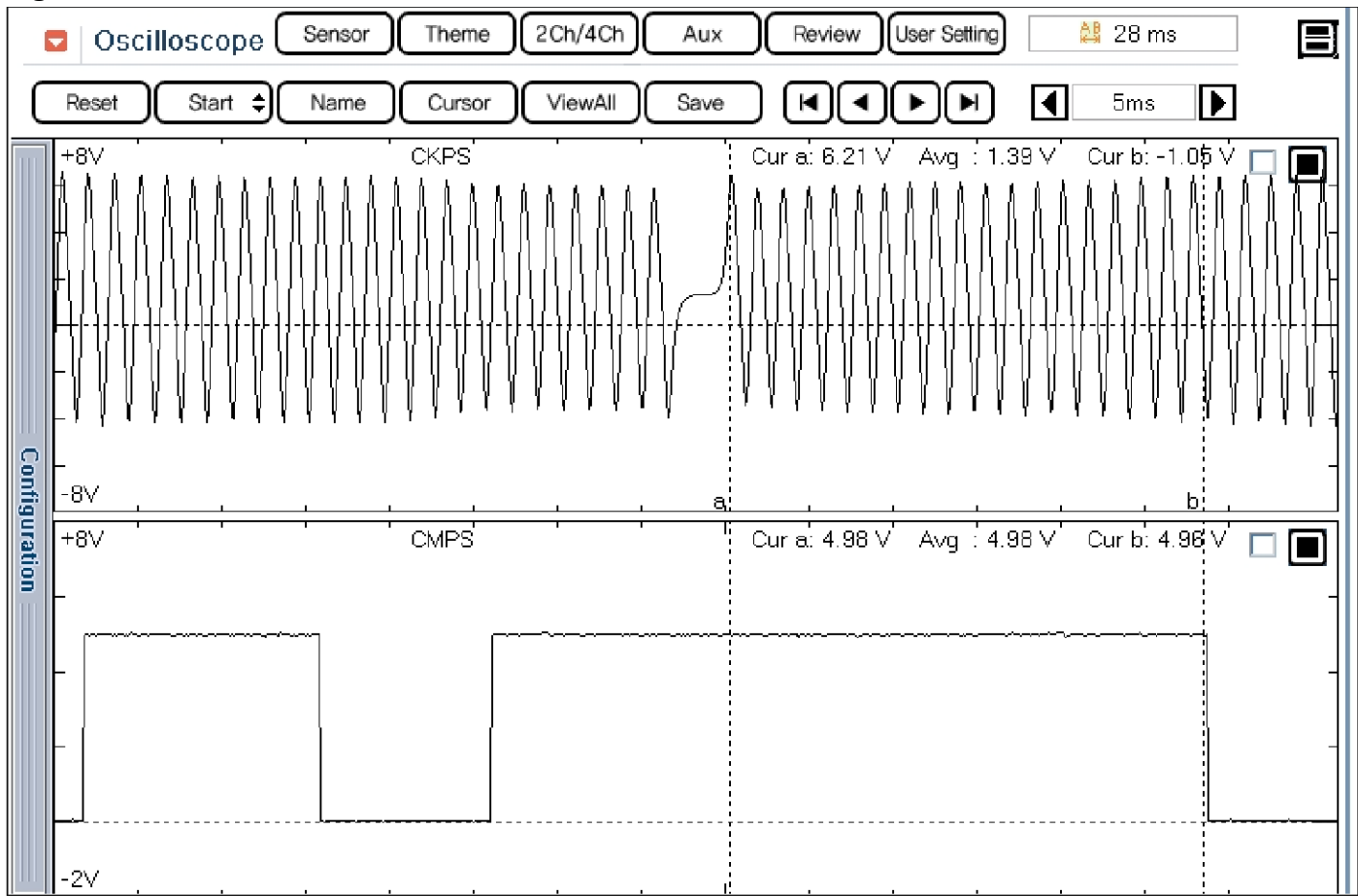


Fig.1

SBHFL9601L

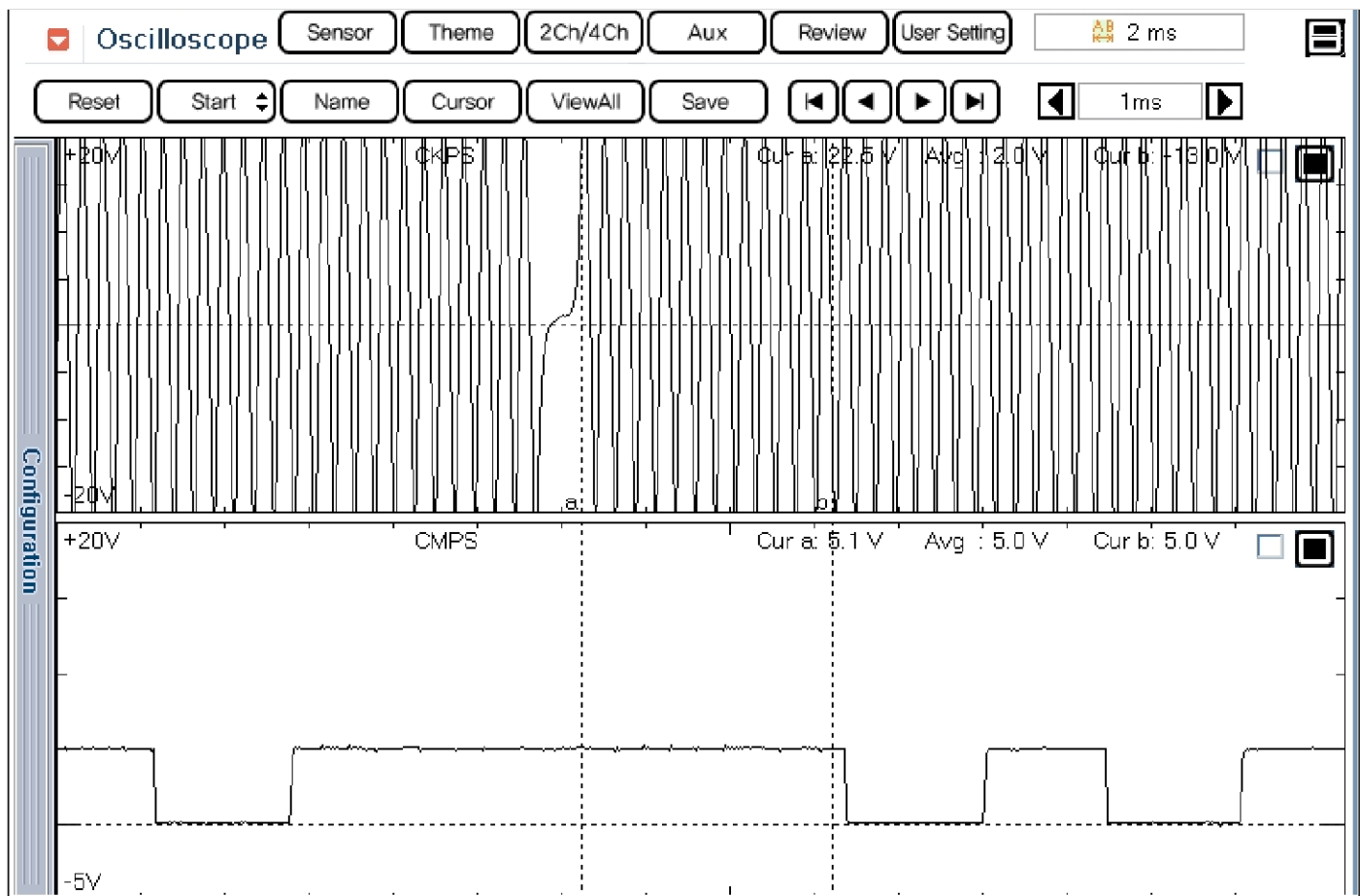


Fig.2

SBHFL9602L

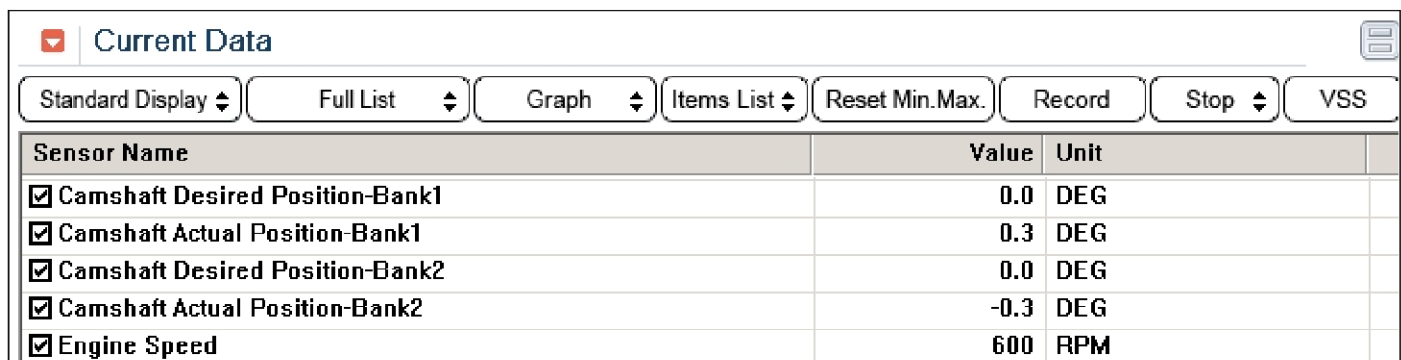
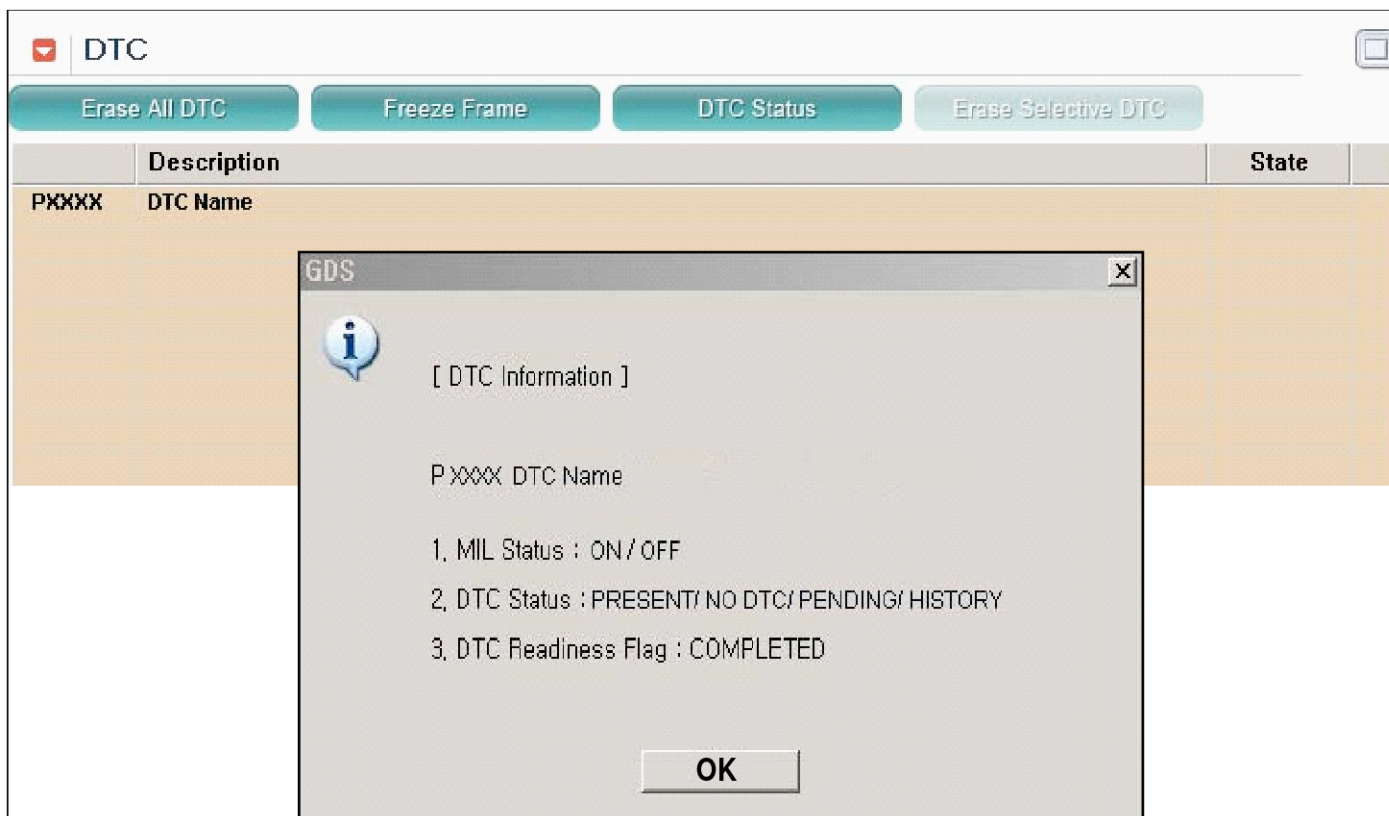


Fig.3

SBHFL9603L



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "System Inspection" procedure.

NO ► Fault is intermittent caused by ECM memory was not cleared after repair. Erase DTC and drive the vehicle to satisfy the enable condition then, go to "System Inspection" procedure.

System Inspection

■ Visual Inspection

1. Check oil level is O.K.
2. Check Oil and OCV is contaminated.
3. Check that any oil leakage is occurred around OCV.
4. Has a problem been found ?

YES ► Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Component Inspection" procedure.

Component Inspection

■ Check OCV resistance

1. IG "OFF" and disconnect OCV connector.

2. Measure resistance between power and signal terminals of OCV. (Component Side)

Specification : 6.7 ~ 7.7 Ω

3. Is the measured resistance within specification?

YES ► Go to "Check CAM PHASER with actuation test" as follows.

NO ► Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

■ Check CAM PHASER with actuation test

1. Connect scantool and IG "ON"
2. Select "CAM PHASER INTAKE BANK 1" on the Actuation Test
3. Select "OIL CONTROL VALVE" on the Actuation Test
4. Activates "CAM PHASER INTAKE BANK 1" by pressing "START" button
5. Activates "OIL CONTROL VALVE" by pressing "START" button
6. Repeat this procedure 4 or 5 times to ensure CAM PHASER and valve control solenoid reliability

Engine Control System

FL-97

Actuation Test

Test Items

A/C Compressor Relay

Fuel Pump Control

Immobilizer Lamp

Canister Shut Off Valve Clocked

Canister Purge Valve

Oil Control Valve

Ignition Coil-#1

Ignition Coil-#2

Ignition Coil-#3

Ignition Coil-#4

Duration

Until Stop Button

Conditions

IG. ON/ENG.OFF

Result

Start

Stop

SBHFL9606L

Actuation Test

Test Items

Injector-Cylinder 6

Fan PWM

ETC Motor

Variable Intake Manifold 1

Cam Phaser Intake Bank1

Cam Phaser Intake Bank2

Spark Advance/Retard

CAM Phaser Exhaust Bank 1

CAM Phaser Exhaust Bank 2

Duration

Until Stop Button

Conditions

ENG. RUN

Result

Success

Start

Stop

SBHFL9607L

7. Has a problem been found ?

YES ▶ Substitute with a known - good CVVT or O-CV and check for proper operation. If the problem is corrected, replace CVVT or OCV and go to "Verification of Vehicle Repair" procedure.

NO ▶ Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

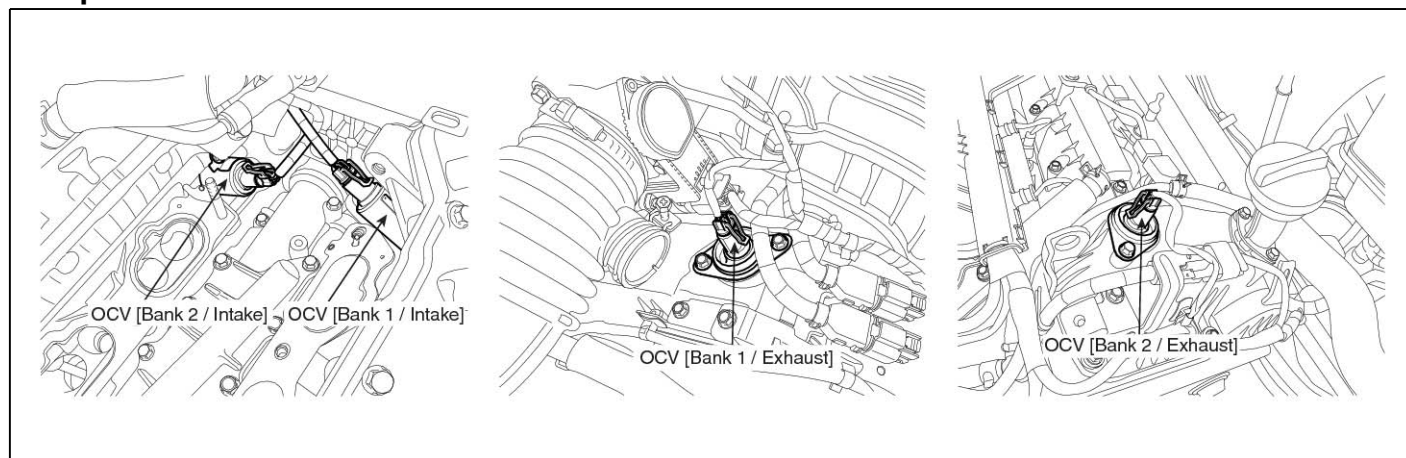
1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

P0015 "B" Camshaft Position - Timing Over-Retarded (Bank 1)

Component Location



SBHFL9325L

General Description

The CVVT (Continuously Variable Valve Timing) system is installed to the chain sprocket of the intake camshaft. This system controls the intake camshaft to provide the optimal valve timing for every driving condition. The ECM controls the Oil Control Valve(OCV), based on the signals output from mass air flow, throttle position and engine coolant temperature. The CVVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft becomes optimal, and the engine torque improves, fuel economy improves, exhaust emissions decrease under overall driving conditions.

DTC Description

ECM monitors CAM phaser error while CMP signal is normally generating and vehicle is driving in 2000 ~ 3000rpm.

If the CAM phaser does not move although ECM commands OCV duty cycle ECM determines that a fault exists and a DTC is stored.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		Determines if the phaser is stuck or has steady-state error	- Engine Oil - OCV stuck - CVVT stuck
Enable Conditions		- CAM signal is normally generating - Vehicle is on driving (2000 ~ 3000RPM) for 5 minutes	
Threshold value	Case 1	5 CAD < Cam Actual Position < 50 CAD - Duty Cycle > 90% or Duty Cycle < 10%	
	Case 2	- Cam Position error > 15 CAD (Difference between Actual Position and Desire Position is more than 15°) - Timing Counter > 80	
Diagnosis Time		Continuous (within 5min.)	
MIL On Condition		2 Driving Cycles	

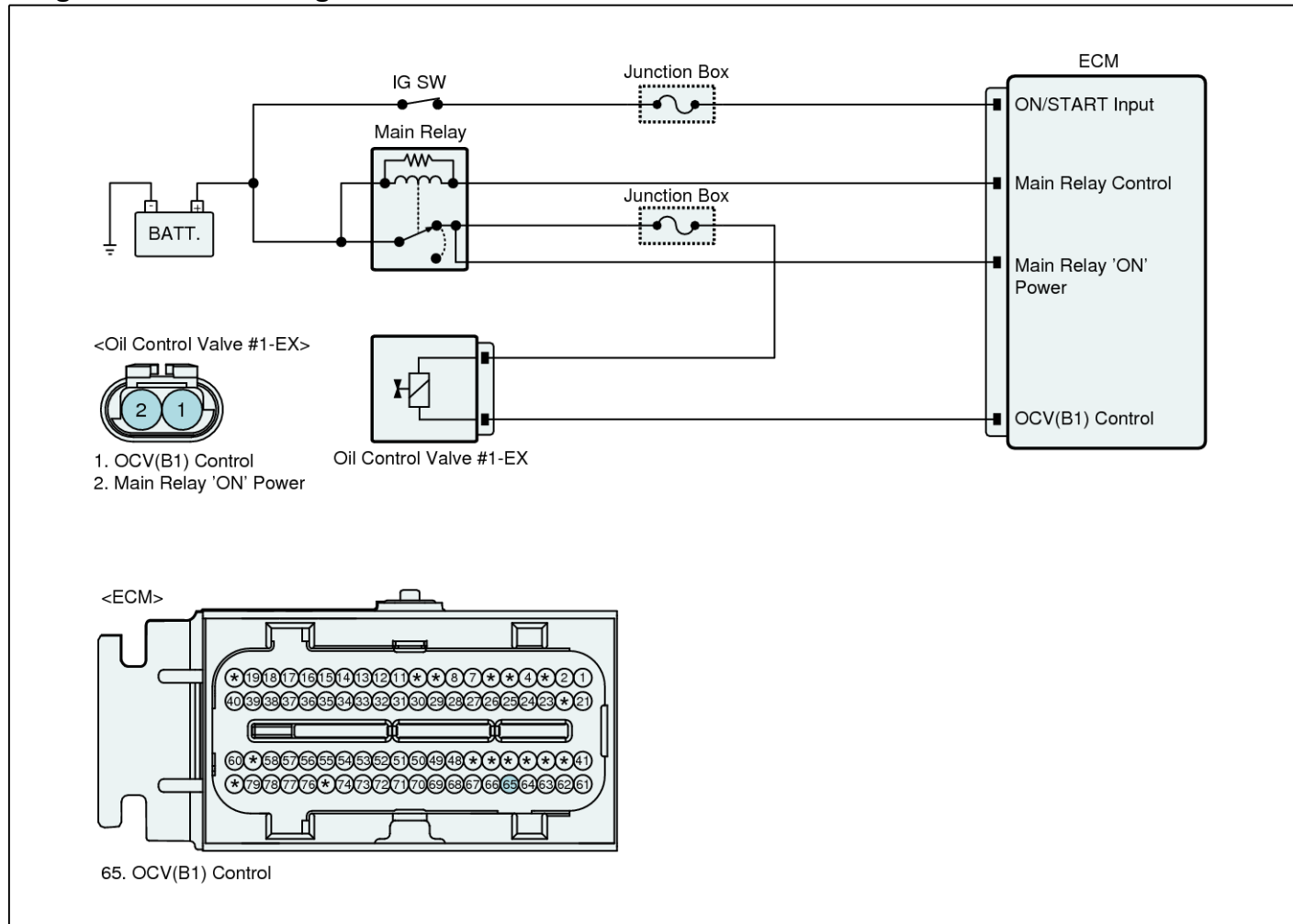
Engine Control System

FL-99

Specification

OCV	Specification
Coil Resistance (Ω)	6.7 ~ 7.7 (20°C)

Diagnostic Circuit Diagram



SBHFL9501L

Signal Waveform & Data

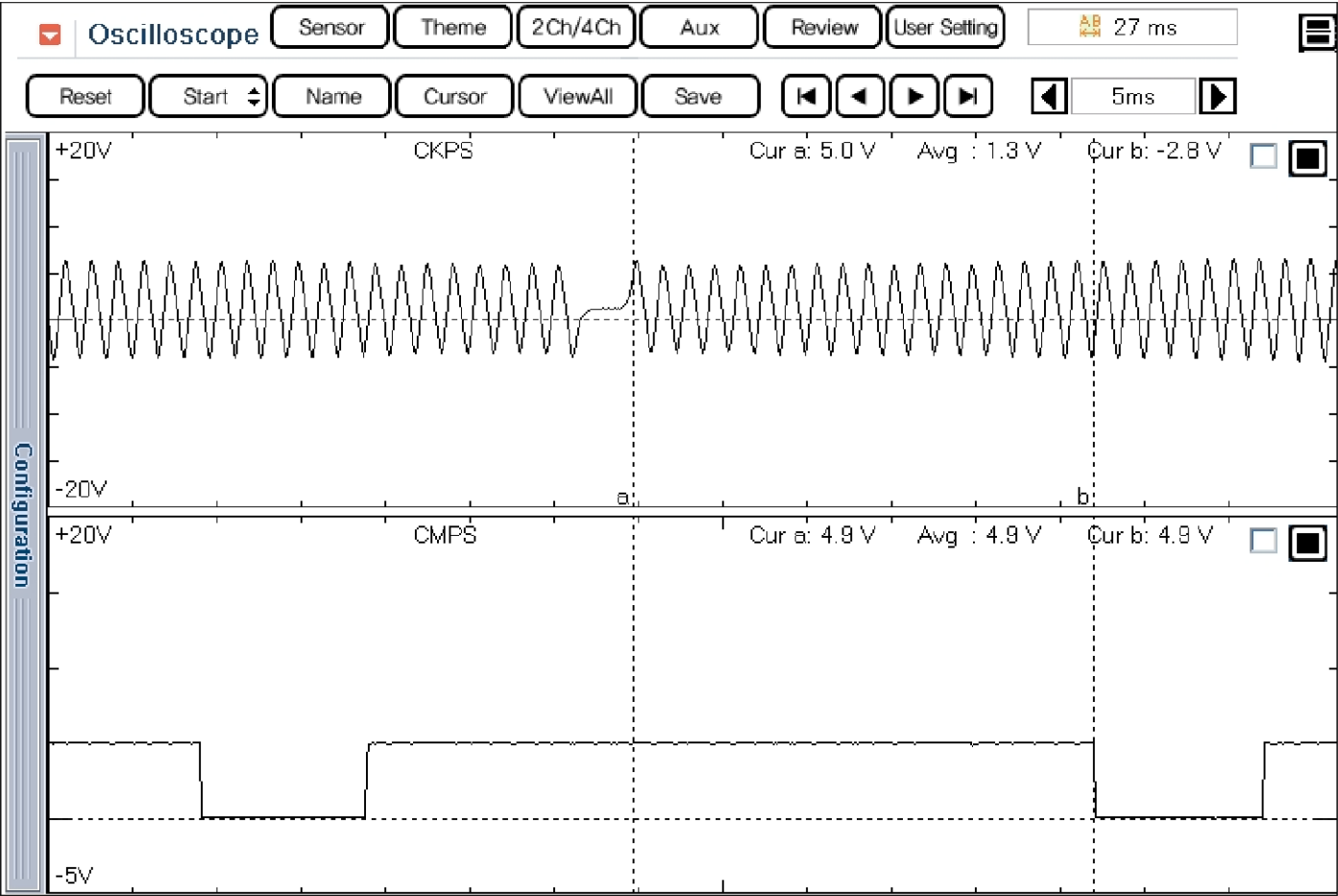


Fig.1

SBHFL9608L

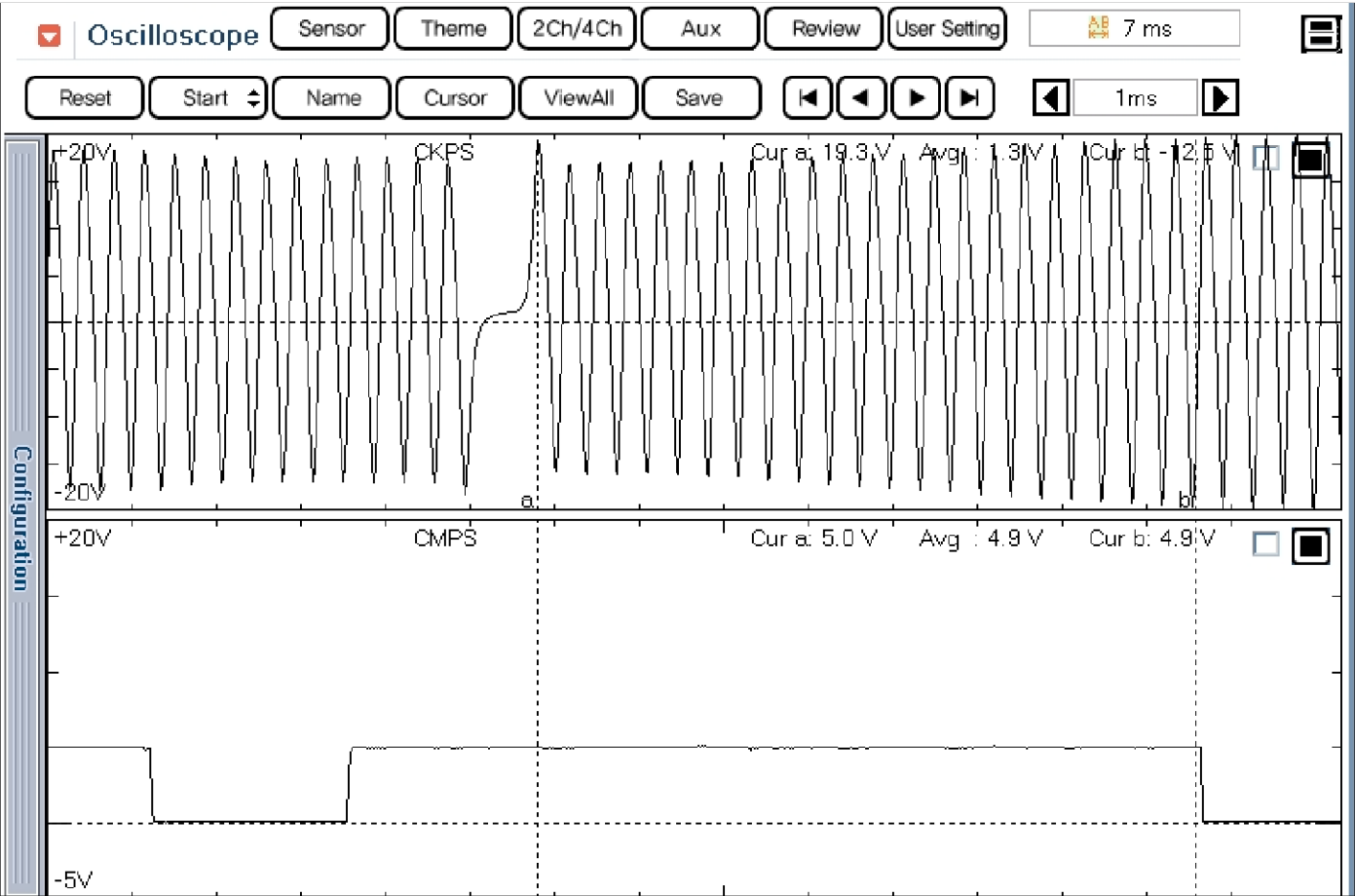


Fig.2

SBHFL9609L

Current Data

Standard Display Full List Graph Items List Reset Min.Max. Record Stop VSS

Sensor Name	Value	Unit
☐ EX-Cam Bank1 Desired Position	0	DEG
☐ EX-Cam Bank1 Actual Position	0	DEG
☐ EX-Cam Bank2 Desired Position	0	DEG
☐ EX-Cam Bank2 Actual Position	0	DEG
☐ EX-Cam Phaser 1 Duty Cycle	0	%
☐ EX-Cam Phaser 2 Duty Cycle	0	%

Fig.3

SBHFL9610L

FL-102

Fuel System

Sensor Name	Value	Unit
☒ Camshaft Control	ON	-
☒ Engine Speed	3840	RPM
☒ EX-Cam Bank1 Actual Position	-15	DEG
☒ EX-Cam Bank1 Desired Position	-14	DEG
☒ EX-Cam Bank2 Desired Position	-14	DEG
☒ EX-Cam Bank2 Actual Position	-15	DEG
☒ EX-Cam Phaser 1 Duty Cycle	43	%
☒ EX-Cam Phaser 2 Duty Cycle	44	%

Fig.4

SBHFL9611L



Fig.5

SBHFL9612L

Fig 1) Normal waveform of CKPS & EX-CMPS at idle.

Fig 2) Normal waveform of CKPS & EX-CMPS at acceleration.

Fig 3) Normal data of EX-CVVT at idle.

Fig 4) Normal data of EX-CVVT at acceleration.

Fig 5) Normal graph of EX-CVVT at acceleration.

This example shows a typical Crankshaft Position Sensor (CKPS) and Camshaft Position Sensor (CMPS) waveform at idle.(Fig1.) If the 17th signal of the CKPS after missing tooth is aligned with the high signal of the CMPS at idle, ECM recognizes that Synchronization between CKPS and CMPS is completed. Under accelerating condition, the number of tooth between missing tooth and tooth aligned with edge of the CMPS high signal is increased than idle conditon.(Fig2.)

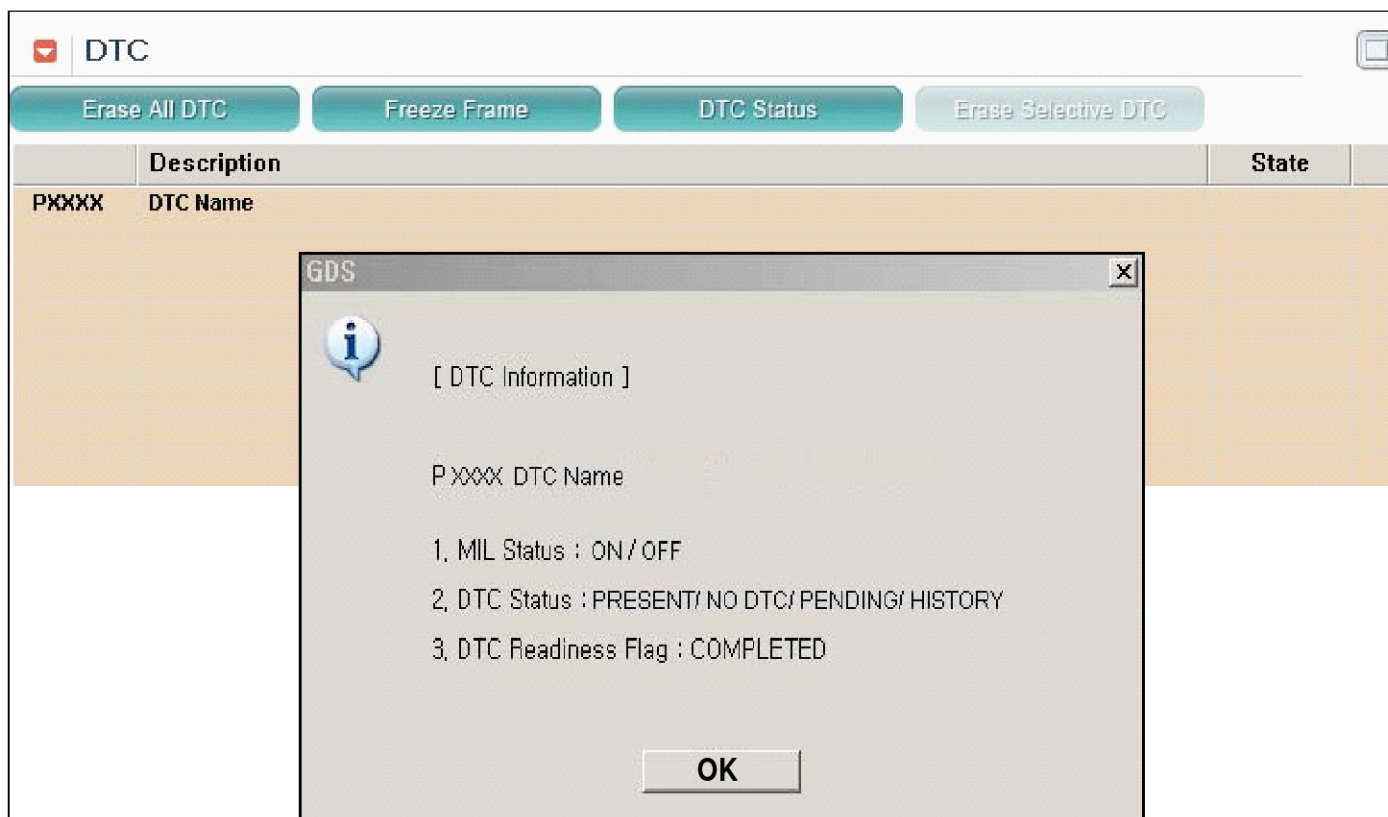
Engine Control System

FL-103

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "System Inspection" procedure.

NO ► Fault is intermittent caused by ECM memory was not cleared after repair. Erase DTC and drive the vehicle to satisfy the enable condition then, go to "System Inspection" procedure.

System Inspection

■ Visual Inspection

1. Check oil level is O.K.
2. Check Oil and OCV is contaminated.
3. Check that any oil leakage is occurred around OCV.
4. Has a problem been found ?

YES ► Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Component Inspection" procedure.

Component Inspection

■ Check OCV resistance

1. IG "OFF" and disconnect OCV connector.
2. Measure resistance between power and signal terminals of OCV. (Component Side)

Specification : 6.7 ~ 7.7 Ω

3. Is the measured resistance within specification?

YES ► Go to "Check CAM PHASER with actuation test" as follows.

NO ► Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

■ Check CAM PHASER with actuation test

1. Connect scantool and IG "ON"
2. Select "CAM PHASER EXHAUST BANK 1" on the Actuation Test
3. Select "OIL CONTROL VALVE" on the Actuation Test

FL-104

Fuel System

4. Activates "CAM PHASER EXHAUST BANK 1" by pressing "START" button
5. Activates "OIL CONTROL VALVE" by pressing "START" button

6. Repeat this procedure 4 or 5 times to ensure CAM PHASER and valve control solenoid reliability

☒ Actuation Test

Test Items
A/C Compressor Relay
Fuel Pump Control
Immobilizer Lamp
Canister Shut Off Valve Clocked
Canister Purge Valve
Oil Control Valve
Ignition Coil-#1
Ignition Coil-#2
Ignition Coil-#3
Ignition Coil-#4

● Duration

● Conditions

● Result

Start

Stop

SBHFL9606L

☒ Actuation Test

Test Items
Injector-Cylinder 6
Fan PWM
ETC Motor
Variable Intake Manifold 1
Cam Phaser Intake Bank1
Cam Phaser Intake Bank2
Spark Advance/Retard
CAM Phaser Exhaust Bank 1
CAM Phaser Exhaust Bank 2

● Duration

● Conditions

● Result

Start

Stop

SBHFL9607L

7. Has a problem been found ?

- YES** ▶ Substitute with a known - good CVVT or O-CV and check for proper operation. If the problem is corrected, replace CVVT or OCV and go to "Verification of Vehicle Repair" procedure.
- NO** ▶ Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

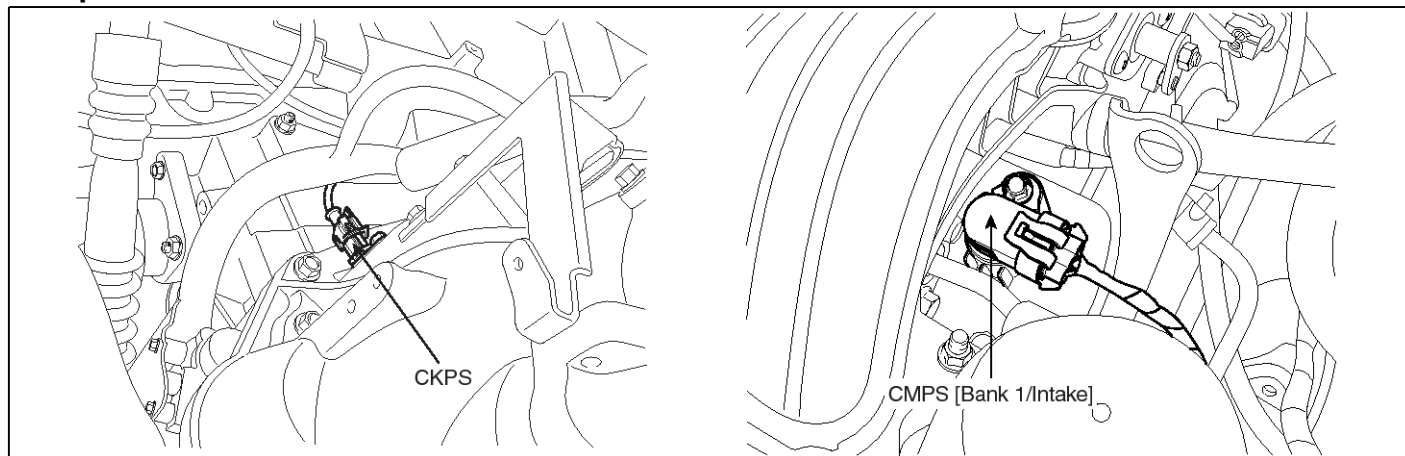
NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-105

P0016 Crankshaft Position–Camshaft Position Correlation (Bank 1 Sensor A)

Component Location



SBHFL9326L

General Description

The CVVT (Continuously Variable Valve Timing) system is installed to the chain sprocket of the intake camshaft. This system controls the intake camshaft to provide the optimal valve timing for every driving condition. The ECM controls the Oil Control Valve(OCV), based on the signals output from mass air flow, throttle position and engine coolant temperature. The CVVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft becomes optimal, and the engine torque improves, fuel economy improves, exhaust emissions decrease under overall driving conditions.

DTC Description

ECM monitors timing misalignment while no active faults is present and fully warmed up engine oil at idle.

If the timing is misaligned ECM determines that a fault exists and a DTC is stored.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		• Determines if CAM target is aligned correctly to crank	• loosened CKPS • Timing Misalignment
Enable Conditions		• No active faults • Fully warmed up at idle	
Threshold value	Case 1	• 1 teeth misalignment at 80 °C(176 °F) < Oil Temperature < 90 °C(194°F)	
	Case 2	• 2 tooth misalignment at Lower than 80 °C(176 °F) or Higher than 90 °C(194°F)	
Diagnosis Time		• Continuous (Within 1min.)	
MIL On Condition		• 2 Driving Cycles	

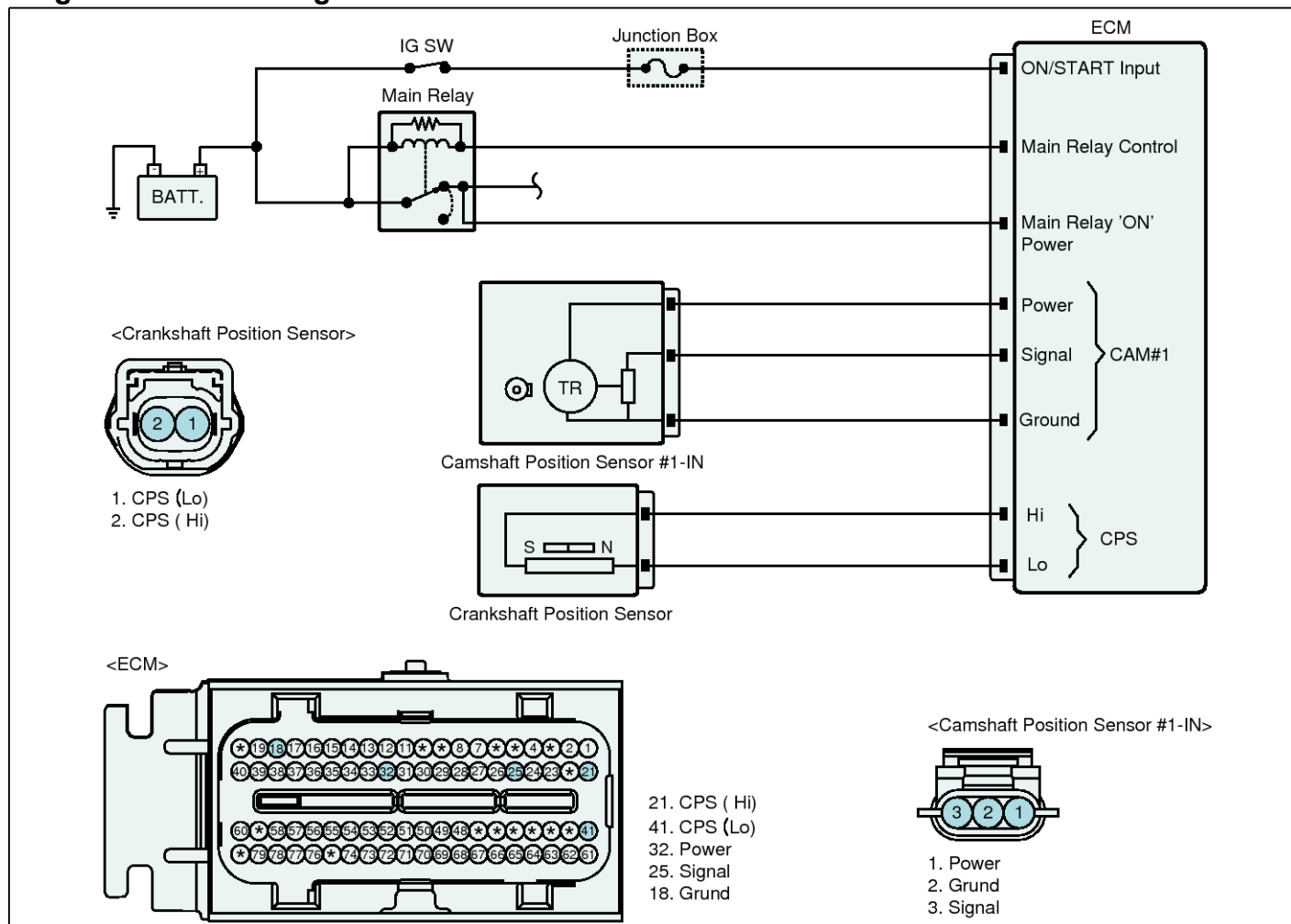
FL-106

Fuel System

Specification

Engine Oil Temperature	Misalignment
80 °C(176 °F) < Engine Oil Temperature < 90 °C(194°F)	1 tooth
Less than 80 °C(176 °F) or Higher than 90 °C(194°F)	2 tooth

Diagnostic Circuit Diagram



SBHFL9502L

Signal Waveform & Data

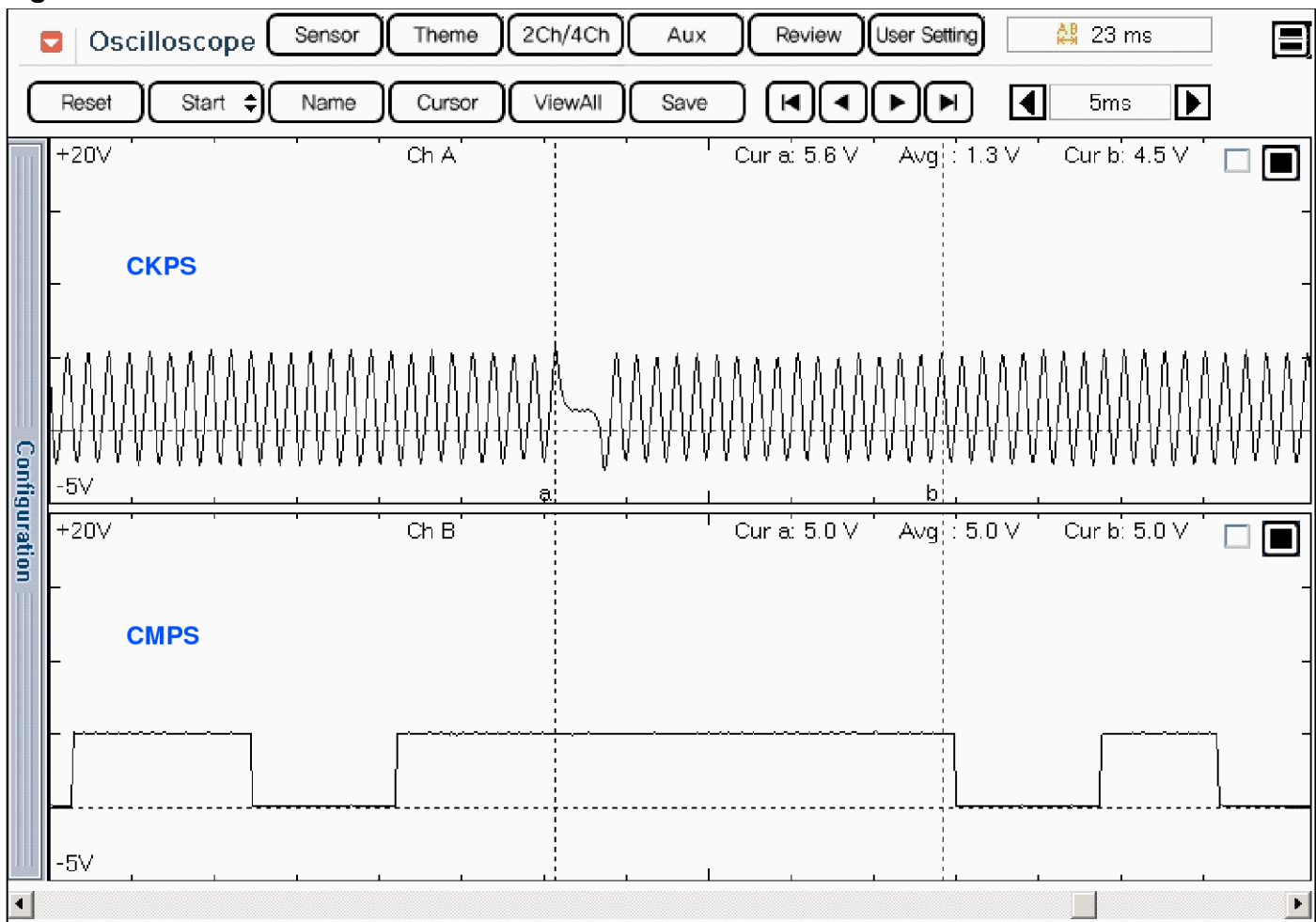


Fig.1

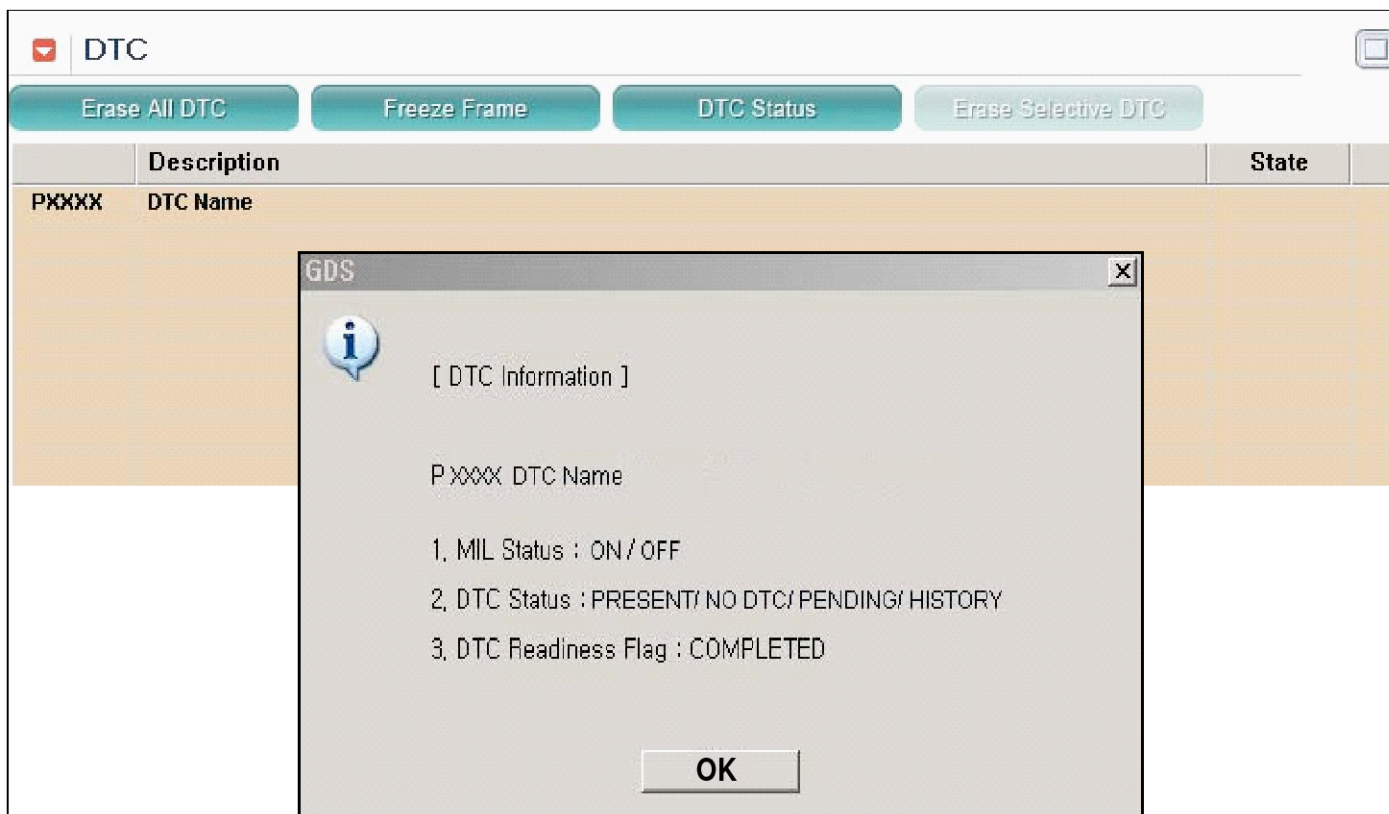
SBHFL9613L

Fig 1) Normal waveform of CKPS & CMPS at idle.

This example shows a typical Crankshaft Position Sensor (CKPS) and Camshaft Position Sensor (CMPS) waveform at idle. If the 17th signal of the CKPS after missing tooth is aligned with the high signal of the CMPS at idle, ECM recognizes that Synchronization between CKPS and CMPS is completed.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ▶ Go to "System Inspection" procedure.

NO ▶ Fault is intermittent caused by ECM memory was not cleared after repair. Erase DTC and drive the vehicle to satisfy the enable condition then, go to "System Inspection" procedure.

Component Inspection

■ Visual Inspection

1. Check oil level is O.K.
2. Check Oil and OCV is contaminated.
3. Has a problem been found ?

YES ▶ Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Visually check CKPS and target wheel" as follow

■ Visually check CKPS and target wheel

1. IG "OFF".
2. Visually check CKPS is loosened or target wheel is deformed or damaged.

3. Is the above items normal ?

YES ▶ Go to "Check CAM PHASER with actuation test" as follows

NO ▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

■ Check CAM PHASER with actuation test

1. Connect scantool and IG "ON"
2. Select "CAM PHASER INTAKE BANK 1" on the Actuation Test
3. Select "OIL CONTROL VALVE" on the Actuation Test
4. Activates "CAM PHASER INTAKE BANK 1" by pressing "START" button
5. Activates "OIL CONTROL VALVE" by pressing "START" button
6. Repeat this procedure 4 or 5 times to ensure CAM PHASER and valve control solenoid reliability

Engine Control System

FL-109

Actuation Test

Test Items

A/C Compressor Relay
Fuel Pump Control
Immobilizer Lamp
Canister Shut Off Valve Clocked
Canister Purge Valve
Oil Control Valve
Ignition Coil-#1
Ignition Coil-#2
Ignition Coil-#3
Ignition Coil-#4

Duration

Until Stop Button

Conditions

IG. ON/ENG.OFF

Result

Start

Stop

SBHFL9606L

Actuation Test

Test Items

Injector-Cylinder 6
Fan PWM
ETC Motor
Variable Intake Manifold 1
Cam Phaser Intake Bank1
Cam Phaser Intake Bank2
Spark Advance/Retard
CAM Phaser Exhaust Bank 1
CAM Phaser Exhaust Bank 2

Duration

Until Stop Button

Conditions

ENG. RUN

Result

Success

Start

Stop

SBHFL9607L

7. Has a problem been found ?

YES ▶ Substitute with a known - good CVVT or O-CV and check for proper operation. If the problem is corrected, replace CVVT or OCV and go to "Verification of Vehicle Repair" procedure.

NO ▶ Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and Go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ CMPS, CKPS Inspection

1. IG "OFF" and connect scantool.
2. ENG "ON" and Measure signal waveform at signal terminal of CMPS.

3. Measure signal waveform at signal terminal of CKPS.

Specification : 17th signal of the CKPS after missing tooth is aligned with the high signal of the CMPS at idle, ECM recognizes that Synchronization between CKPS and CMPS is completed.

※ Refer to Signal Waveform & Data

4. Is the measured signal waveform O.K ?

YES ▶ Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Timing Mark Inspection" procedure as follow.

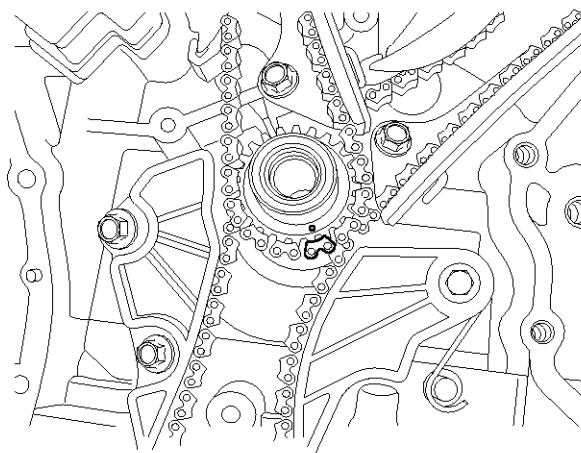
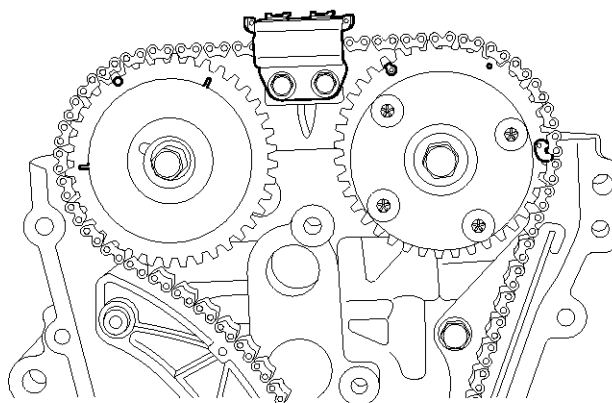
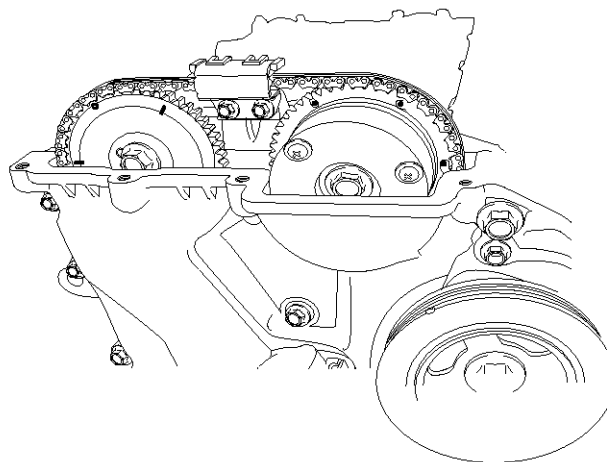
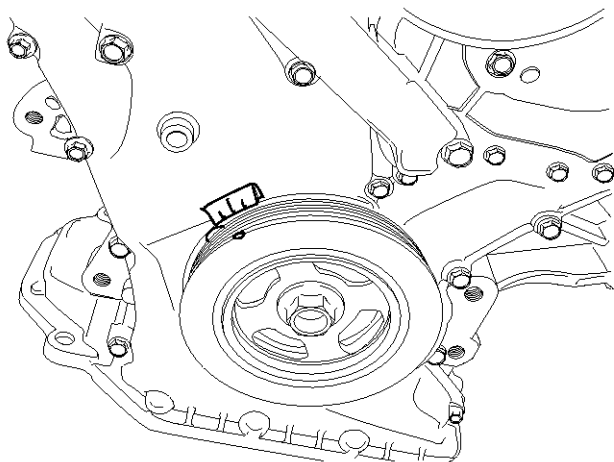
FL-110

Fuel System

■ Timing Mark Inspection

1. IG "OFF" and check the timing mark is correctly aligned.

Reference :



SBHFL9614L

2. Is the timing mark correctly aligned ?

YES ► Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and go to "Verification of Vehicle Repair" procedure.

NO ► Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.

2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.

3. Read "DTC Status" parameter.

4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

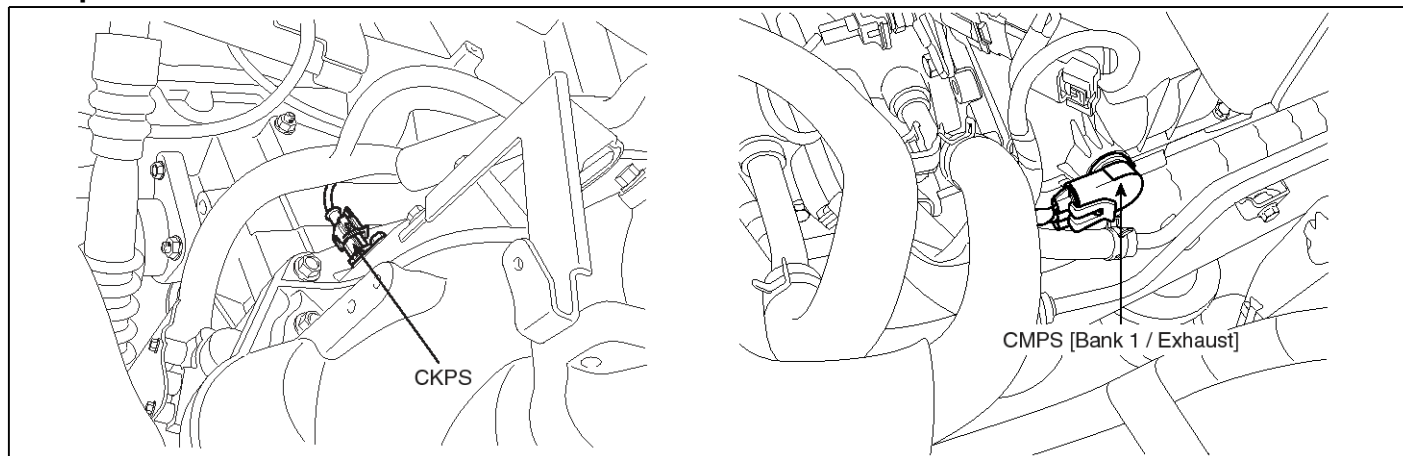
NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-111

P0017 Crankshaft Position – Camshaft Position Correlation (Bank 1 Sensor B)

Component Location



SBHFL9327L

General Description

The CVVT (Continuously Variable Valve Timing) system is installed to the chain sprocket of the intake camshaft. This system controls the intake camshaft to provide the optimal valve timing for every driving condition. The ECM controls the Oil Control Valve(OCV), based on the signals output from mass air flow, throttle position and engine coolant temperature. The CVVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft becomes optimal, and the engine torque improves, fuel economy improves, exhaust emissions decrease under overall driving conditions.

DTC Description

ECM monitors timing misalignment while no active faults is present and fully warmed up engine oil at idle.

If the timing is misaligned ECM determines that a fault exists and a DTC is stored.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		• Determines if CAM target is aligned correctly to crank	• loosened CKPS • Timing Misalignment
Enable Conditions		• No active faults • Fully warmed up at idle	
Threshold value	Case 1	• 1 teeth misalignment at 80 °C(176 °F) < Oil Temperature < 90 °C(194°F)	
	Case 2	• 2 tooth misalignment at Lower than 80 °C(176 °F) or Higher than 90 °C(194°F)	
Diagnosis Time		• Continuous (Within 1min.)	
MIL On Condition		• 2 Driving Cycles	

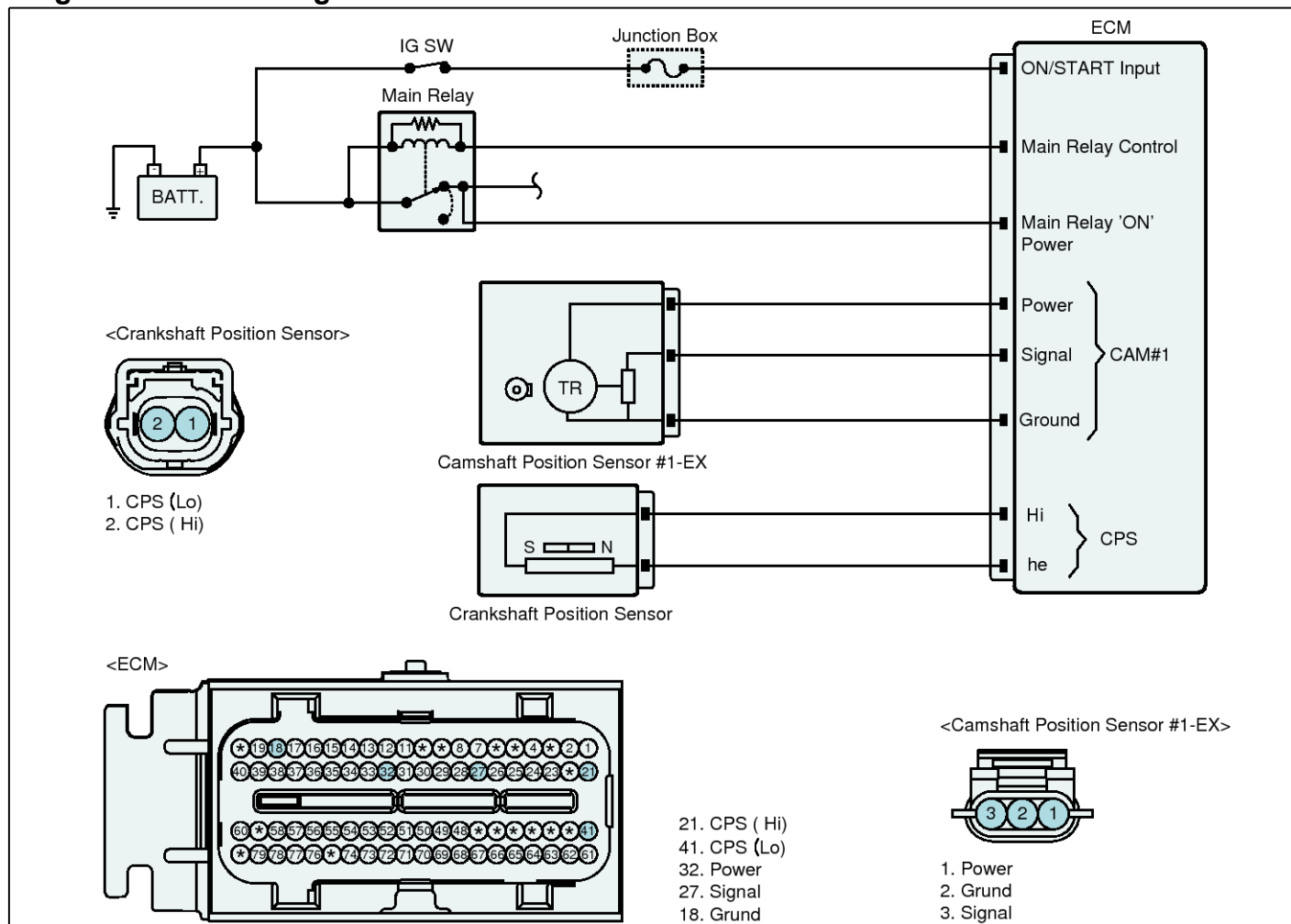
FL-112

Fuel System

Specification

Engine Oil Temperature	Misalignment
80 °C(176 °F) < Engine Oil Temperature < 90 °C(194°F)	1 tooth
Less than 80 °C(176 °F) or Higher than 90 °C(194°F)	2 tooth

Diagnostic Circuit Diagram



SBHFL9503L

Signal Waveform & Data

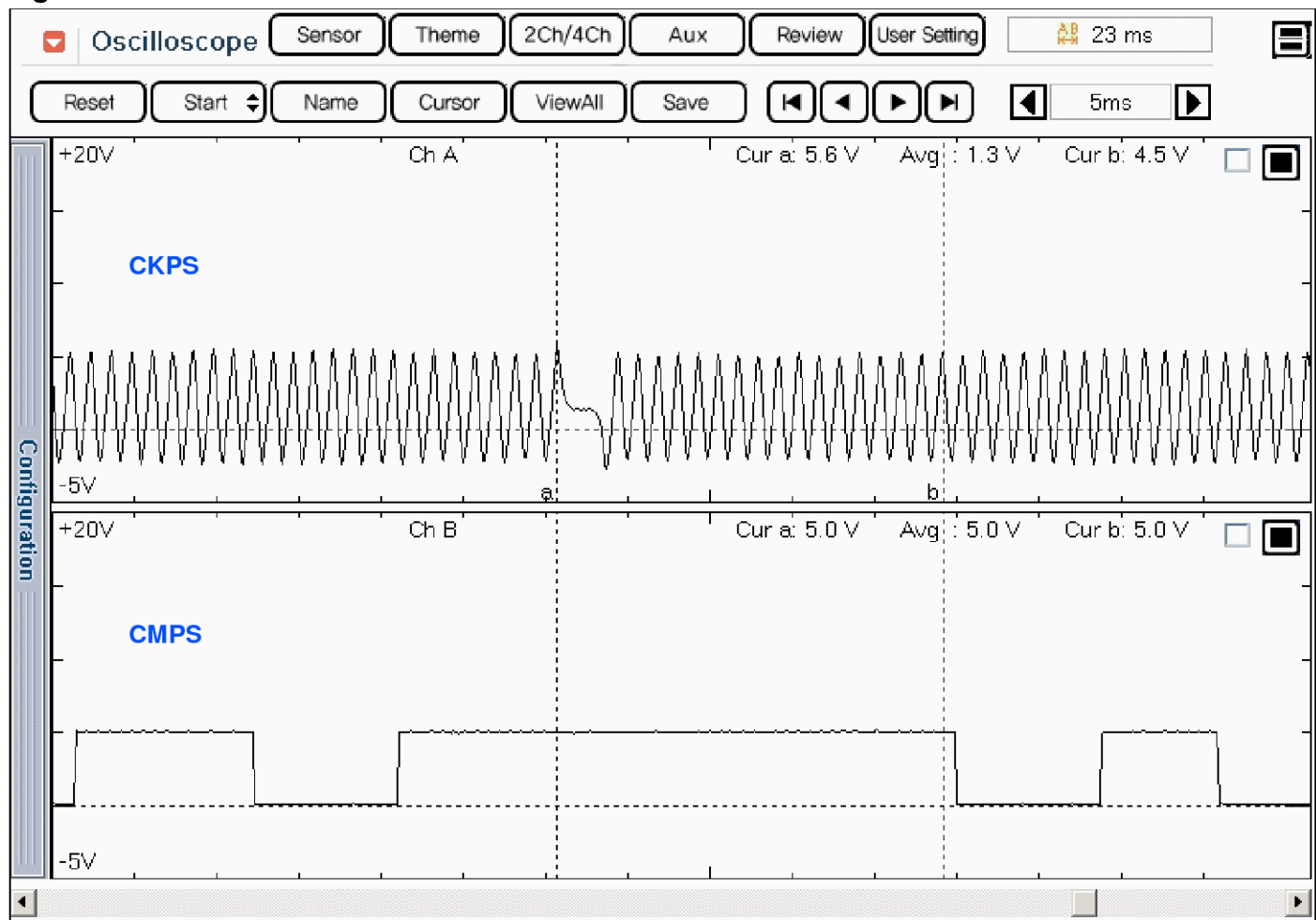


Fig.1

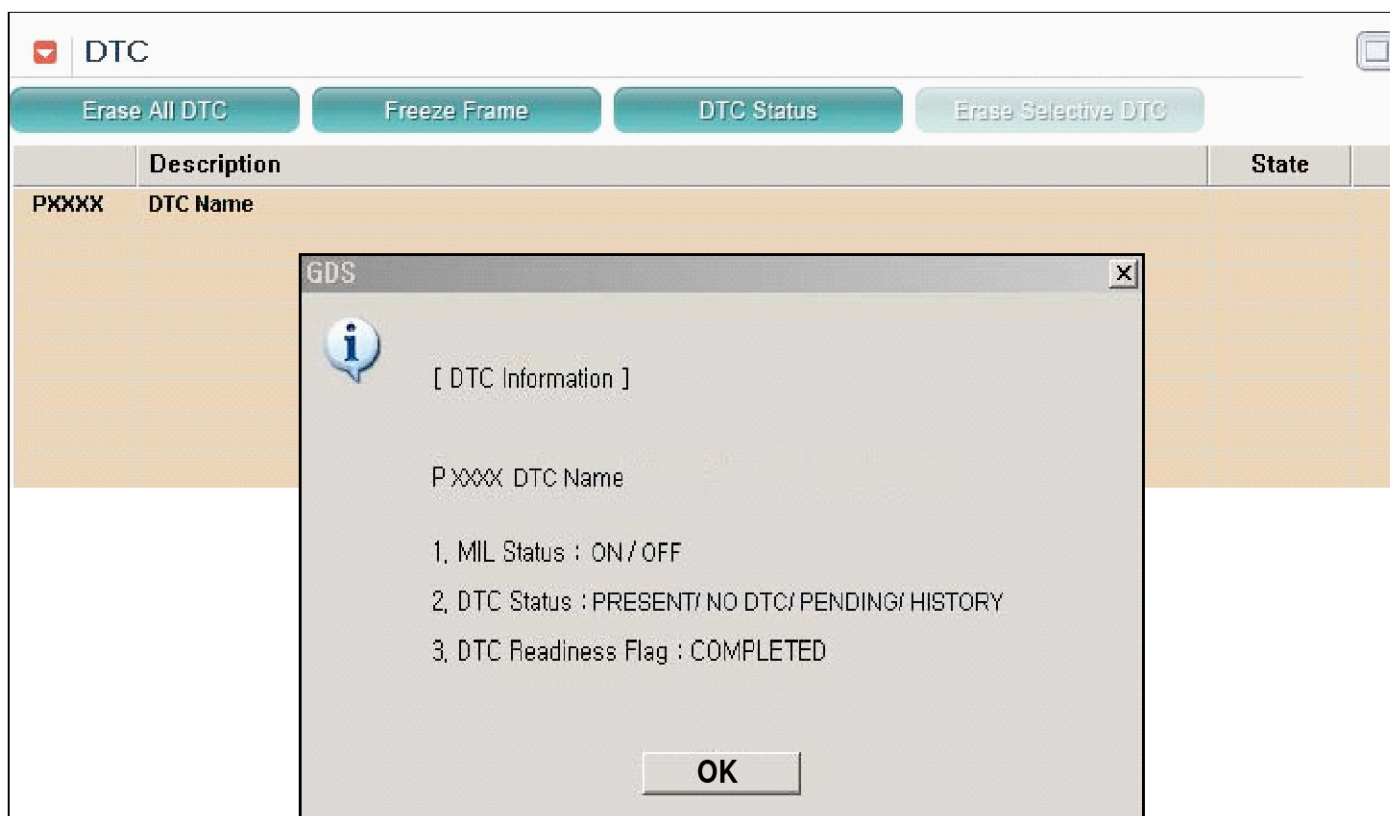
SBHFL9613L

Fig 1) Normal waveform of CKPS & CMPS at idle.

This example shows a typical Crankshaft Position Sensor (CKPS) and Camshaft Position Sensor (CMPS) waveform at idle. If the 17th signal of the CKPS after missing tooth is aligned with the high signal of the CMPS at idle, ECM recognizes that Synchronization between CKPS and CMPS is completed.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "System Inspection" procedure.

NO ► Fault is intermittent caused by ECM memory was not cleared after repair. Erase DTC and drive the vehicle to satisfy the enable condition then, go to "System Inspection" procedure.

System Inspection

■ Visual Inspection

1. Check oil level is O.K.
2. Check Oil and OCV is contaminated.
3. Has a problem been found ?

YES ► Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Visually check CKPS and target wheel" as follow

■ Visually check CKPS and target wheel

1. IG "OFF".
2. Visually check CKPS is loosened or target wheel is deformed or damaged.

3. Is the above items normal ?

YES ► Go to "Check CAM PHASER with actuation test" as follows

NO ► Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

■ Check CAM PHASER with actuation test

1. Connect scantool and IG "ON"
2. Select "CAM PHASER EXHAUST BANK 1" on the Actuation Test
3. Select "OIL CONTROL VALVE" on the Actuation Test
4. Activates "CAM PHASER EXHAUST BANK 1" by pressing "START" button
5. Activates "OIL CONTROL VALVE" by pressing "START" button
6. Repeat this procedure 4 or 5 times to ensure CAM PHASER and valve control solenoid reliability

Engine Control System

FL-115

Actuation Test

Test Items

A/C Compressor Relay
Fuel Pump Control
Immobilizer Lamp
Canister Shut Off Valve Clocked
Canister Purge Valve
Oil Control Valve
Ignition Coil-#1
Ignition Coil-#2
Ignition Coil-#3
Ignition Coil-#4

Duration

Until Stop Button

Conditions

IG. ON/ENG.OFF

Result

Start

Stop

SBHFL9606L

Actuation Test

Test Items

Injector-Cylinder 6
Fan PWM
ETC Motor
Variable Intake Manifold 1
Cam Phaser Intake Bank1
Cam Phaser Intake Bank2
Spark Advance/Retard
CAM Phaser Exhaust Bank 1
CAM Phaser Exhaust Bank 2

Duration

Until Stop Button

Conditions

ENG. RUN

Result

Success

Start

Stop

SBHFL9607L

7. Has a problem been found ?

YES ▶ Substitute with a known - good CVVT or O-CV and check for proper operation. If the problem is corrected, replace CVVT or OCV and go to "Verification of Vehicle Repair" procedure.

NO ▶ Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and Go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ CMPS, CKPS Inspection

1. IG "OFF" and connect scantool.
2. ENG "ON" and Measure signal waveform at signal terminal of CMPS.

3. Measure signal waveform at signal terminal of CKPS.

Specification : 17th signal of the CKPS after missing tooth is aligned with the high signal of the CMPS at idle, ECM recognizes that Synchronization between CKPS and CMPS is completed.

※ Refer to Signal Waveform & Data

4. Is the measured signal waveform O.K ?

YES ▶ Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Timing Mark Inspection" procedure as follow.

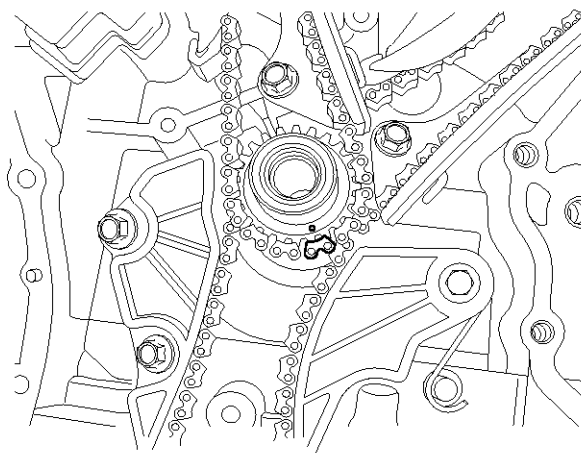
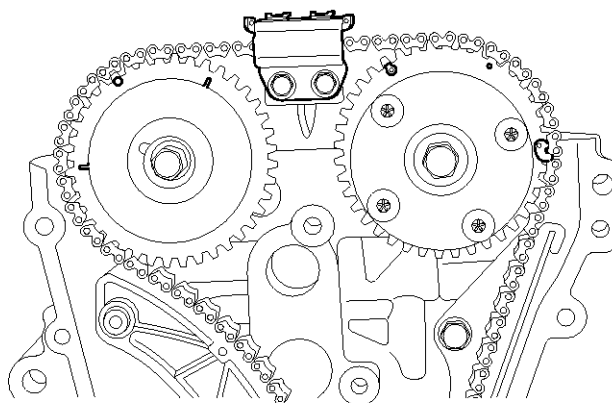
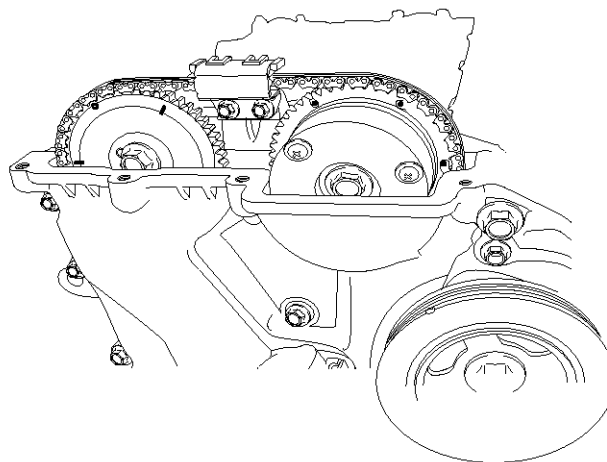
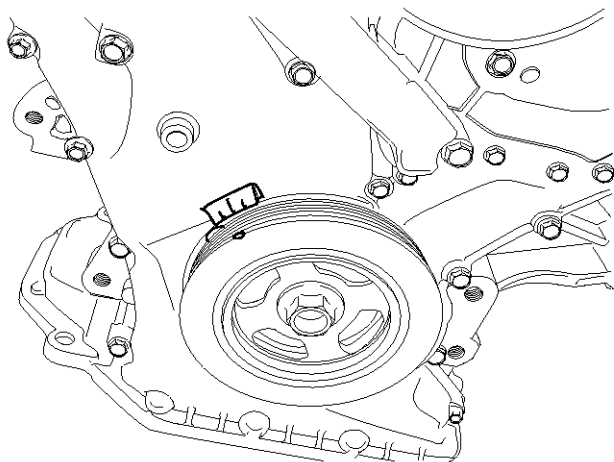
FL-116

Fuel System

■ Timing Mark Inspection

1. IG "OFF" and check the timing mark is correctly aligned.

Reference :



SBHFL9614L

2. Is the timing mark correctly aligned ?

YES ► Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and go to "Verification of Vehicle Repair" procedure.

NO ► Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.

2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.

3. Read "DTC Status" parameter.

4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

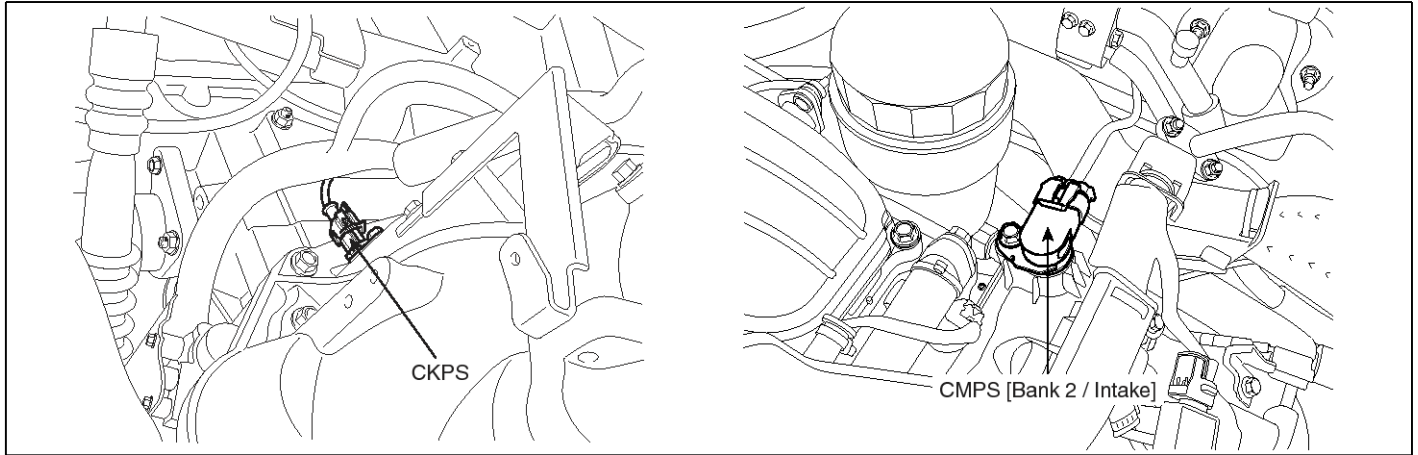
NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-117

P0018 Crankshaft Position-Camshaft Position Correlation (Bank 2 Sensor A)

Component Location



SBHFL9328L

General Description

The CVVT (Continuously Variable Valve Timing) system is installed to the chain sprocket of the intake camshaft. This system controls the intake camshaft to provide the optimal valve timing for every driving condition. The ECM controls the Oil Control Valve(OCV), based on the signals output from mass air flow, throttle position and engine coolant temperature. The CVVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft becomes optimal, and the engine torque improves, fuel economy improves, exhaust emissions decrease under overall driving conditions.

DTC Description

ECM monitors timing misalignment while no active faults is present and fully warmed up engine oil at idle.

If the timing is misaligned ECM determines that a fault exists and a DTC is stored.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		• Determines if CAM target is aligned correctly to crank	• loosened CKPS • Timing Misalignment
Enable Conditions		• No active faults • Fully warmed up at idle	
Threshold value	Case 1	• 1 teeth misalignment at 80 °C(176 °F) < Oil Temperature < 90 °C(194°F)	
	Case 2	• 2 tooth misalignment at Lower than 80 °C(176 °F) or Higher than 90 °C(194°F)	
Diagnosis Time		• Continuous (Within 1min.)	
MIL On Condition		• 2 Driving Cycles	

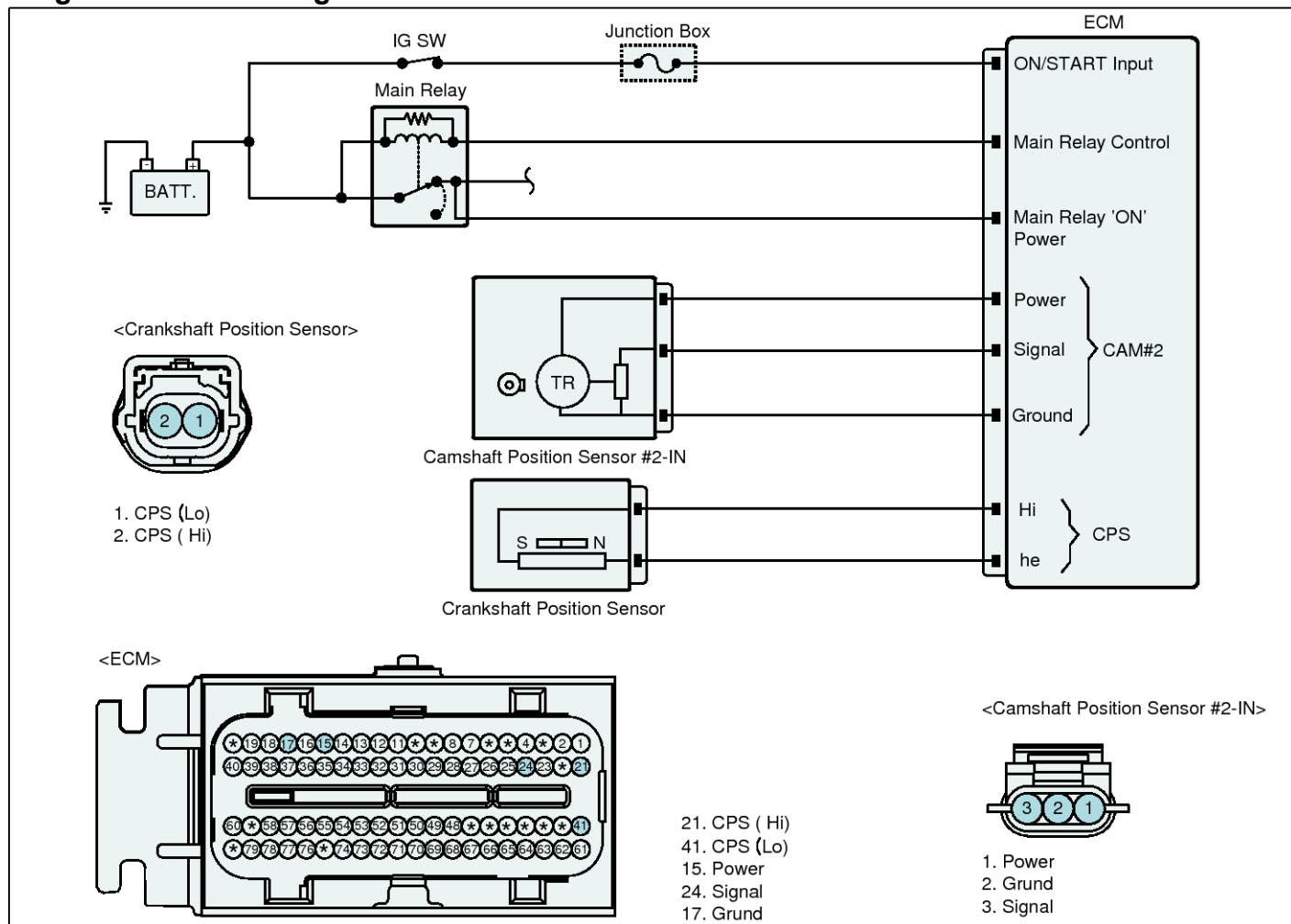
FL-118

Fuel System

Specification

Engine Oil Temperature	Misalignment
80 °C(176 °F) < Engine Oil Temperature < 90 °C(194°F)	1 tooth
Less than 80 °C(176 °F) or Higher than 90 °C(194°F)	2 tooth

Diagnostic Circuit Diagram



SBHFL9504L

Signal Waveform & Data

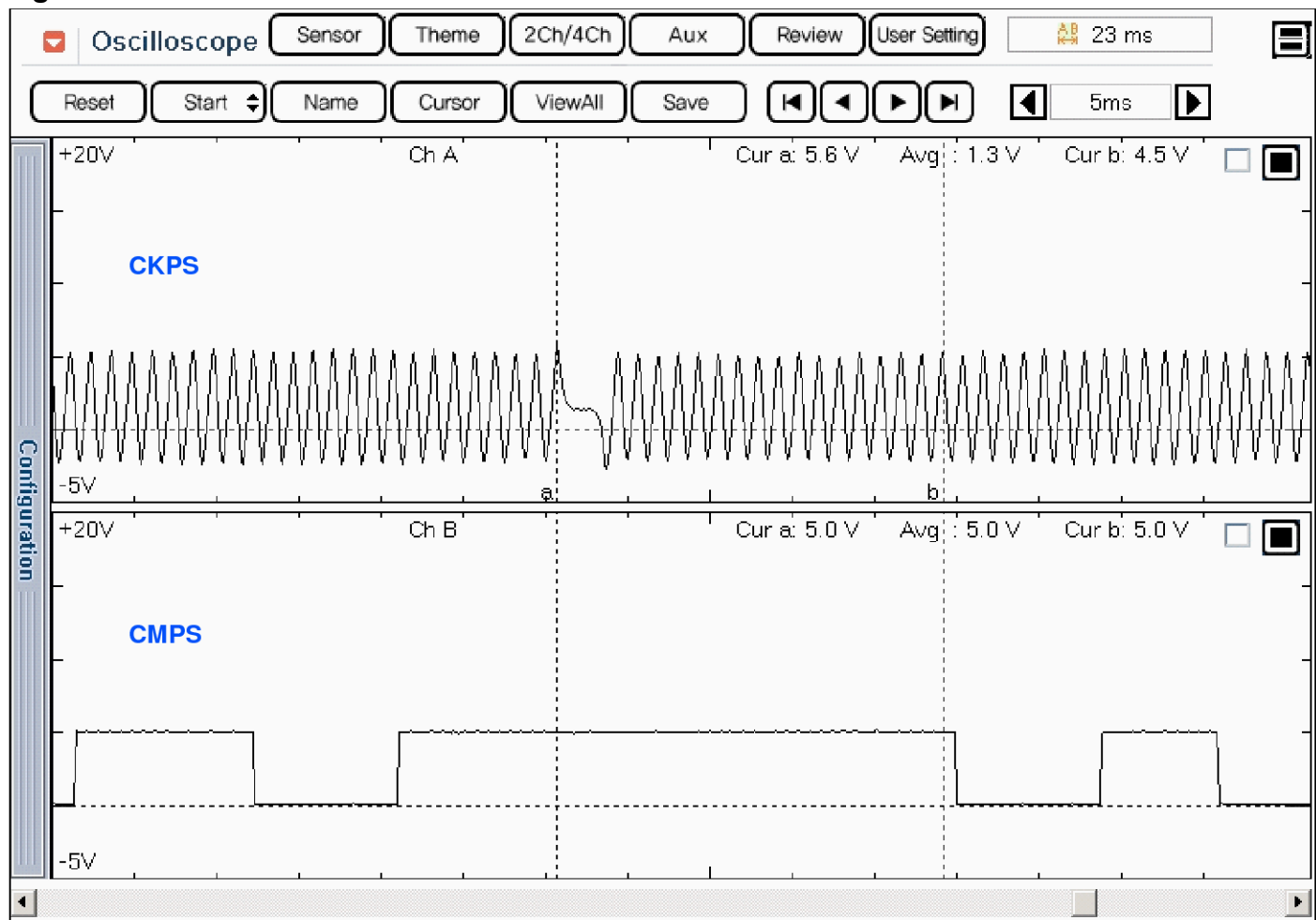


Fig.1

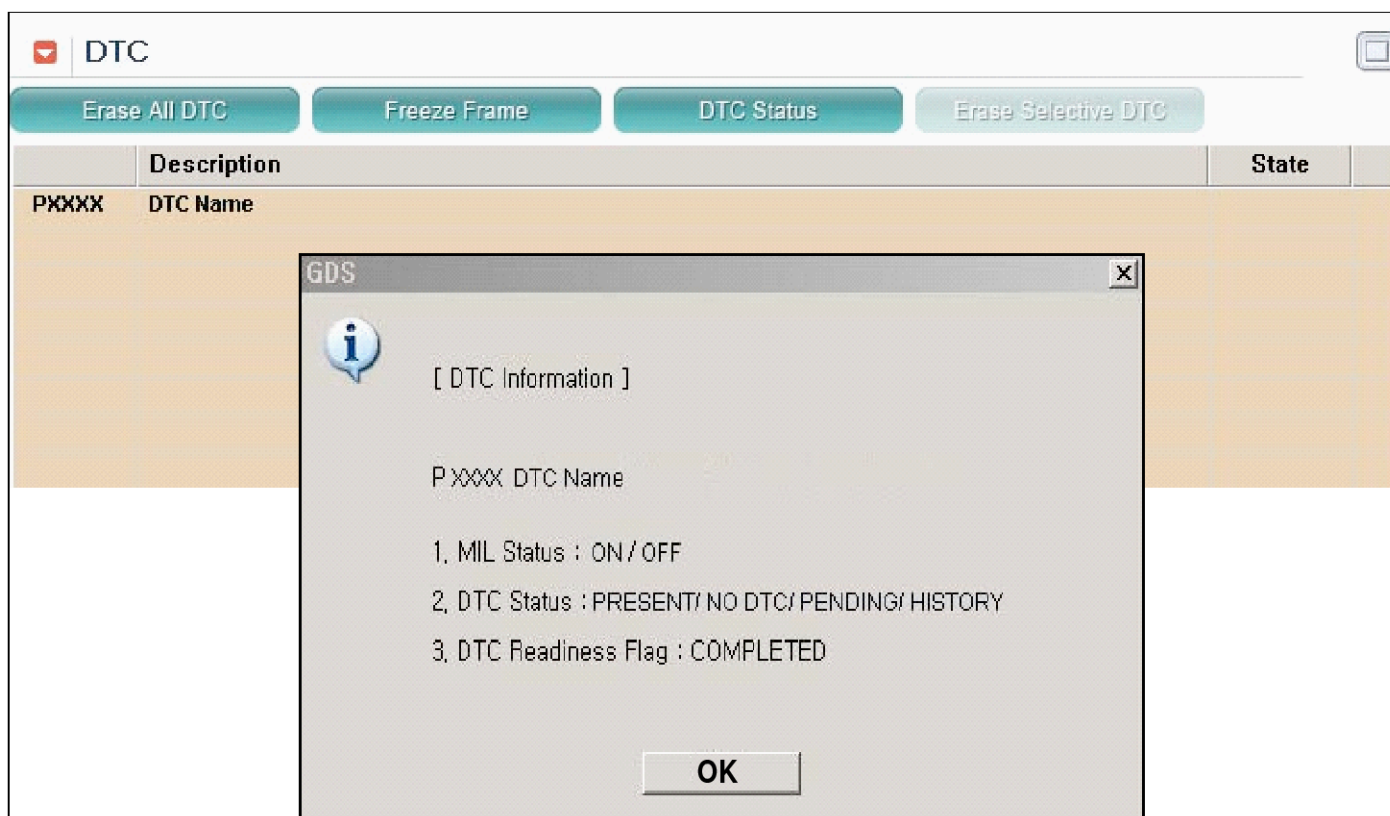
SBHFL9613L

Fig 1) Normal waveform of CKPS & CMPS at idle.

This example shows a typical Crankshaft Position Sensor (CKPS) and Camshaft Position Sensor (CMPS) waveform at idle. If the 17th signal of the CKPS after missing tooth is aligned with the high signal of the CMPS at idle, ECM recognizes that Synchronization between CKPS and CMPS is completed.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "System Inspection" procedure.

NO ► Fault is intermittent caused by ECM memory was not cleared after repair. Erase DTC and drive the vehicle to satisfy the enable condition then, go to "System Inspection" procedure.

System Inspection

■ Visual Inspection

1. Check oil level is O.K.
2. Check Oil and OCV is contaminated.
3. Has a problem been found ?

YES ► Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Visually check CKPS and target wheel" as follow

■ Visually check CKPS and target wheel

1. IG "OFF".
2. Visually check CKPS is loosened or target wheel is deformed or damaged.

3. Is the above items normal ?

YES ► Go to "Check CAM PHASER with actuation test" as follows

NO ► Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

■ Check CAM PHASER with actuation test

1. Connect scantool and IG "ON"
2. Select "CAM PHASER INTAKE BANK 1" on the Actuation Test
3. Select "OIL CONTROL VALVE" on the Actuation Test
4. Activates "CAM PHASER INTAKE BANK 1" by pressing "START" button
5. Activates "OIL CONTROL VALVE" by pressing "START" button
6. Repeat this procedure 4 or 5 times to ensure CAM PHASER and valve control solenoid reliability

Engine Control System

FL-121

Actuation Test

Test Items

A/C Compressor Relay
Fuel Pump Control
Immobilizer Lamp
Canister Shut Off Valve Clocked
Canister Purge Valve
Oil Control Valve
Ignition Coil-#1
Ignition Coil-#2
Ignition Coil-#3
Ignition Coil-#4

Duration

Until Stop Button

Conditions

IG. ON/ENG.OFF

Result

Start

Stop

SBHFL9606L

Actuation Test

Test Items

Injector-Cylinder 6
Fan PWM
ETC Motor
Variable Intake Manifold 1
Cam Phaser Intake Bank1
Cam Phaser Intake Bank2
Spark Advance/Retard
CAM Phaser Exhaust Bank 1
CAM Phaser Exhaust Bank 2

Duration

Until Stop Button

Conditions

ENG. RUN

Result

Success

Start

Stop

SBHFL9607L

7. Has a problem been found ?

YES ▶ Substitute with a known - good CVVT or O-CV and check for proper operation. If the problem is corrected, replace CVVT or OCV and go to "Verification of Vehicle Repair" procedure.

NO ▶ Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and Go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ CMPS, CKPS Inspection

1. IG "OFF" and connect scantool.
2. ENG "ON" and Measure signal waveform at signal terminal of CMPS.

3. Measure signal waveform at signal terminal of CKPS.

Specification : 17th signal of the CKPS after missing tooth is aligned with the high signal of the CMPS at idle, ECM recognizes that Synchronization between CKPS and CMPS is completed.

※ Refer to Signal Waveform & Data

4. Is the measured signal waveform O.K ?

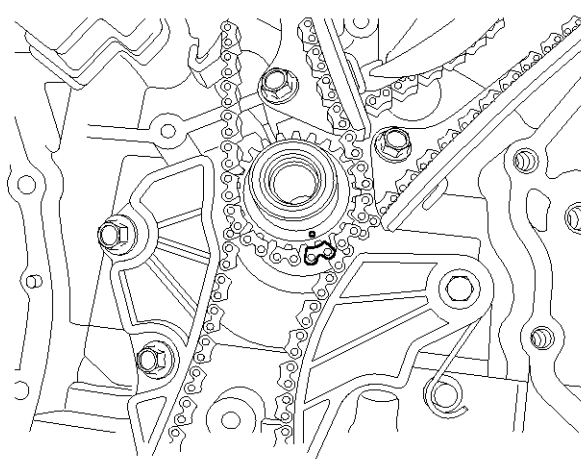
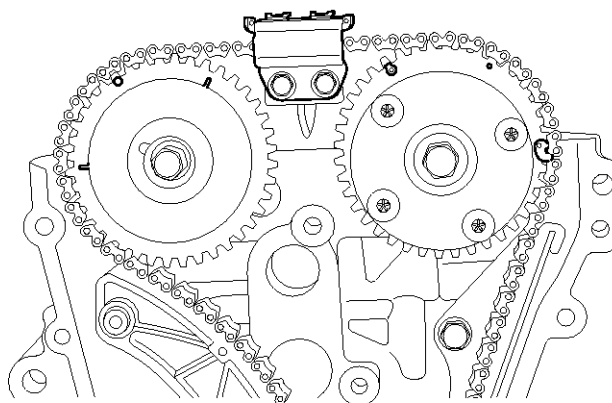
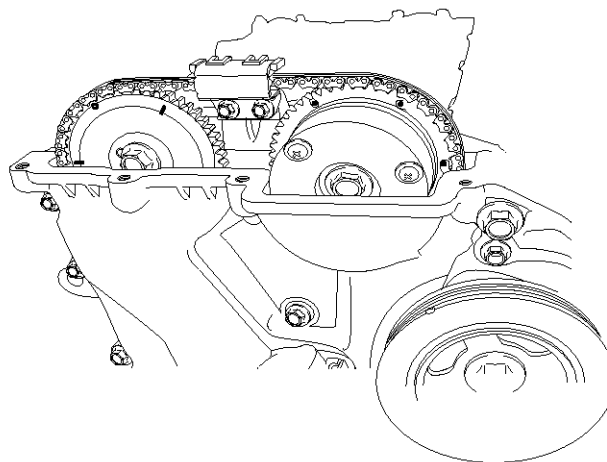
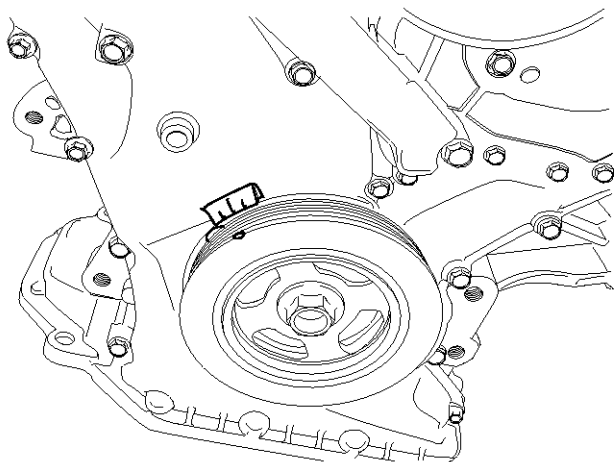
YES ▶ Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Timing Mark Inspection" procedure as follow.

■ Timing Mark Inspection

1. IG "OFF" and check the timing mark is correctly aligned.

Reference :



SBHFL9614L

2. Is the timing mark correctly aligned ?

YES ► Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and go to "Verification of Vehicle Repair" procedure.

NO ► Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.

2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.

3. Read "DTC Status" parameter.

4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

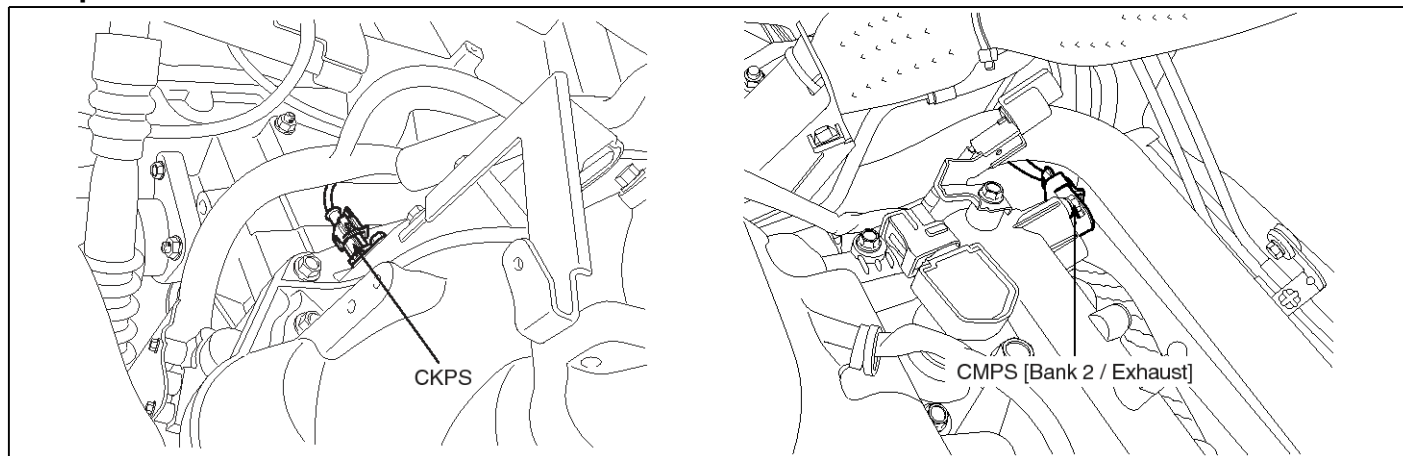
NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-123

P0019 Crankshaft Position – Camshaft Position Correlation (Bank 2 Sensor B)

Component Location



SBHFL9329L

General Description

The CVVT (Continuously Variable Valve Timing) system is installed to the chain sprocket of the intake camshaft. This system controls the intake camshaft to provide the optimal valve timing for every driving condition. The ECM controls the Oil Control Valve(OCV), based on the signals output from mass air flow, throttle position and engine coolant temperature. The CVVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft becomes optimal, and the engine torque improves, fuel economy improves, exhaust emissions decrease under overall driving conditions.

DTC Description

ECM monitors timing misalignment while no active faults is present and fully warmed up engine oil at idle.

If the timing is misaligned ECM determines that a fault exists and a DTC is stored.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		• Determines if CAM target is aligned correctly to crank	• loosened CKPS • Timing Misalignment
Enable Conditions		• No active faults • Fully warmed up at idle	
Threshold value	Case 1	• 1 teeth misalignment at 80 °C(176 °F) < Oil Temperature < 90 °C(194°F)	
	Case 2	• 2 tooth misalignment at Lower than 80 °C(176 °F) or Higher than 90 °C(194°F)	
Diagnosis Time		• Continuous (Within 1min.)	
MIL On Condition		• 2 Driving Cycles	

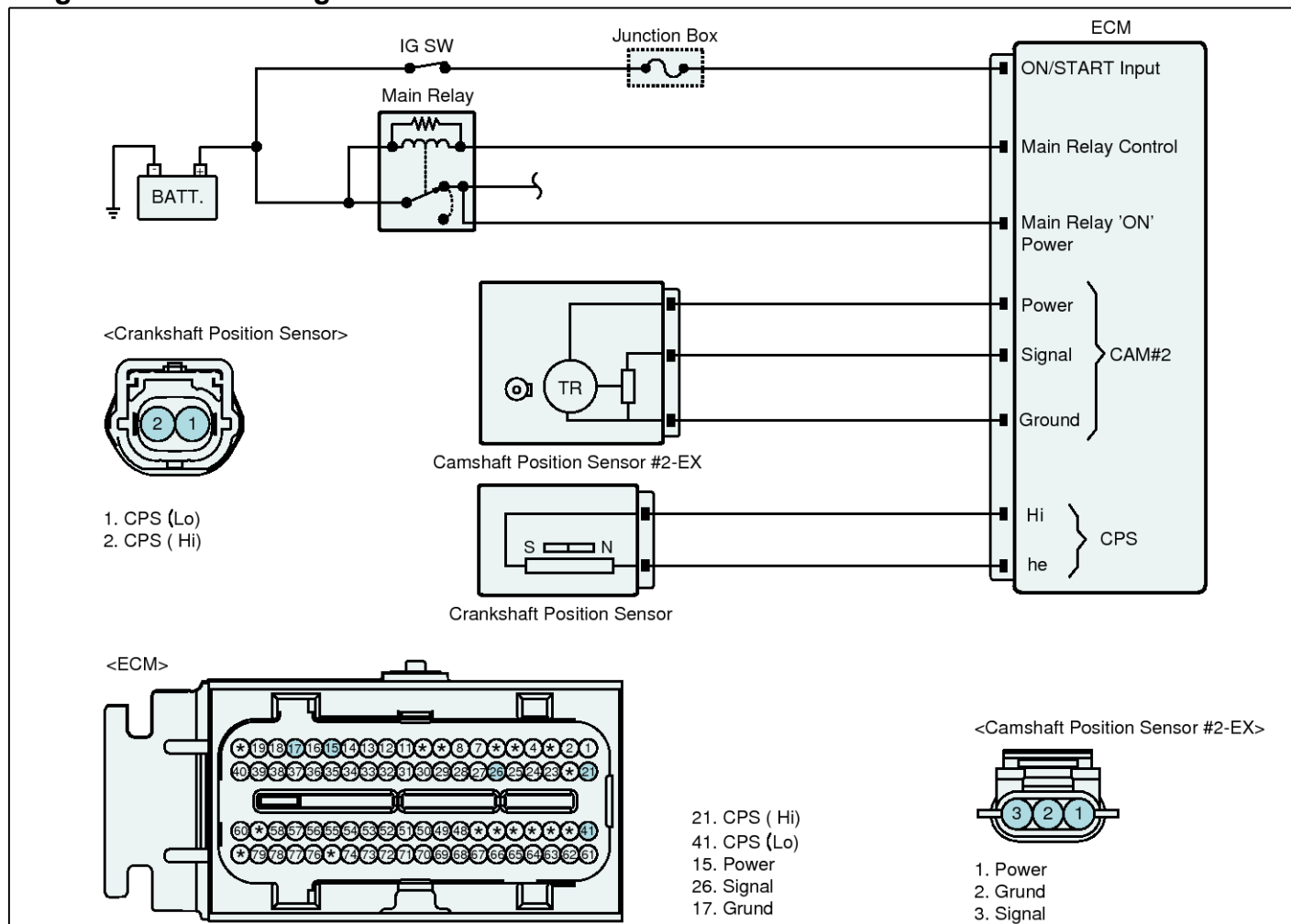
FL-124

Fuel System

Specification

Engine Oil Temperature	Misalignment
80 °C(176 °F) < Engine Oil Temperature < 90 °C(194°F)	1 tooth
Less than 80 °C(176 °F) or Higher than 90 °C(194°F)	2 tooth

Diagnostic Circuit Diagram



SBHFL9505L

Signal Waveform & Data

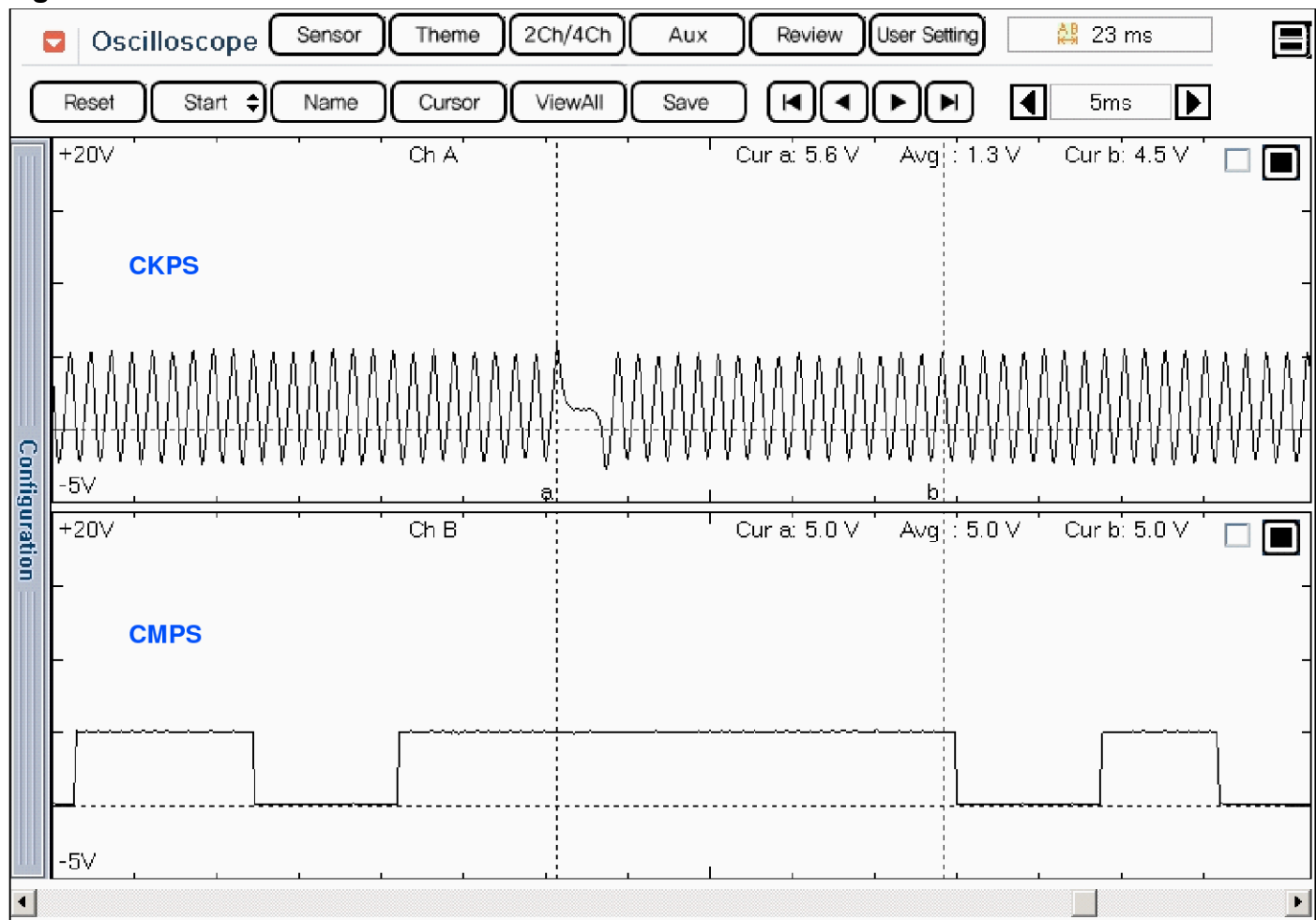


Fig.1

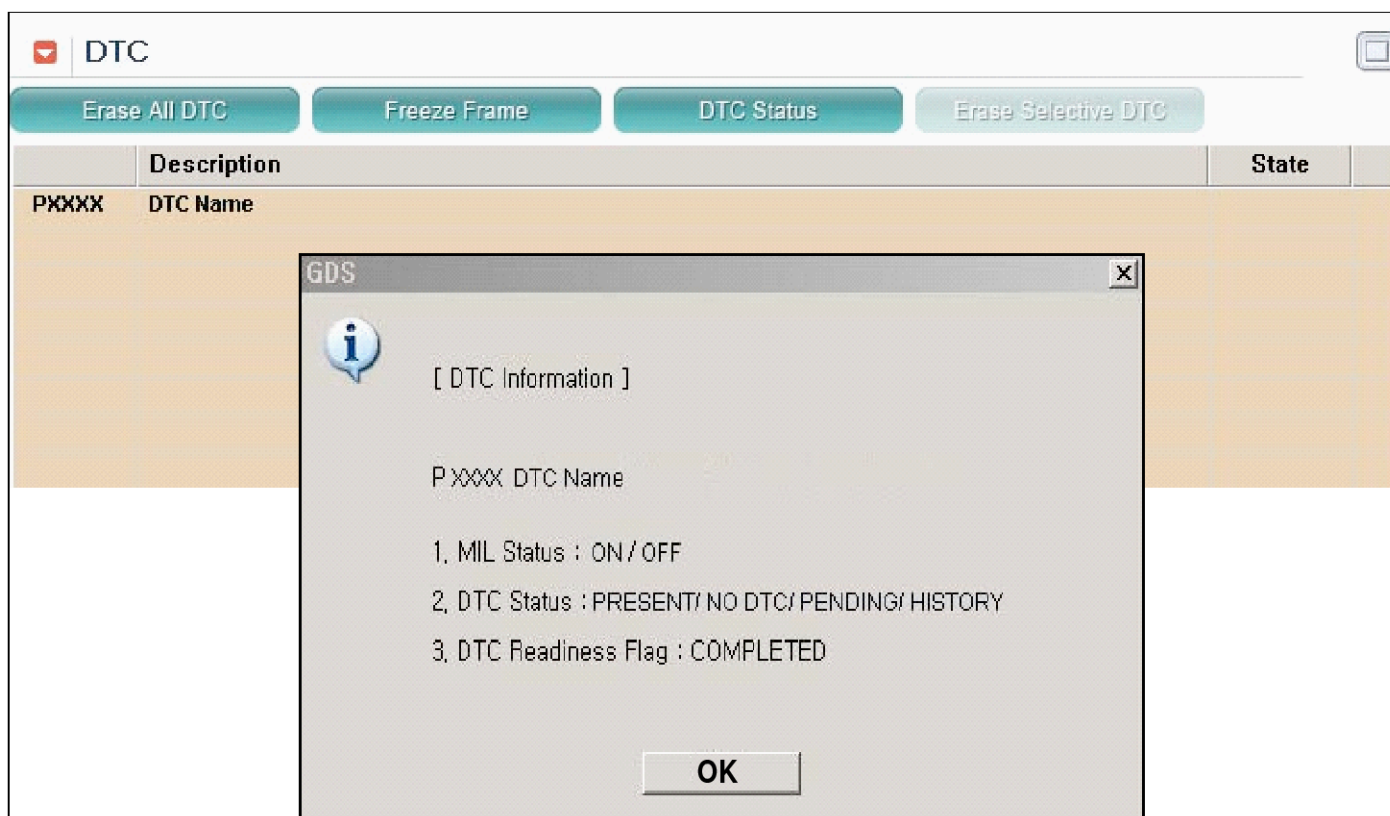
SBHFL9613L

Fig 1) Normal waveform of CKPS & CMPS at idle.

This example shows a typical Crankshaft Position Sensor (CKPS) and Camshaft Position Sensor (CMPS) waveform at idle. If the 17th signal of the CKPS after missing tooth is aligned with the high signal of the CMPS at idle, ECM recognizes that Synchronization between CKPS and CMPS is completed.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "System Inspection" procedure.

NO ► Fault is intermittent caused by ECM memory was not cleared after repair. Erase DTC and drive the vehicle to satisfy the enable condition then, go to "System Inspection" procedure.

System Inspection

■ Visual Inspection

1. Check oil level is O.K.
2. Check Oil and OCV is contaminated.
3. Has a problem been found ?

YES ► Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Visually check CKPS and target wheel" as follow

■ Visually check CKPS and target wheel

1. IG "OFF".
2. Visually check CKPS is loosened or target wheel is deformed or damaged.

3. Is the above items normal ?

YES ► Go to "Check CAM PHASER with actuation test" as follows

NO ► Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

■ Check CAM PHASER with actuation test

1. Connect scantool and IG "ON"
2. Select "CAM PHASER EXHAUST BANK 2" on the Actuation Test
3. Select "OIL CONTROL VALVE" on the Actuation Test
4. Activates "CAM PHASER EXHAUST BANK 2" by pressing "START" button
5. Activates "OIL CONTROL VALVE" by pressing "START" button
6. Repeat this procedure 4 or 5 times to ensure CAM PHASER and valve control solenoid reliability

Engine Control System

FL-127

Actuation Test

Test Items

A/C Compressor Relay
Fuel Pump Control
Immobilizer Lamp
Canister Shut Off Valve Clocked
Canister Purge Valve
Oil Control Valve
Ignition Coil-#1
Ignition Coil-#2
Ignition Coil-#3
Ignition Coil-#4

Duration

Until Stop Button

Conditions

IG. ON/ENG.OFF

Result

Start

Stop

SBHFL9606L

Actuation Test

Test Items

Injector-Cylinder 6
Fan PWM
ETC Motor
Variable Intake Manifold 1
Cam Phaser Intake Bank1
Cam Phaser Intake Bank2
Spark Advance/Retard
CAM Phaser Exhaust Bank 1
CAM Phaser Exhaust Bank 2

Duration

Until Stop Button

Conditions

ENG. RUN

Result

Success

Start

Stop

SBHFL9607L

7. Has a problem been found ?

YES ▶ Substitute with a known - good CVVT or O-CV and check for proper operation. If the problem is corrected, replace CVVT or OCV and go to "Verification of Vehicle Repair" procedure.

NO ▶ Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and Go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ CMPS, CKPS Inspection

1. IG "OFF" and connect scantool.
2. ENG "ON" and Measure signal waveform at signal terminal of CMPS.

3. Measure signal waveform at signal terminal of CKPS.

Specification : 17th signal of the CKPS after missing tooth is aligned with the high signal of the CMPS at idle, ECM recognizes that Synchronization between CKPS and CMPS is completed.

※ Refer to Signal Waveform & Data

4. Is the measured signal waveform O.K ?

YES ▶ Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Timing Mark Inspection" procedure as follow.

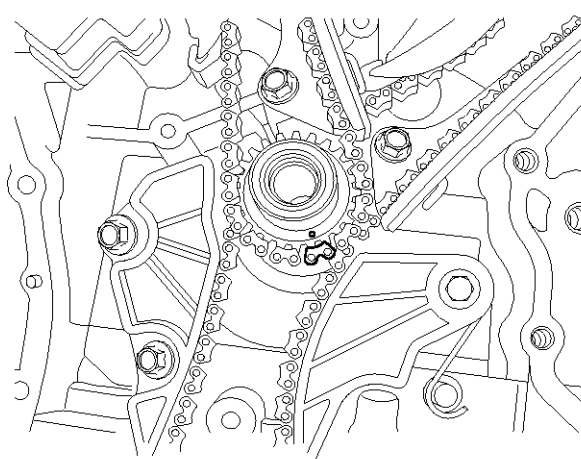
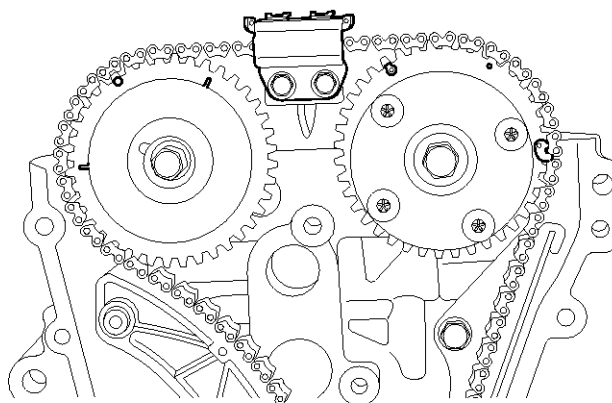
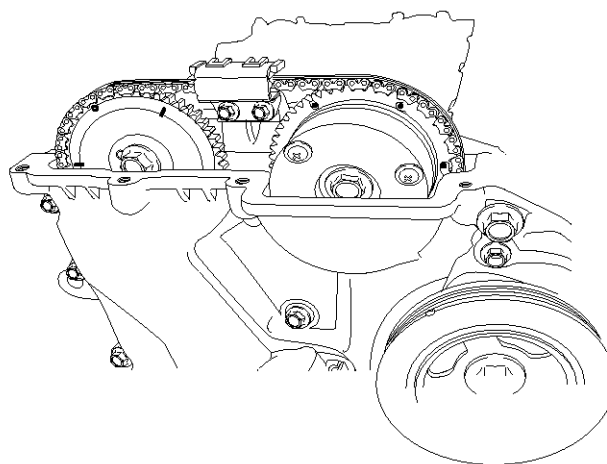
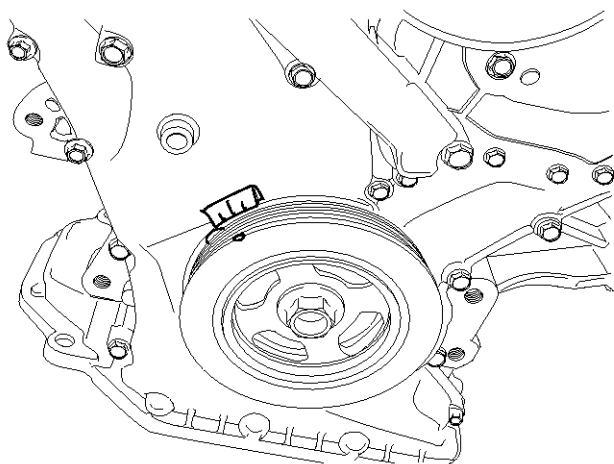
FL-128

Fuel System

■ Timing Mark Inspection

1. IG "OFF" and check the timing mark is correctly aligned.

Reference :



SBHFL9614L

2. Is the timing mark correctly aligned ?

YES ► Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and go to "Verification of Vehicle Repair" procedure.

NO ► Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.

2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.

3. Read "DTC Status" parameter.

4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

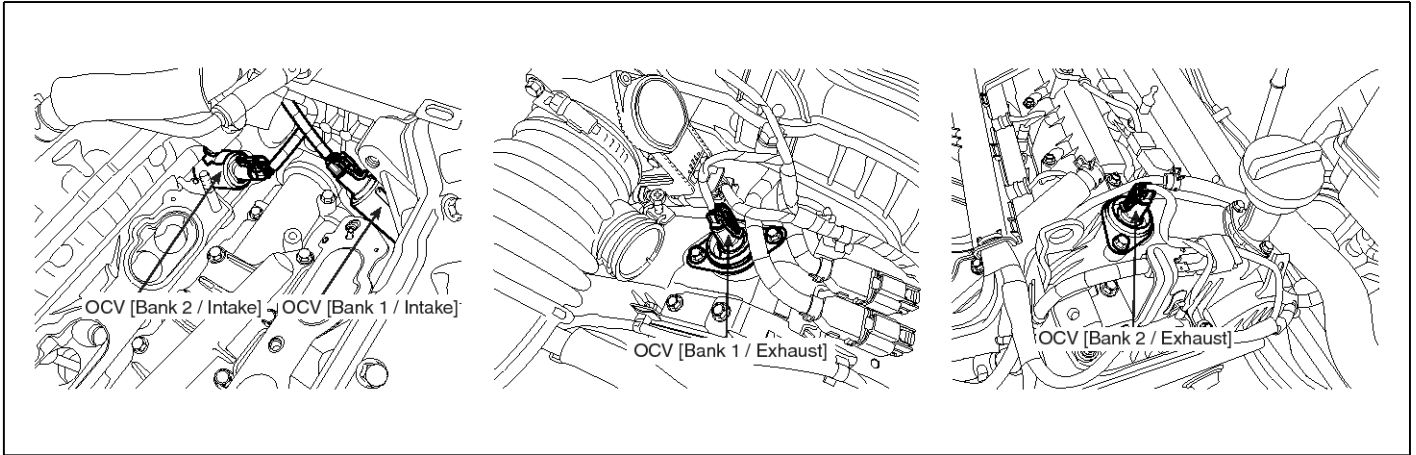
NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-129

P0022 "A" Camshaft Position-Timing Over-Retarded (Bank 2)

Component Location



SBHFL9325L

General Description

The CVVT (Continuously Variable Valve Timing) system is installed to the chain sprocket of the intake camshaft. This system controls the intake camshaft to provide the optimal valve timing for every driving condition. The ECM controls the Oil Control Valve(OCV), based on the signals output from mass air flow, throttle position and engine coolant temperature. The CVVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft becomes optimal, and the engine torque improves, fuel economy improves, exhaust emissions decrease under overall driving conditions.

DTC Description

ECM monitors CAM phaser error while CMP signal is normally generating and vehicle is driving in 2000 ~ 3000rpm .

If the CAM phaser does not move although ECM commands OCV duty cycle ECM determines that a fault exists and a DTC is stored.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		Determines if the phaser is stuck or has steady-state error	- Engine Oil - OCV stuck - CVVT stuck
Enable Conditions		- CAM signal is normally generating - Vehicle is on driving (2000 ~ 3000RPM) for 5 minutes	
Threshold value	Case 1	5 CAD < Cam Actual Position < 50 CAD - Duty Cycle > 90% or Duty Cycle < 10%	
	Case 2	- Cam Position error > 15 CAD (Difference between Actual Position and Desire Position is more than 15°) - Timing Counter > 80	
Diagnosis Time		Continuous (within 5min.)	
MIL On Condition		2 Driving Cycles	

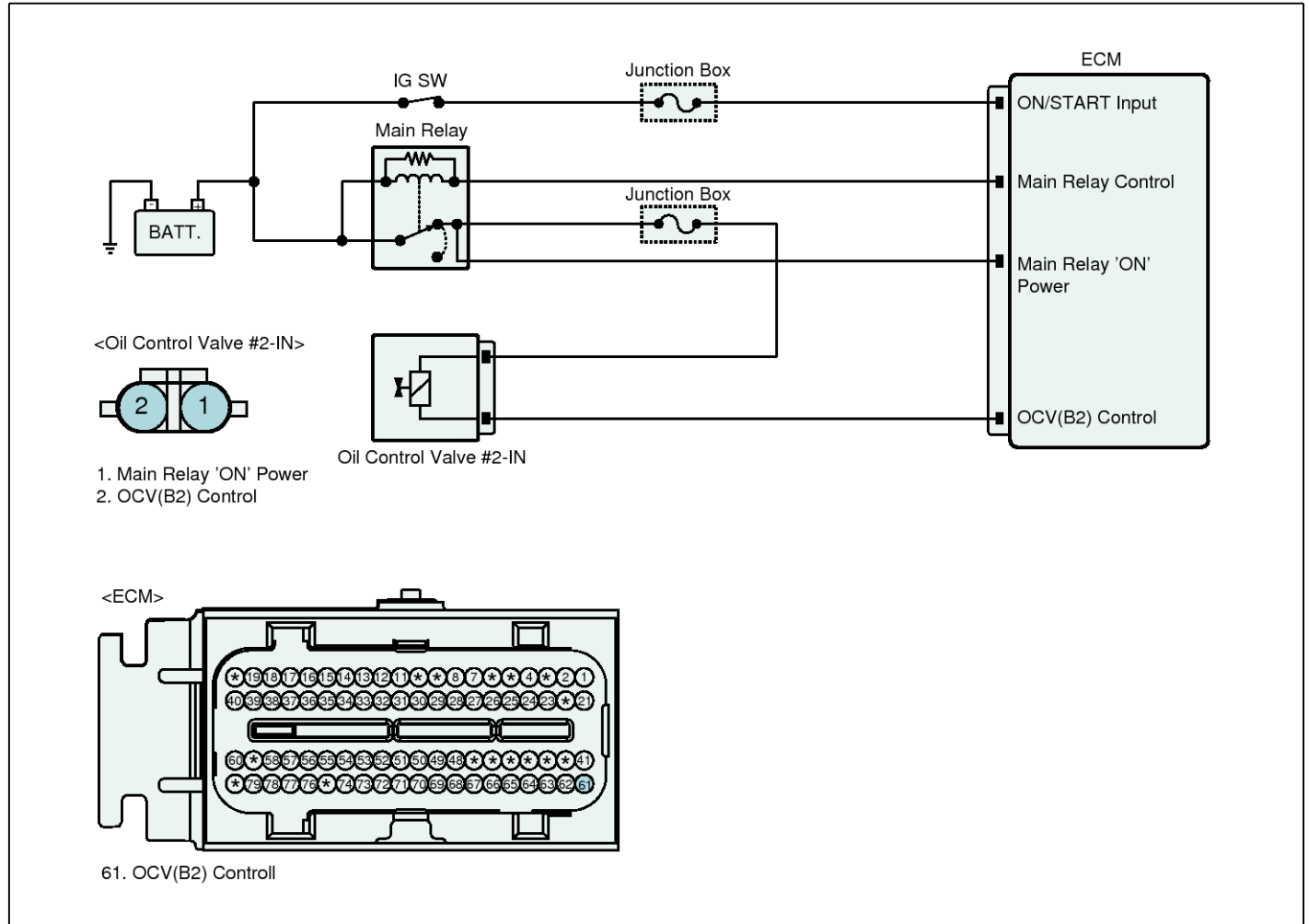
FL-130

Fuel System

Specification

OCV	Specification
Coil Resistance (Ω)	6.7 ~ 7.7 (20°C)

Diagnostic Circuit Diagram



SBHFL9506L

Signal Waveform & Data

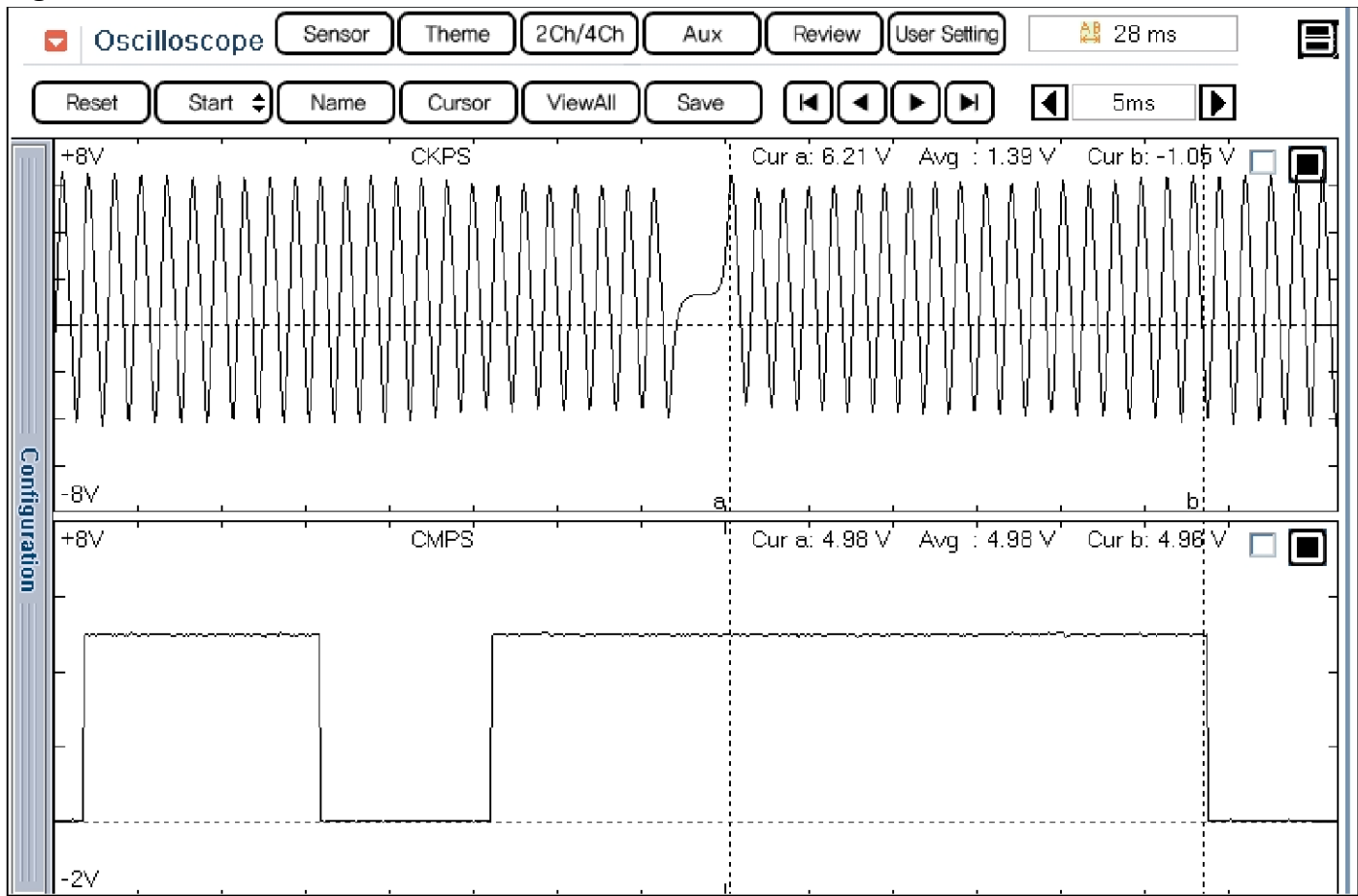


Fig.1

SBHFL9601L

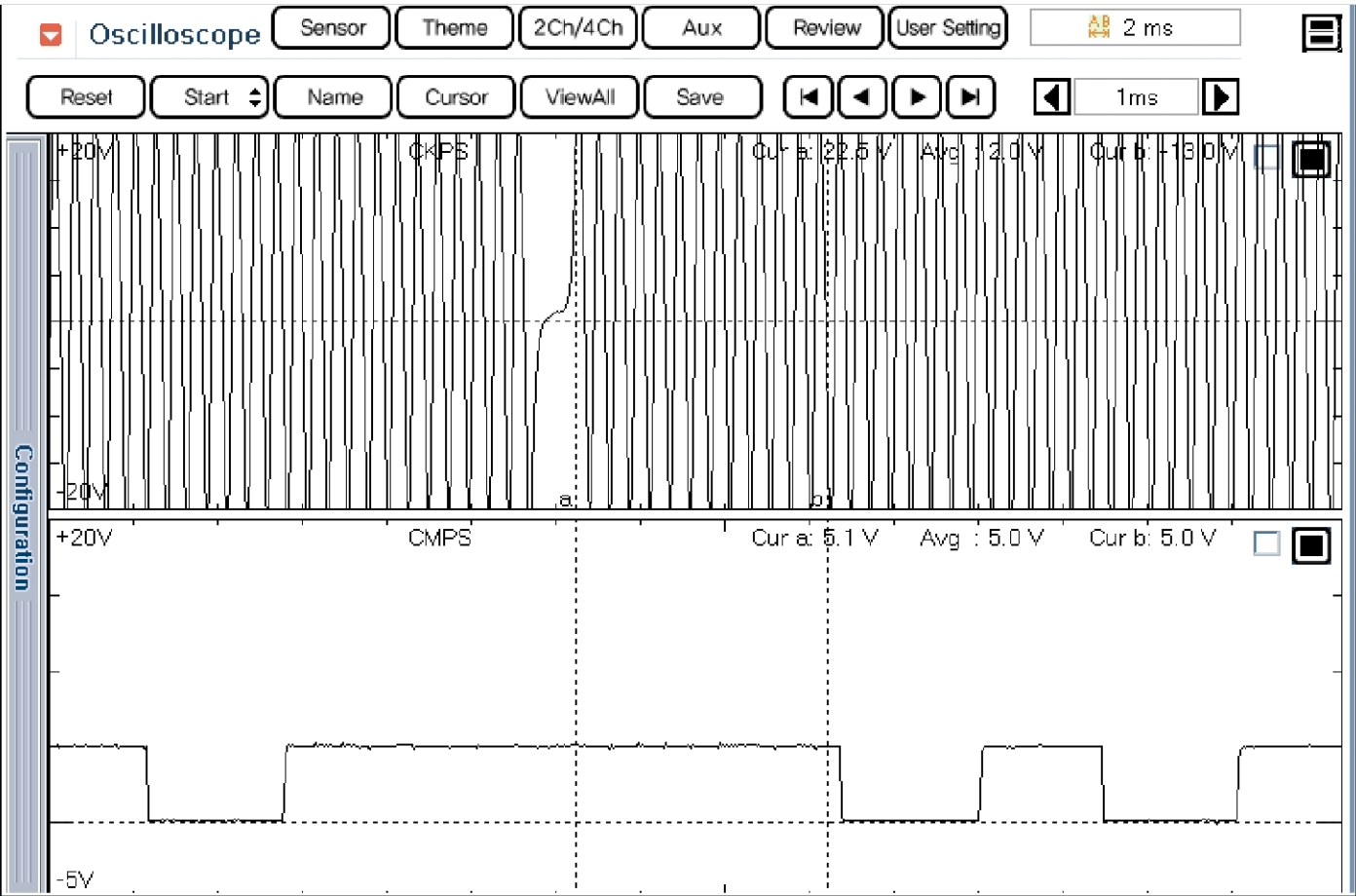


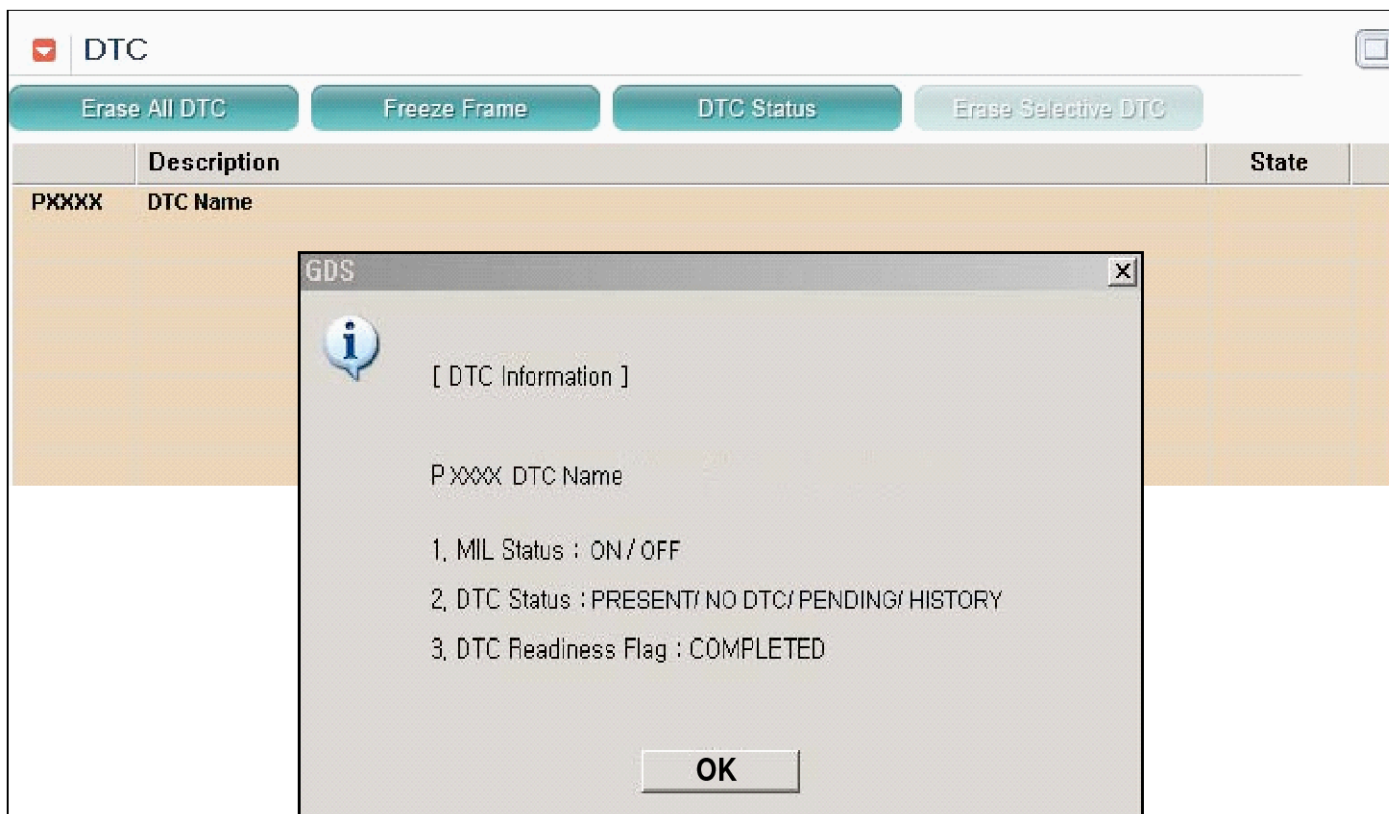
Fig.2

SBHFL9602L

Current Data		
Standard Display	Full List	Graph
Items List	Reset Min.Max.	Record
Stop	VSS	
Sensor Name	Value	Unit
☒ Camshaft Desired Position-Bank1	0.0	DEG
☒ Camshaft Actual Position-Bank1	0.3	DEG
☒ Camshaft Desired Position-Bank2	0.0	DEG
☒ Camshaft Actual Position-Bank2	-0.3	DEG
☒ Engine Speed	600	RPM

Fig.3

SBHFL9603L



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ▶ Go to "System Inspection" procedure.

NO ▶ Fault is intermittent caused by ECM memory was not cleared after repair. Erase DTC and drive the vehicle to satisfy the enable condition then, go to "System Inspection" procedure.

System Inspection

■ Visual Inspection

1. Check oil level is O.K.
2. Check Oil and OCV is contaminated.
3. Check that any oil leakage is occurred around OCV.
4. Has a problem been found ?

YES ▶ Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" procedure.

Component Inspection

■ Check OCV resistance

1. IG "OFF" and disconnect OCV connector.

2. Measure resistance between power and signal terminals of OCV. (Component Side)

Specification : 6.7 ~ 7.7 Ω

3. Is the measured resistance within specification?

YES ▶ Go to "Check CAM PHASER with actuation test" as follows.

NO ▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

■ Check CAM PHASER with actuation test

1. Connect scantool and IG "ON"
2. Select "CAM PHASER INTAKE BANK 1" on the Actuation Test
3. Select "OIL CONTROL VALVE" on the Actuation Test
4. Activates "CAM PHASER INTAKE BANK 1" by pressing "START" button
5. Activates "OIL CONTROL VALVE" by pressing "START" button
6. Repeat this procedure 4 or 5 times to ensure CAM PHASER and valve control solenoid reliability

Engine Control System

FL-135

Actuation Test

Test Items

A/C Compressor Relay

Fuel Pump Control

Immobilizer Lamp

Canister Shut Off Valve Clocked

Canister Purge Valve

Oil Control Valve

Ignition Coil-#1

Ignition Coil-#2

Ignition Coil-#3

Ignition Coil-#4

Duration

Until Stop Button

Conditions

IG. ON/ENG.OFF

Result

Start

Stop

SBHFL9606L

Actuation Test

Test Items

Injector-Cylinder 6

Fan PWM

ETC Motor

Variable Intake Manifold 1

Cam Phaser Intake Bank1

Cam Phaser Intake Bank2

Spark Advance/Retard

CAM Phaser Exhaust Bank 1

CAM Phaser Exhaust Bank 2

Duration

Until Stop Button

Conditions

ENG. RUN

Result

Success

Start

Stop

SBHFL9607L

7. Has a problem been found ?

YES ▶ Substitute with a known - good CVVT or O-CV and check for proper operation. If the problem is corrected, replace CVVT or OCV and go to "Verification of Vehicle Repair" procedure.

NO ▶ Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

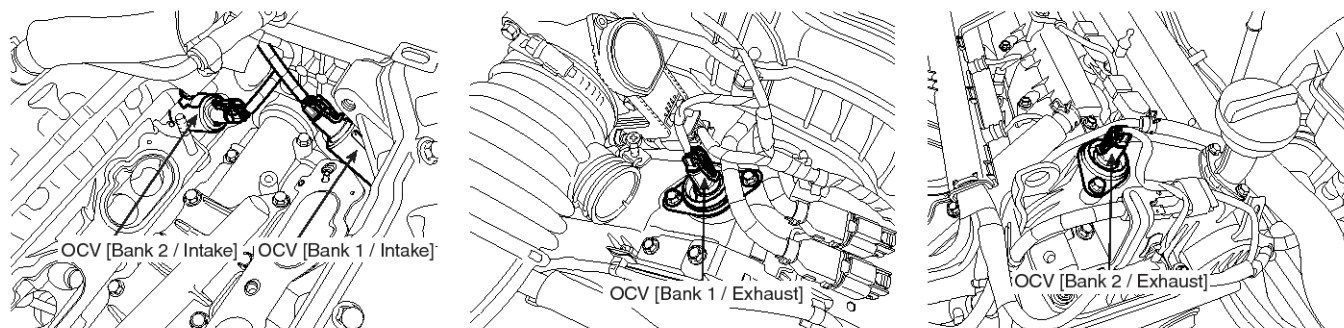
NO ▶ Go to the applicable troubleshooting procedure.

FL-136

Fuel System

P0025 "B" Camshaft Position - Timing Over-Retarded (Bank 2)

Component Location



SBHFL9325L

General Description

The CVVT (Continuously Variable Valve Timing) system is installed to the chain sprocket of the intake camshaft. This system controls the intake camshaft to provide the optimal valve timing for every driving condition. The ECM controls the Oil Control Valve(OCV), based on the signals output from mass air flow, throttle position and engine coolant temperature. The CVVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft becomes optimal, and the engine torque improves, fuel economy improves, exhaust emissions decrease under overall driving conditions.

DTC Description

ECM monitors CAM phaser error while CMP signal is normally generating and vehicle is driving in 2000 ~ 3000rpm.

If the CAM phaser does not move although ECM commands OCV duty cycle ECM determines that a fault exists and a DTC is stored.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		Determines if the phaser is stuck or has steady-state error	- Engine Oil - OCV stuck - CVVT stuck
Enable Conditions		- CAM signal is normally generating - Vehicle is on driving (2000 ~ 3000RPM) for 5 minutes	
Threshold value	Case 1	5 CAD < Cam Actual Position < 50 CAD - Duty Cycle > 90% or Duty Cycle < 10%	
	Case 2	- Cam Position error > 15 CAD (Difference between Actual Position and Desire Position is more than 15°) - Timing Counter > 80	
Diagnosis Time		Continuous (within 5min.)	
MIL On Condition		2 Driving Cycles	

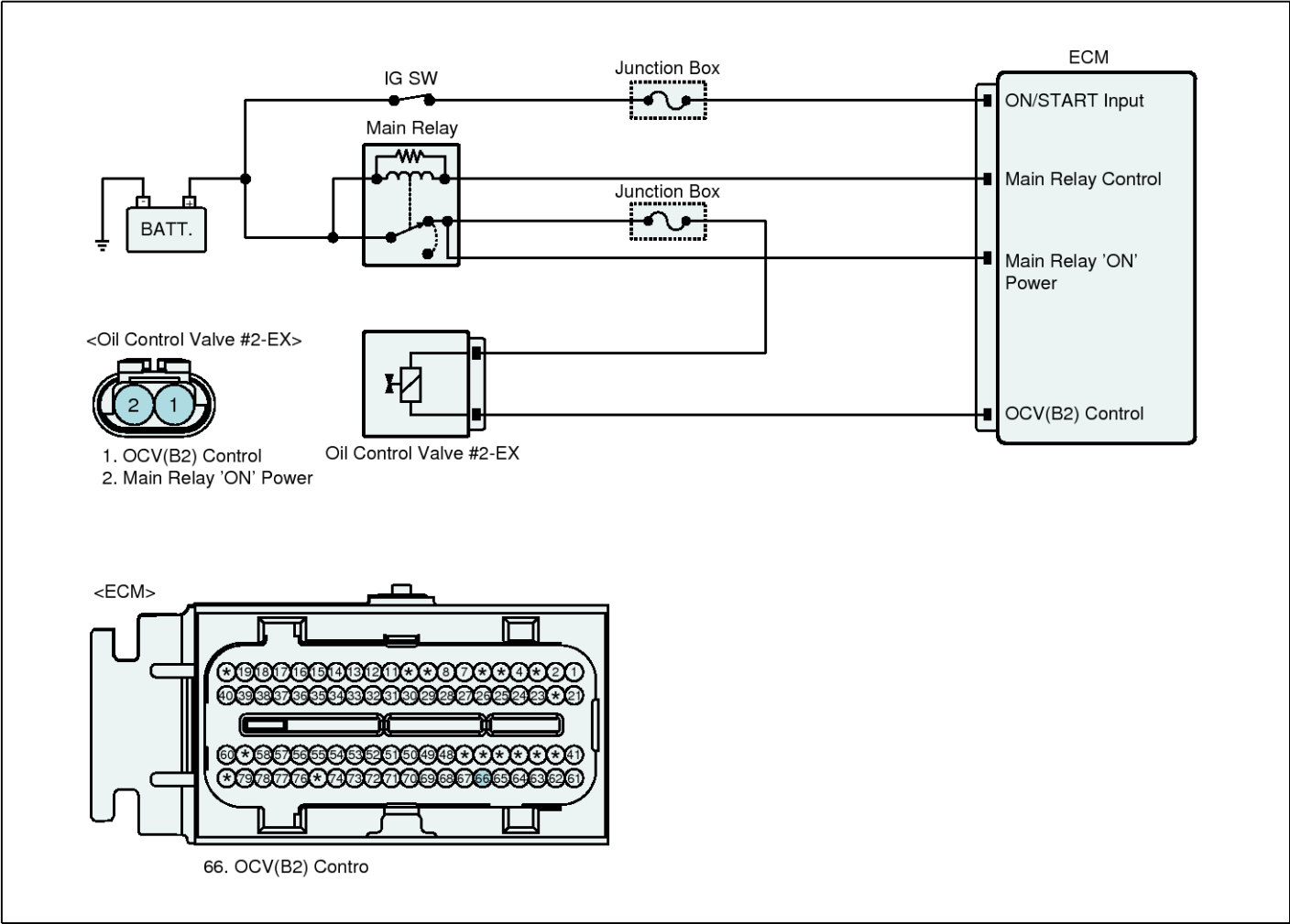
Engine Control System

FL-137

Specification

OCV	Specification
Coil Resistance (Ω)	6.7 ~ 7.7 (20℃)

Diagnostic Circuit Diagram



SBHFL9507L

Signal Waveform & Data

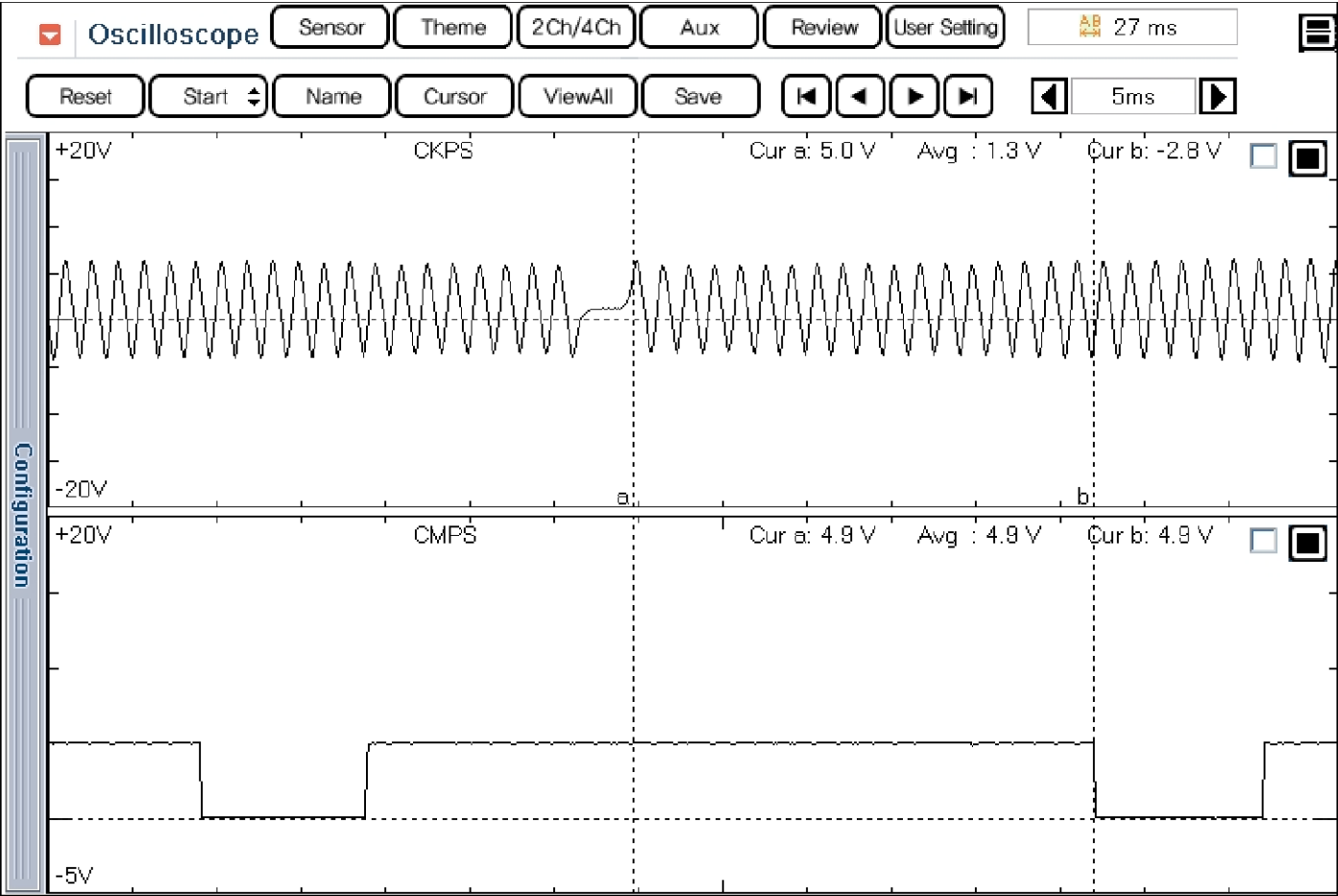


Fig.1

SBHFL9608L

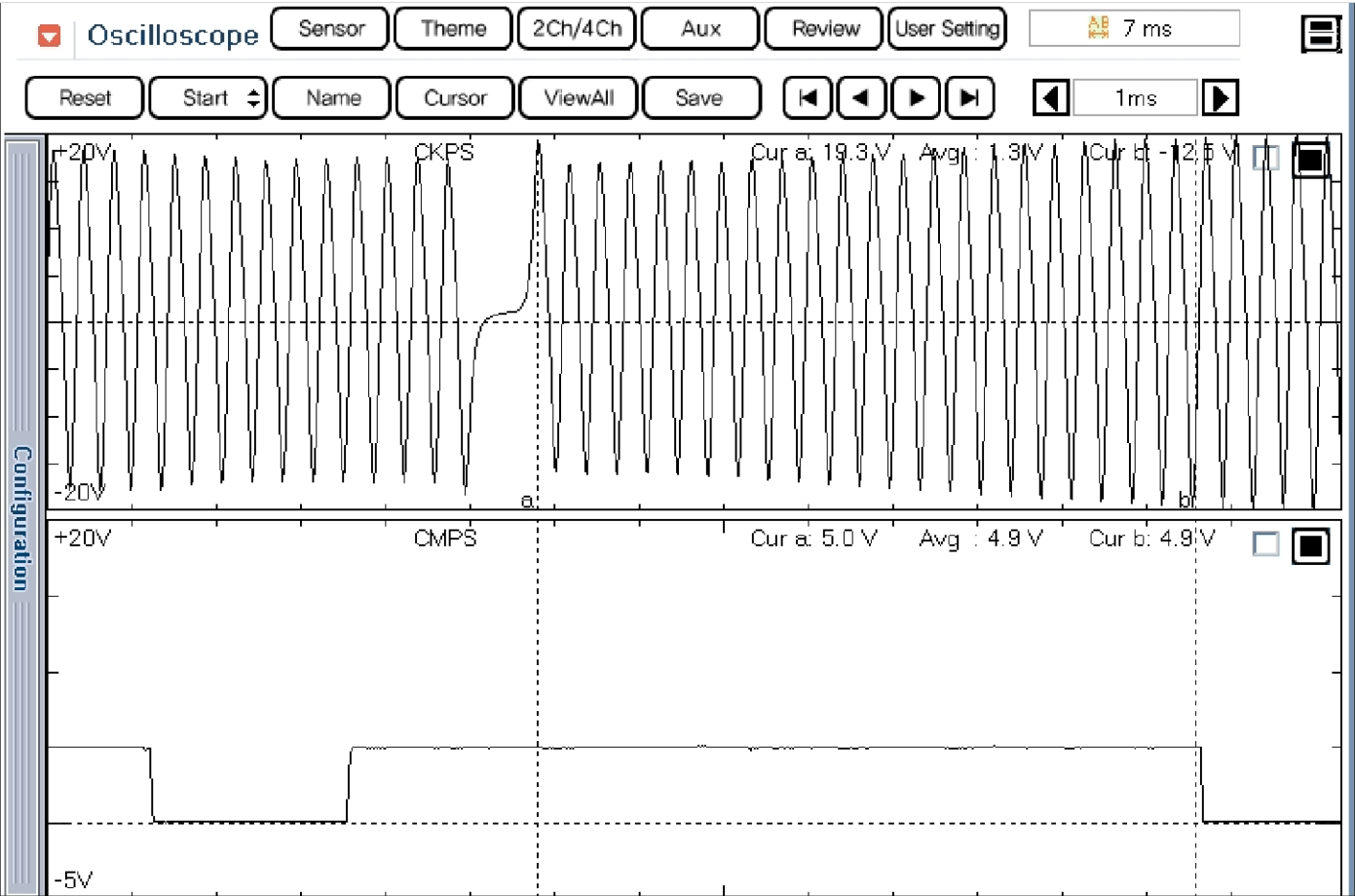


Fig.2

SBHFL9609L

Current Data

Standard Display Full List Graph Items List Reset Min.Max. Record Stop VSS

Sensor Name	Value	Unit
☐ EX-Cam Bank1 Desired Position	0	DEG
☐ EX-Cam Bank1 Actual Position	0	DEG
☐ EX-Cam Bank2 Desired Position	0	DEG
☐ EX-Cam Bank2 Actual Position	0	DEG
☐ EX-Cam Phaser 1 Duty Cycle	0	%
☐ EX-Cam Phaser 2 Duty Cycle	0	%

Fig.3

SBHFL9610L

FL-140

Fuel System

Sensor Name	Value	Unit
☒ Camshaft Control	ON	-
☒ Engine Speed	3840	RPM
☒ EX-Cam Bank1 Actual Position	-15	DEG
☒ EX-Cam Bank1 Desired Position	-14	DEG
☒ EX-Cam Bank2 Desired Position	-14	DEG
☒ EX-Cam Bank2 Actual Position	-15	DEG
☒ EX-Cam Phaser 1 Duty Cycle	43	%
☒ EX-Cam Phaser 2 Duty Cycle	44	%

Fig.4

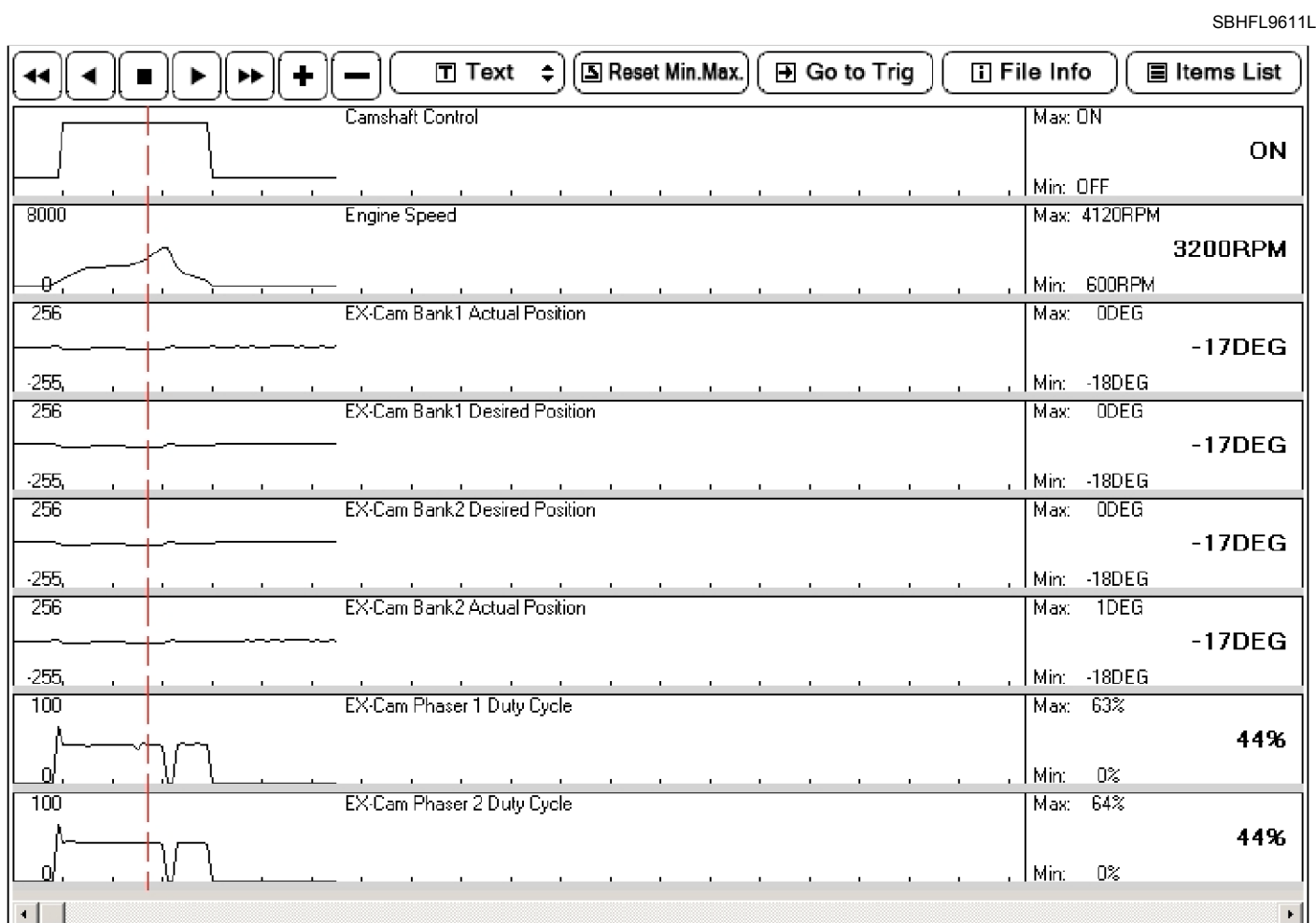


Fig.5

SBHFL9612L

Fig 1) Normal waveform of CKPS & EX-CMPS at idle.

Fig 2) Normal waveform of CKPS & EX-CMPS at acceleration.

Fig 3) Normal data of EX-CVVT at idle.

Fig 4) Normal data of EX-CVVT at acceleration.

Fig 5) Normal graph of EX-CVVT at acceleration.

This example shows a typical Crankshaft Position Sensor (CKPS) and Camshaft Position Sensor (CMPS) waveform at idle.(Fig1.) If the 17th signal of the CKPS after missing tooth is aligned with the high signal of the CMPS at idle, ECM recognizes that Synchronization between CKPS and CMPS is completed. Under acceleracting condition, the number of tooth between missing tooth and tooth aligned with edge of the CMPS high signal is increased than idle conditon.(Fig2.)

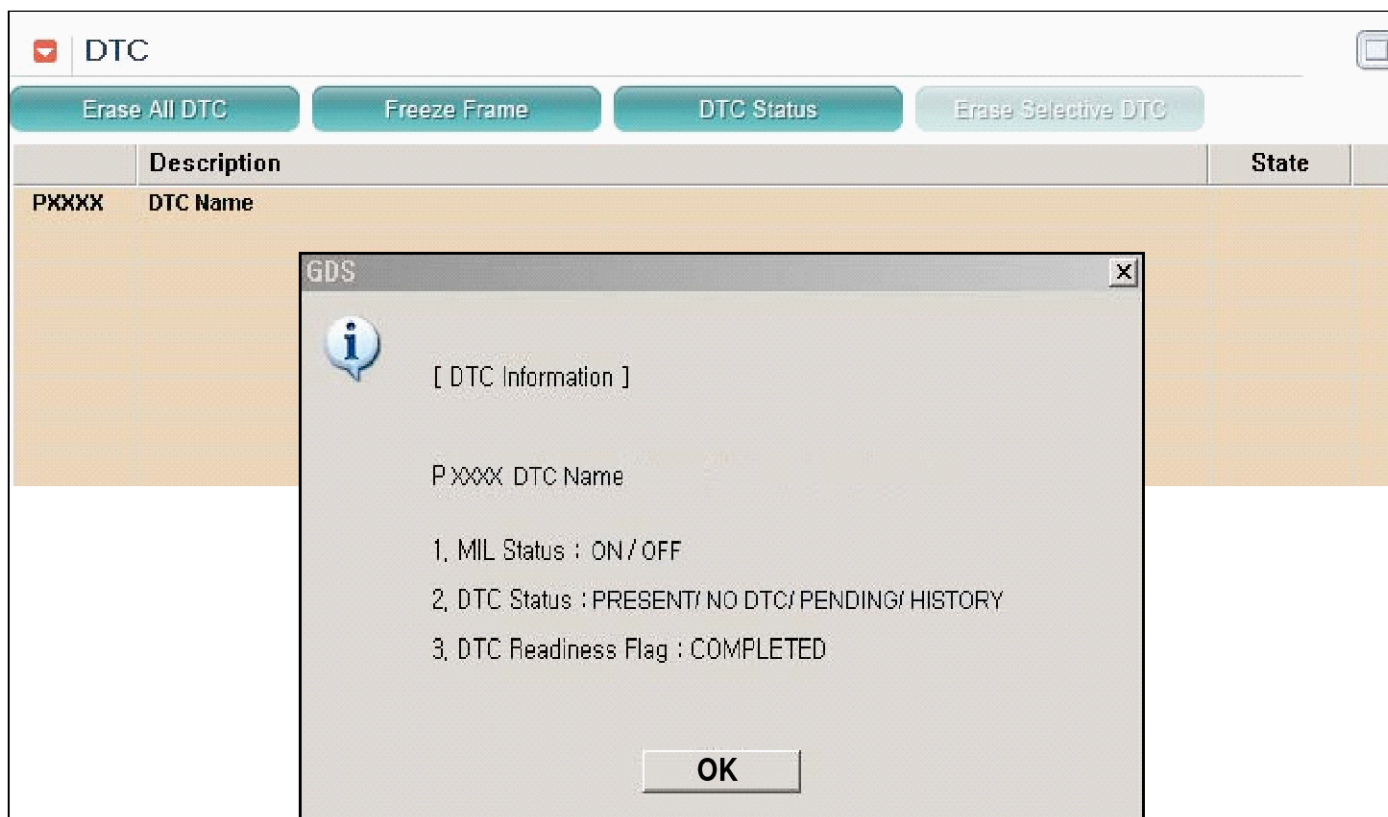
Engine Control System

FL-141

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "System Inspection" procedure.

NO ► Fault is intermittent caused by ECM memory was not cleared after repair. Erase DTC and drive the vehicle to satisfy the enable condition then, go to "System Inspection" procedure.

System Inspection

■ Visual Inspection

1. Check oil level is O.K.
2. Check Oil and OCV is contaminated.
3. Check that any oil leakage is occurred around OCV.
4. Has a problem been found ?

YES ► Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Component Inspection" procedure.

Component Inspection

■ Check OCV resistance

1. IG "OFF" and disconnect OCV connector.
2. Measure resistance between power and signal terminals of OCV. (Component Side)

Specification : 6.7 ~ 7.7 Ω

3. Is the measured resistance within specification?

YES ► Go to "Check CAM PHASER with actuation test" as follows.

NO ► Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

■ Check CAM PHASER with actuation test

1. Connect scantool and IG "ON"
2. Select "CAM PHASER EXHAUST BANK 2" on the Actuation Test
3. Select "OIL CONTROL VALVE" on the Actuation Test

FL-142

Fuel System

4. Activates "CAM PHASER EXHAUST BANK 2" by pressing "START" button
5. Activates "OIL CONTROL VALVE" by pressing "START" button

6. Repeat this procedure 4 or 5 times to ensure CAM PHASER and valve control solenoid reliability

☒ **Actuation Test**

Test Items
A/C Compressor Relay
Fuel Pump Control
Immobilizer Lamp
Canister Shut Off Valve Clocked
Canister Purge Valve
Oil Control Valve
Ignition Coil-#1
Ignition Coil-#2
Ignition Coil-#3
Ignition Coil-#4

Duration:

Conditions:

Result:

Start

Stop

SBHFL9606L

☒ **Actuation Test**

Test Items
Injector-Cylinder 6
Fan PWM
ETC Motor
Variable Intake Manifold 1
Cam Phaser Intake Bank1
Cam Phaser Intake Bank2
Spark Advance/Retard
CAM Phaser Exhaust Bank 1
CAM Phaser Exhaust Bank 2

Duration:

Conditions:

Result:

Start

Stop

SBHFL9607L

7. Has a problem been found ?

- YES** ▶ Substitute with a known - good CVVT or O-CV and check for proper operation. If the problem is corrected, replace CVVT or OCV and go to "Verification of Vehicle Repair" procedure.
- NO** ▶ Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

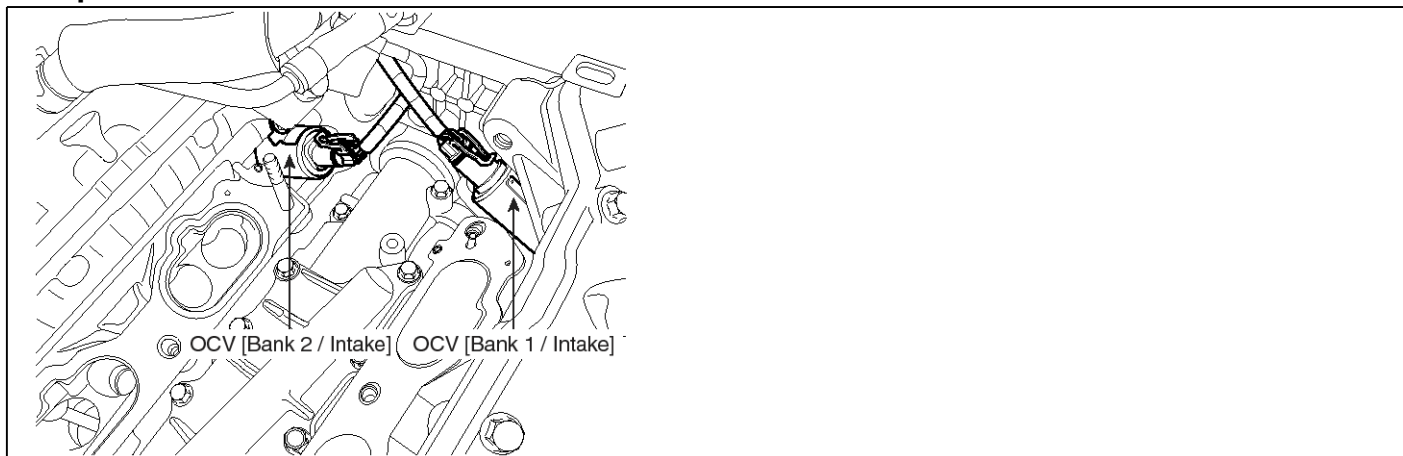
1. Connect scantool and select "DTC" button.
 2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
 3. Read "DTC Status" parameter.
 4. Is parameter displayed "History(Not Present) fault"?
- YES** ▶ System performing to specification at this time. Clear the DTC.
- NO** ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-143

P0026 Intake Valve Control Solenoid Circuit Range/Performance (Bank 1)

Component Location



SBHFL9320L

General Description

The CVVT (Continuously Variable Valve Timing) system is installed to the chain sprocket of the intake camshaft. This system controls the intake camshaft to provide the optimal valve timing for every driving condition. The ECM controls the Oil Control Valve(OCV), based on the signals output from mass air flow, throttle position and engine coolant temperature. The CVVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft becomes optimal, and the engine torque improves, fuel economy improves, exhaust emissions decrease under overall driving conditions.

DTC Description

ECM monitors OCV stuck while cam sinal is normally generating and Valve cleaning is not in progress .If the CAM Acutal Position is too high or low and Difference between Cam Actual Positionand Desire Position is higher than 20° ECM determines that a fault exists and a DTC is stored.

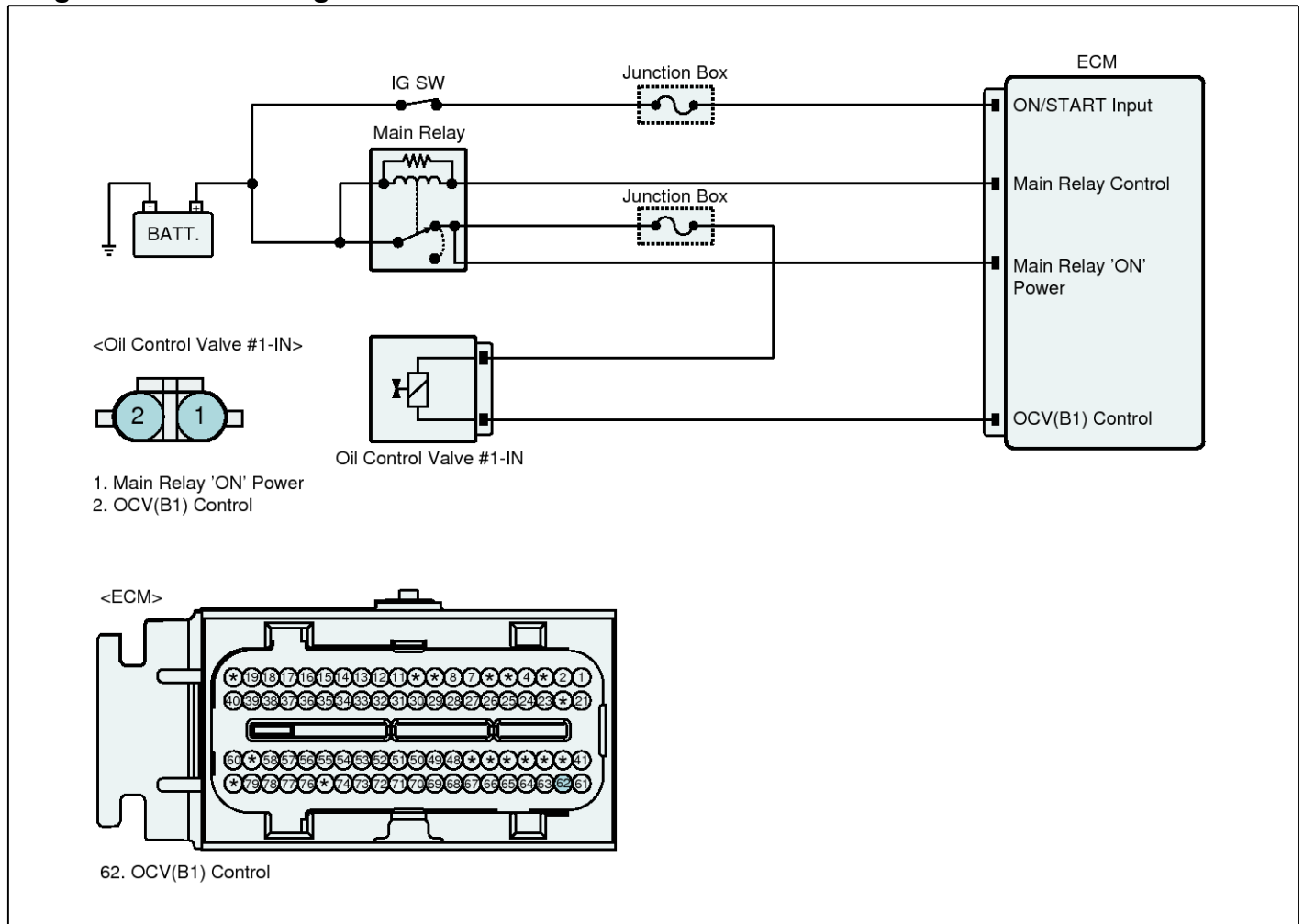
DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		• Determines if oil control valve is stuck	• Oil Pressure Loss • OCV seizure
Enable Conditions		• Valve cleaning not in progress • CAM signal is normally generating	
Threshold value	Case 1	• Cam Actual Position > 50 CAD and Difference between CAM Actual Position and Desire Position > 20 CAD	
	Case 2	• Cam Actual Position < 5 CAD and Difference between CAM Actual Position and Desire Position > 20 CAD	
Diagnosis Time		• Continuous (Within 1min.)	
MIL On Condition		• 2 Driving Cycles	

Specification

OCV	Specification
Coil Resistance (Ω)	6.7 ~ 7.7 (20℃)

Diagnostic Circuit Diagram



SBHFL9500L

Engine Control System

FL-145

Signal Waveform & Data

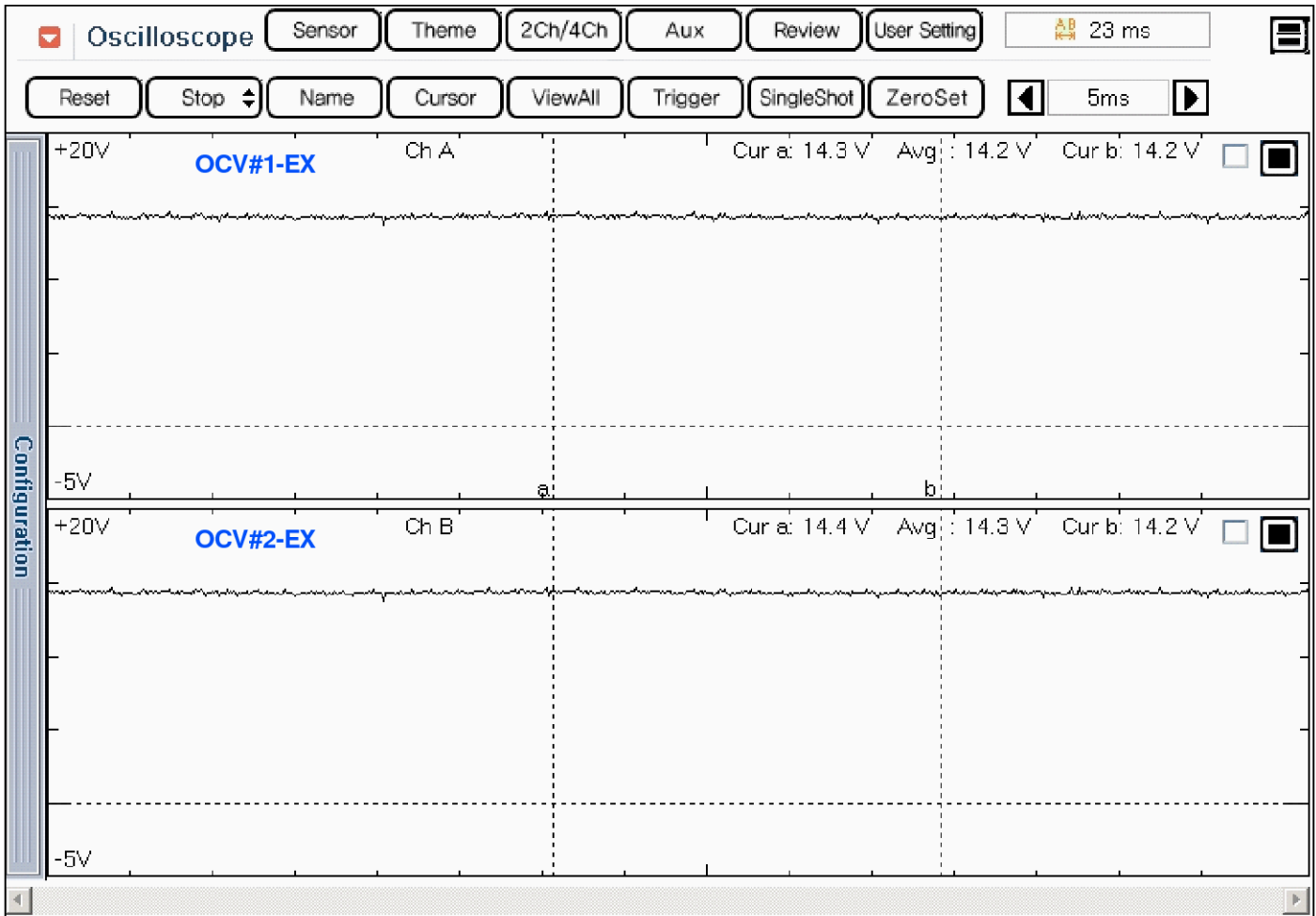


Fig.1

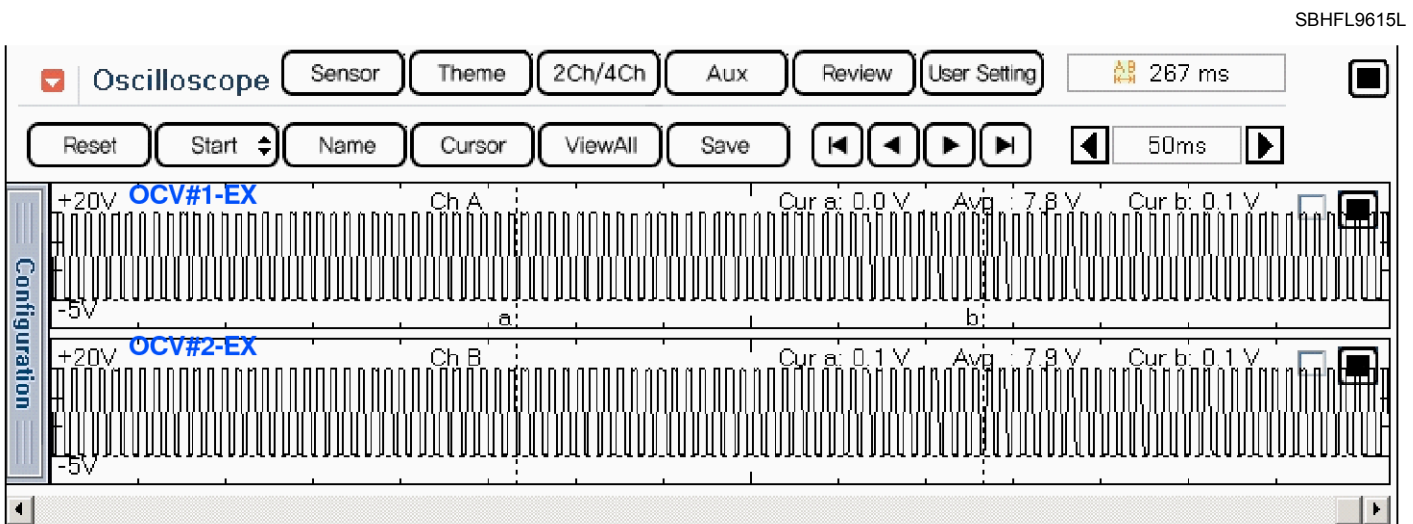


Fig.2

SBHFL9615L

SBHFL9616L

FL-146

Fuel System

Current Data		
Standard Display	Full List	Graph
Items List	Reset Min.Max.	Record
Stop	VSS	
Sensor Name	Value	Unit
☒ Camshaft Desired Position-Bank1	0.0	DEG
☒ Camshaft Actual Position-Bank1	0.3	DEG
☒ Camshaft Desired Position-Bank2	0.0	DEG
☒ Camshaft Actual Position-Bank2	-0.3	DEG
☒ Engine Speed	600	RPM

Fig.3

SBHFL9603L

Current Data		
Standard Display	Full List	Graph
Items List	Reset Min.Max.	Record
Run	VSS	
Sensor Name	Value	Unit
☒ Camshaft Desired Position-Bank1	18.8	DEG
☒ Camshaft Actual Position-Bank1	28.4	DEG
☒ Camshaft Desired Position-Bank2	18.8	DEG
☒ Camshaft Actual Position-Bank2	26.1	DEG
☒ Engine Speed	1040	RPM
☒ Actual Torque	64.3	%

Fig.4

SBHFL9604L

Fig 1) Normal waveform of OCV at idle.

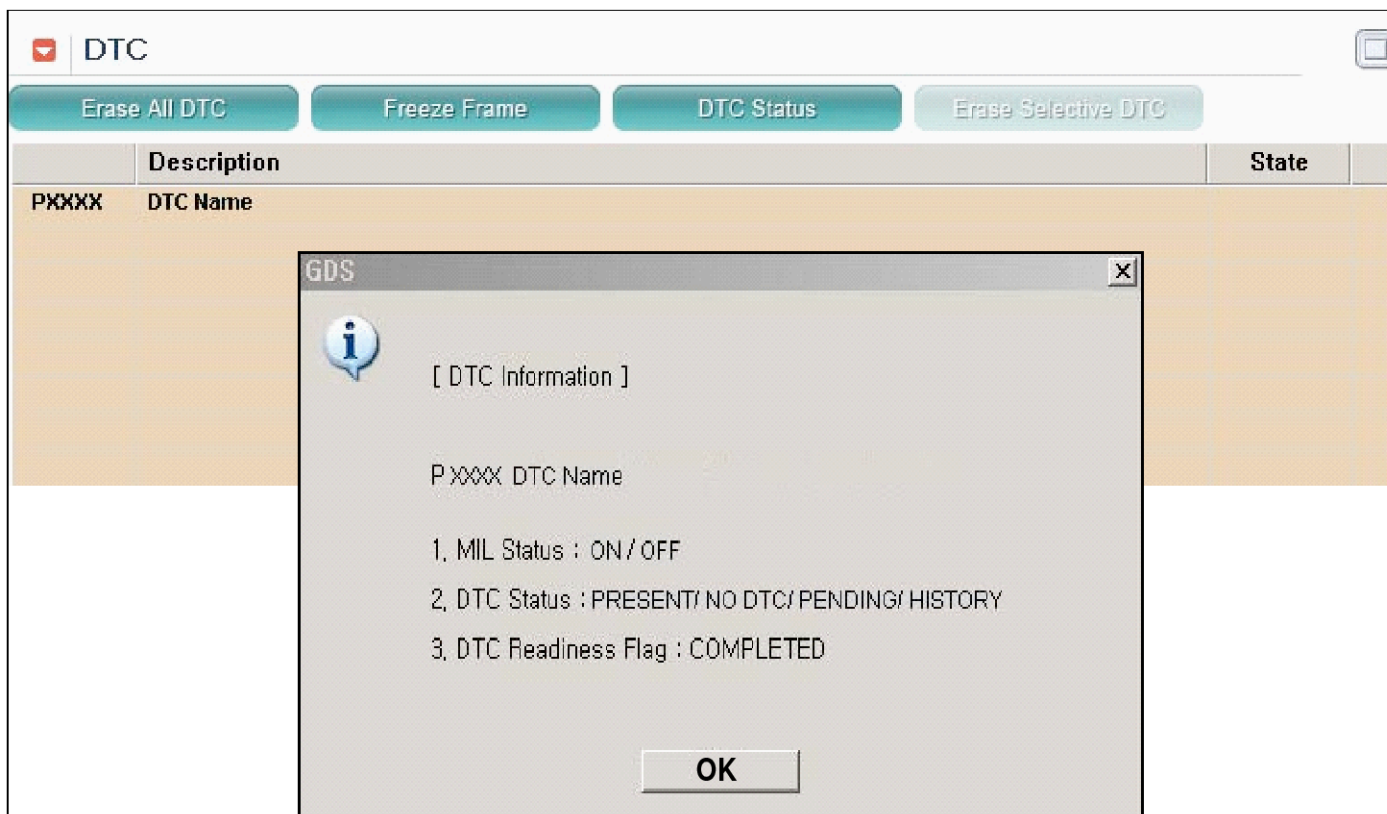
Fig 2) Normal waveform of OCV at acceleration.
(3500rpm)

Fig 3) Normal data of IN-CVVT at idle.

Fig 4) Normal data of IN-CVVT at acceleration with load.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Power Circuit Inspection " as follow.

Power Circuit Inspection

Check voltage

- IG "OFF" and disconnect OCV connector.
- IG "ON".
- Measure voltage between power terminal of OCV harness connector and chassis ground.

NOTICE

Be careful not to change the connectors for Bank1 and Bank2

Specification : B+

- Is the measured voltage within specification ?

YES ► Go to " Control Circuit Inspection " procedure.

NO ► Check that Fuse between Main Relay and OCV is open.
 ► Check open between main relay and OCV.
 ► Check short to ground between Main Relay and OCV.
 ► Repair or replace as necessary go to "Verification of Vehicle Repair " procedure.

FL-148

Fuel System

Control Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect OCV connector.
2. IG "ON".
3. Measure voltage between control terminal of OCV harness connector and chassis ground.

Specification : Approx. below 1V

4. Is the measured voltage within specification ?

YES ▶ Go to "System Inspection" procedure.

NO ▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

System Inspection

■ Visual Inspection

1. Check oil level and oil cleanness is O.K.
2. Check OCV is contaminated.
3. Check that any oil leakage is occurred around OCV.
4. Has a problem been found ?

YES ▶ Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" procedure.

Component Inspection

■ Check OCV resistance

1. IG "OFF" and disconnect OCV connector.
2. Measure resistance between power and signal terminals of OCV. (Component Side)

Specification : 6.7 ~ 7.7 Ω

3. Is the measured resistance within specification?

YES ▶ Go to "Check CAM PHASER with actuation test" as follows.

NO ▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

■ Check CAM PHASER with actuation test

1. Connect scantool and IG "ON"
2. Select "CAM PHASER INTAKE BANK 1" on the Actuation Test
3. Select "OIL CONTROL VALVE" on the Actuation Test
4. Activates "CAM PHASER INTAKE BANK 1" by pressing "START" button
5. Activates "OIL CONTROL VALVE" by pressing "START" button
6. Repeat this procedure 4 or 5 times to ensure CAM PHASER and valve control solenoid reliability

Actuation Test

Test Items

A/C Compressor Relay

Fuel Pump Control

Immobilizer Lamp

Canister Shut Off Valve Clocked

Canister Purge Valve

Oil Control Valve

Ignition Coil-#1

Ignition Coil-#2

Ignition Coil-#3

Ignition Coil-#4

Duration

Until Stop Button

Conditions

IG, ON/ENG, OFF

Result

Start

Stop

SBHFL9606L

Engine Control System

FL-149

Actuation Test

Test Items
Injector-Cylinder 6
Fan PWM
ETC Motor
Variable Intake Manifold 1
Cam Phaser Intake Bank1
Cam Phaser Intake Bank2
Spark Advance/Retard
CAM Phaser Exhaust Bank 1
CAM Phaser Exhaust Bank 2

Duration

Until Stop Button

Conditions

ENG. RUN

Result

Success

Start

Stop

SBHFL9607L

7. Has a problem been found ?

YES ▶ Substitute with a known - good CVVT or O-CV and check for proper operation. If the problem is corrected, replace CVVT or OCV and go to "Verification of Vehicle Repair" procedure.

NO ▶ Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

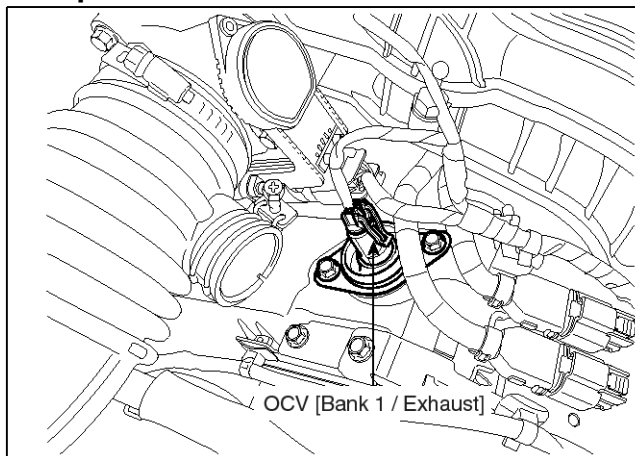
NO ▶ Go to the applicable troubleshooting procedure.

FL-150

Fuel System

P0027 Exhaust Valve Control Solenoid Circuit Range/Performance (Bank 1)

Component Location



SBHFL9321L

General Description

The CVVT (Continuously Variable Valve Timing) system is installed to the chain sprocket of the intake camshaft. This system controls the intake camshaft to provide the optimal valve timing for every driving condition. The ECM controls the Oil Control Valve(OCV), based on the signals output from mass air flow, throttle position and engine coolant temperature. The CVVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft becomes optimal, and the engine torque improves, fuel economy improves, exhaust emissions decrease under overall driving conditions.

DTC Description

ECM monitors OCV stuck while cam signal is normally generating and Valve cleaning is not in progress .

If the CAM Actual Position is too high or low and Difference between Cam Actual Position and Desire Position is higher than 20° ECM determines that a fault exists and a DTC is stored.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		• Determines if oil control valve is stuck	• Oil Pressure Loss • OCV seizure
Enable Conditions		• Valve cleaning not in progress • CAM signal is normally generating	
Threshold value	Case 1	• Cam Actual Position > 50 CAD and Difference between CAM Actual Position and Desire Position > 20 CAD	
	Case 2	• Cam Actual Position < 5 CAD and Difference between CAM Actual Position and Desire Position > 20 CAD	
Diagnosis Time		• Continuous (Within 1min.)	
MIL On Condition		• 2 Driving Cycles	

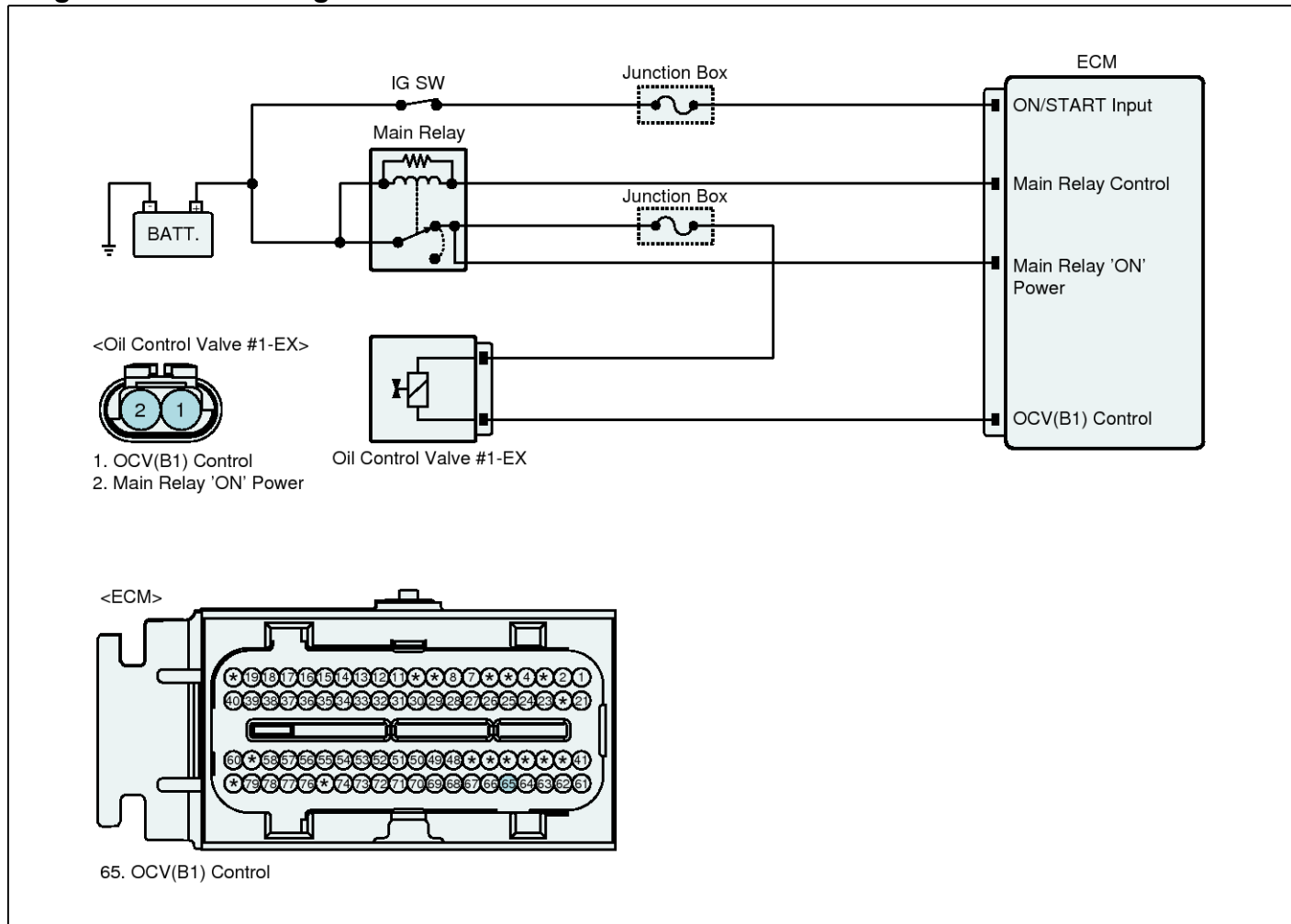
Specification

OCV	Specification
Coil Resistance (Ω)	6.7 ~ 7.7 (20℃)

Engine Control System

FL-151

Diagnostic Circuit Diagram



SBHFL9501L

Signal Waveform & Data

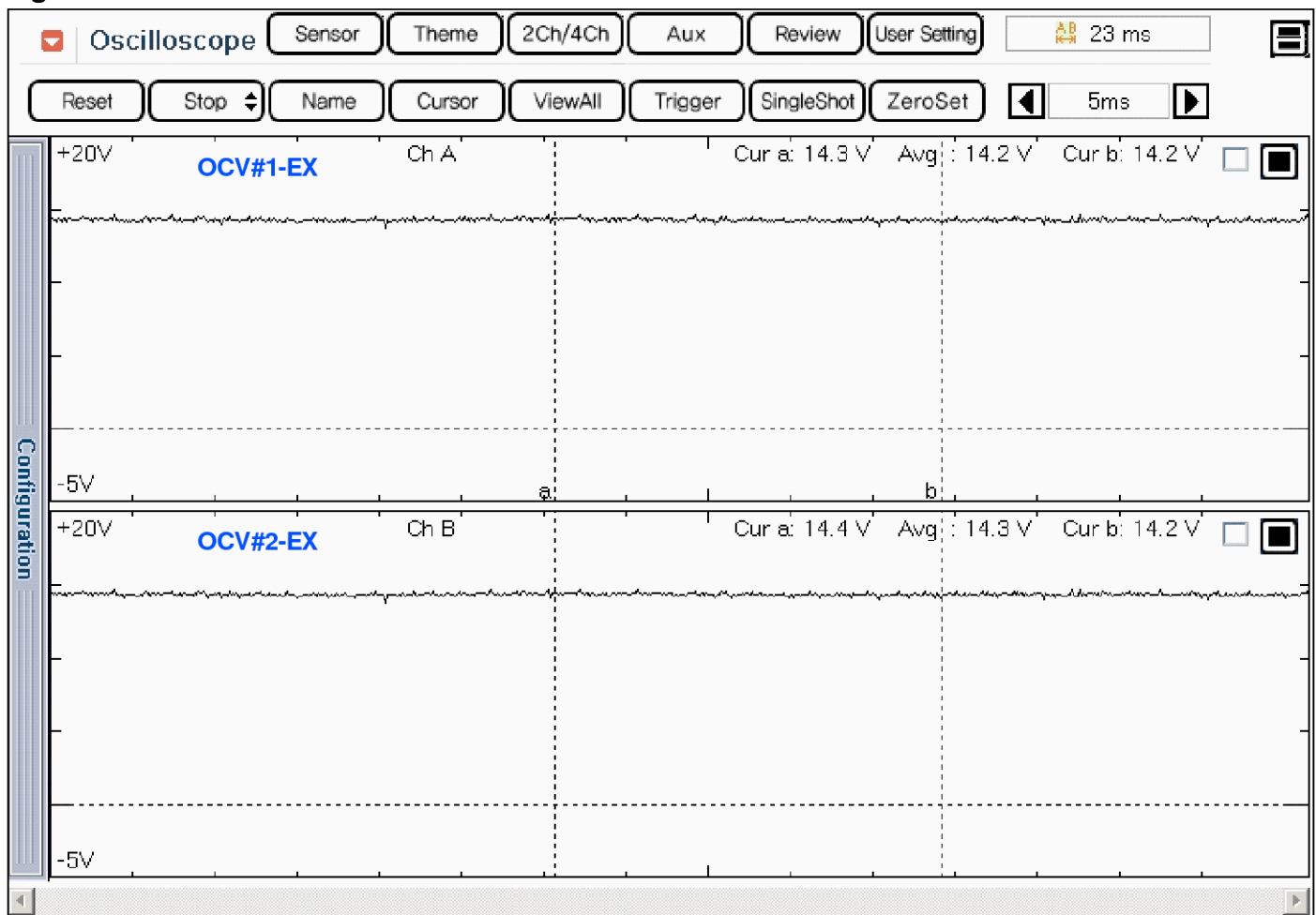


Fig.1

SBHFL9615L

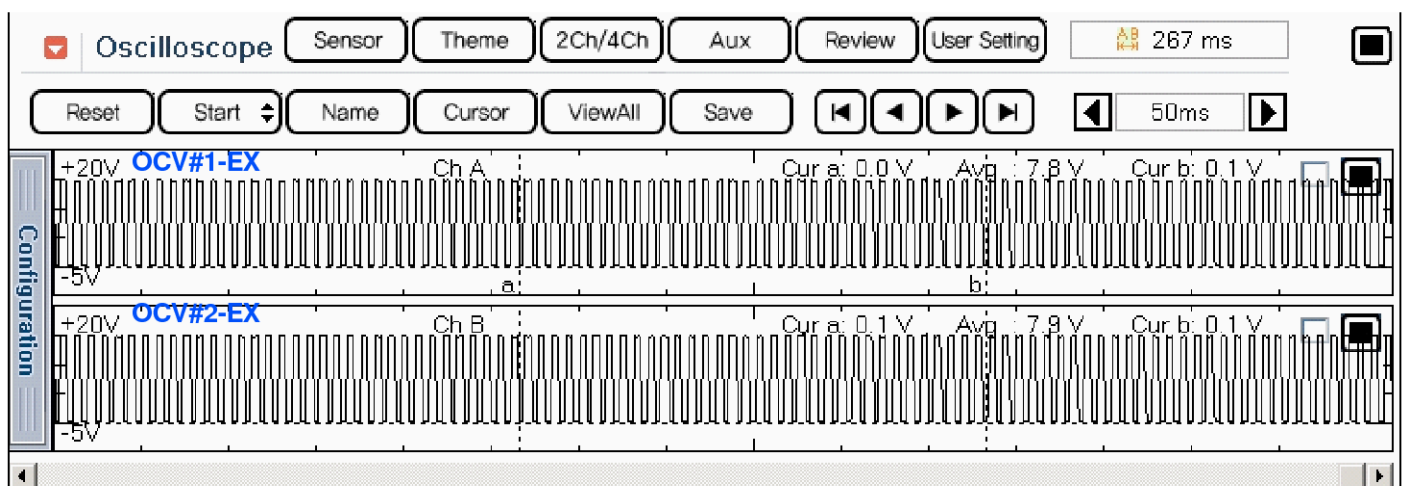


Fig.2

SBHFL9616L

Engine Control System

FL-153

Current Data			
Standard Display ▾	Full List ▾	Graph ▾	Items List ▾
Reset Min.Max.		Record	Stop ▾
VSS			
Sensor Name	Value	Unit	
☐ EX-Cam Bank1 Desired Position	0	DEG	
☐ EX-Cam Bank1 Actual Position	0	DEG	
☐ EX-Cam Bank2 Desired Position	0	DEG	
☐ EX-Cam Bank2 Actual Position	0	DEG	
☐ EX-Cam Phaser 1 Duty Cycle	0	%	
☐ EX-Cam Phaser 2 Duty Cycle	0	%	

Fig.3

SBHFL9610L

Sensor Name	Value	Unit	
☒ Camshaft Control	ON	-	
☒ Engine Speed	3840	RPM	
☒ EX-Cam Bank1 Actual Position	-15	DEG	
☒ EX-Cam Bank1 Desired Position	-14	DEG	
☒ EX-Cam Bank2 Desired Position	-14	DEG	
☒ EX-Cam Bank2 Actual Position	-15	DEG	
☒ EX-Cam Phaser 1 Duty Cycle	43	%	
☒ EX-Cam Phaser 2 Duty Cycle	44	%	

Fig.4

SBHFL9611L

FL-154

Fuel System

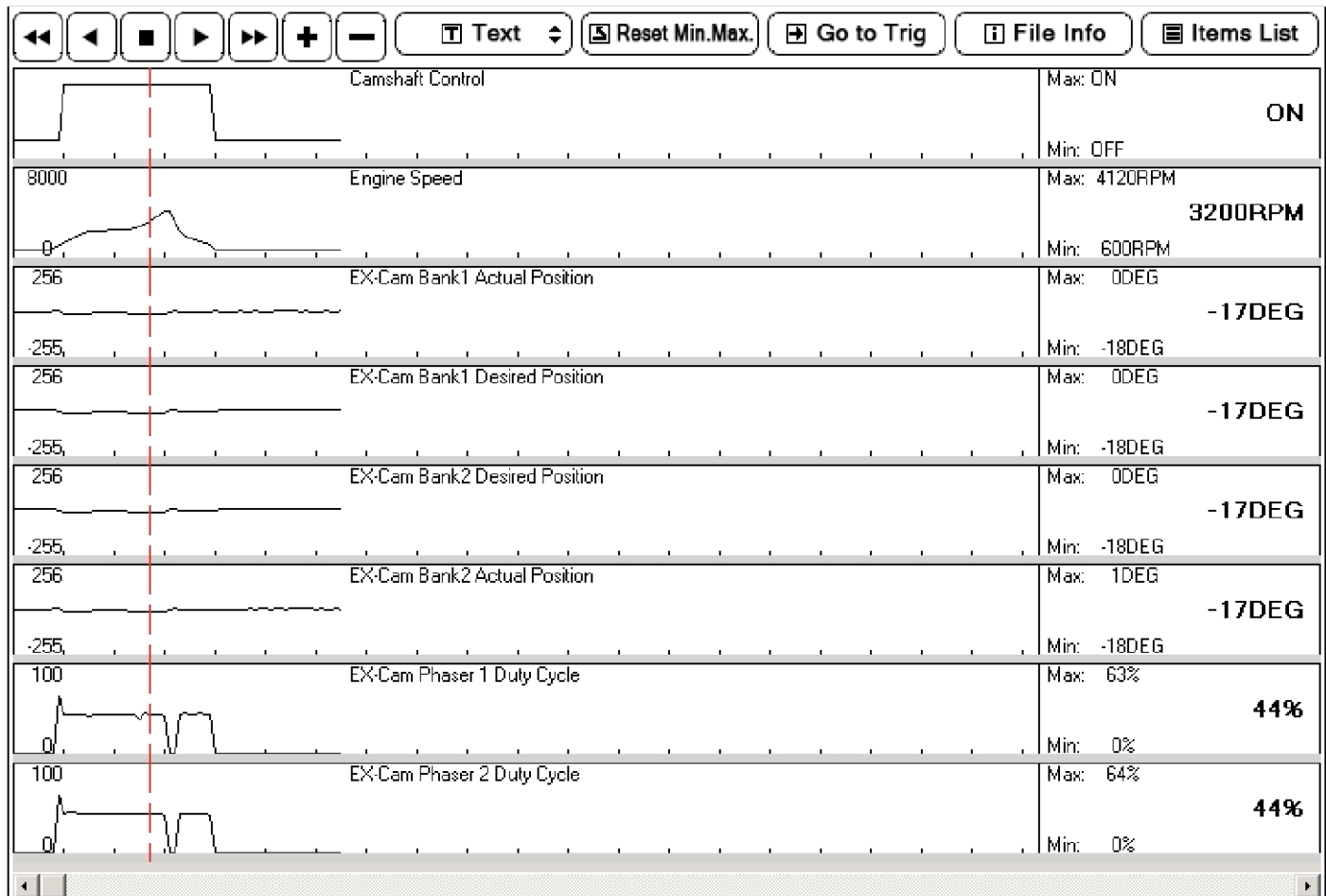


Fig.5

SBHFL9612L

Fig 1) Normal waveform of OCV at idle.

Fig 2) Normal waveform of OCV at acceleration. (3500rpm)

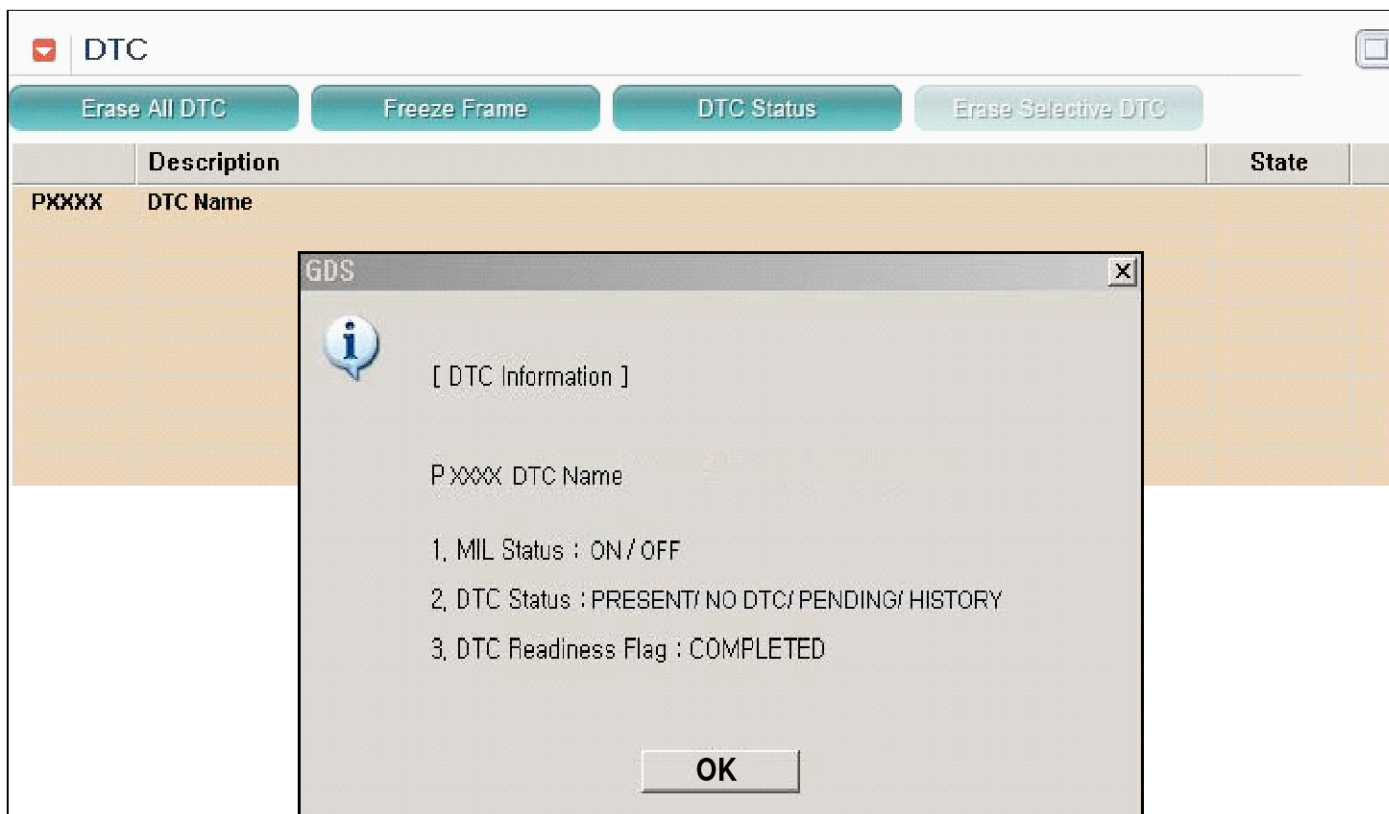
Fig 3) Normal data of IN-CVVT at idle.

Fig 4) Normal data of EX-CVVT at acceleration.

Fig 5) Normal graph of EX-CVVT at acceleration.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Power Circuit Inspection " as follow.

Power Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect OCV connector.
- IG "ON".
- Measure voltage between power terminal of OCV harness connector and chassis ground.

NOTICE

Be careful not to change the connectors for Bank1 and Bank2

Specification : B+

- Is the measured voltage within specification ?

YES ► Go to " Control Circuit Inspection " procedure.

NO ► Check that Fuse between Main Relay and OCV is open.
 ► Check open between main relay and OCV.
 ► Check short to ground between Main Relay and OCV.
 ► Repair or replace as necessary go to "Verification of Vehicle Repair " procedure.

FL-156

Fuel System

Control Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect OCV connector.
2. IG "ON".
3. Measure voltage between control terminal of OCV harness connector and chassis ground.

Specification : Approx. below 1V

4. Is the measured voltage within specification ?

YES ▶ Go to "System Inspection" procedure.

NO ▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

System Inspection

■ Visual Inspection

1. Check oil level and oil cleanness is O.K.
2. Check OCV is contaminated.
3. Check that any oil leakage is occurred around OCV.
4. Has a problem been found ?

YES ▶ Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" procedure.

Component Inspection

■ Check OCV resistance

1. IG "OFF" and disconnect OCV connector.
2. Measure resistance between power and signal terminals of OCV. (Component Side)

Specification : 6.7 ~ 7.7 Ω

3. Is the measured resistance within specification?

YES ▶ Go to "Check CAM PHASER with actuation test" as follows.

NO ▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

■ Check CAM PHASER with actuation test

1. Connect scantool and IG "ON"
2. Select "CAM PHASER EXHAUST BANK 1" on the Actuation Test
3. Select "OIL CONTROL VALVE" on the Actuation Test
4. Activates "CAM PHASER EXHAUST BANK 1" by pressing "START" button
5. Activates "OIL CONTROL VALVE" by pressing "START" button
6. Repeat this procedure 4 or 5 times to ensure CAM PHASER and valve control solenoid reliability

Actuation Test

Test Items

A/C Compressor Relay

Fuel Pump Control

Immobilizer Lamp

Canister Shut Off Valve Clocked

Canister Purge Valve

Oil Control Valve

Ignition Coil-#1

Ignition Coil-#2

Ignition Coil-#3

Ignition Coil-#4

Duration

Until Stop Button

Conditions

IG, ON/ENG, OFF

Result

Start

Stop

SBHFL9606L

Engine Control System

FL-157

Actuation Test

Test Items
Injector-Cylinder 6
Fan PWM
ETC Motor
Variable Intake Manifold 1
Cam Phaser Intake Bank1
Cam Phaser Intake Bank2
Spark Advance/Retard
CAM Phaser Exhaust Bank 1
CAM Phaser Exhaust Bank 2

Duration

Until Stop Button

Conditions

ENG. RUN

Result

Success

Start

Stop

SBHFL9607L

7. Has a problem been found ?

YES ▶ Substitute with a known - good CVVT or O-CV and check for proper operation. If the problem is corrected, replace CVVT or OCV and go to "Verification of Vehicle Repair" procedure.

NO ▶ Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

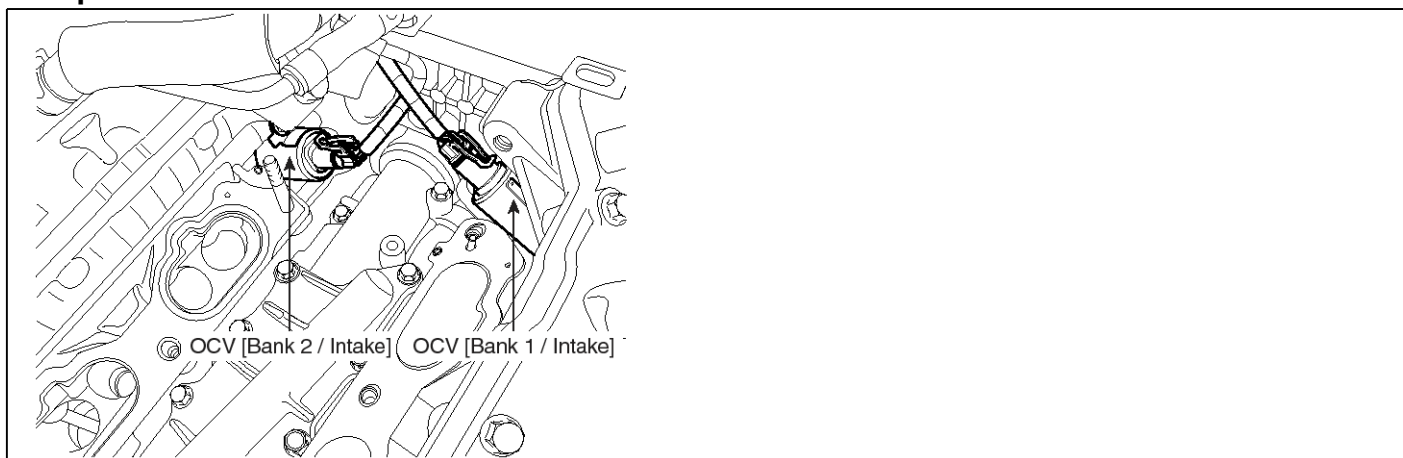
NO ▶ Go to the applicable troubleshooting procedure.

FL-158

Fuel System

P0028 Intake Valve Control Solenoid Circuit Range/Performance (Bank 2)

Component Location



SBHFL9320L

General Description

The CVVT (Continuously Variable Valve Timing) system is installed to the chain sprocket of the intake camshaft. This system controls the intake camshaft to provide the optimal valve timing for every driving condition. The ECM controls the Oil Control Valve(OCV), based on the signals output from mass air flow, throttle position and engine coolant temperature. The CVVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft becomes optimal, and the engine torque improves, fuel economy improves, exhaust emissions decrease under overall driving conditions.

DTC Description

ECM monitors OCV stuck while cam signal is normally generating and Valve cleaning is not in progress .

If the CAM Actual Position is too high or low and Difference between Cam Actual Position and Desire Position is higher than 20° ECM determines that a fault exists and a DTC is stored.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		• Determines if oil control valve is stuck	• Oil Pressure Loss • OCV seizure
Enable Conditions		• Valve cleaning not in progress • CAM signal is normally generating	
Threshold value	Case 1	• Cam Actual Position > 50 CAD and Difference between CAM Actual Position and Desire Position > 20 CAD	
	Case 2	• Cam Actual Position < 5 CAD and Difference between CAM Actual Position and Desire Position > 20 CAD	
Diagnosis Time		• Continuous (Within 1min.)	
MIL On Condition		• 2 Driving Cycles	

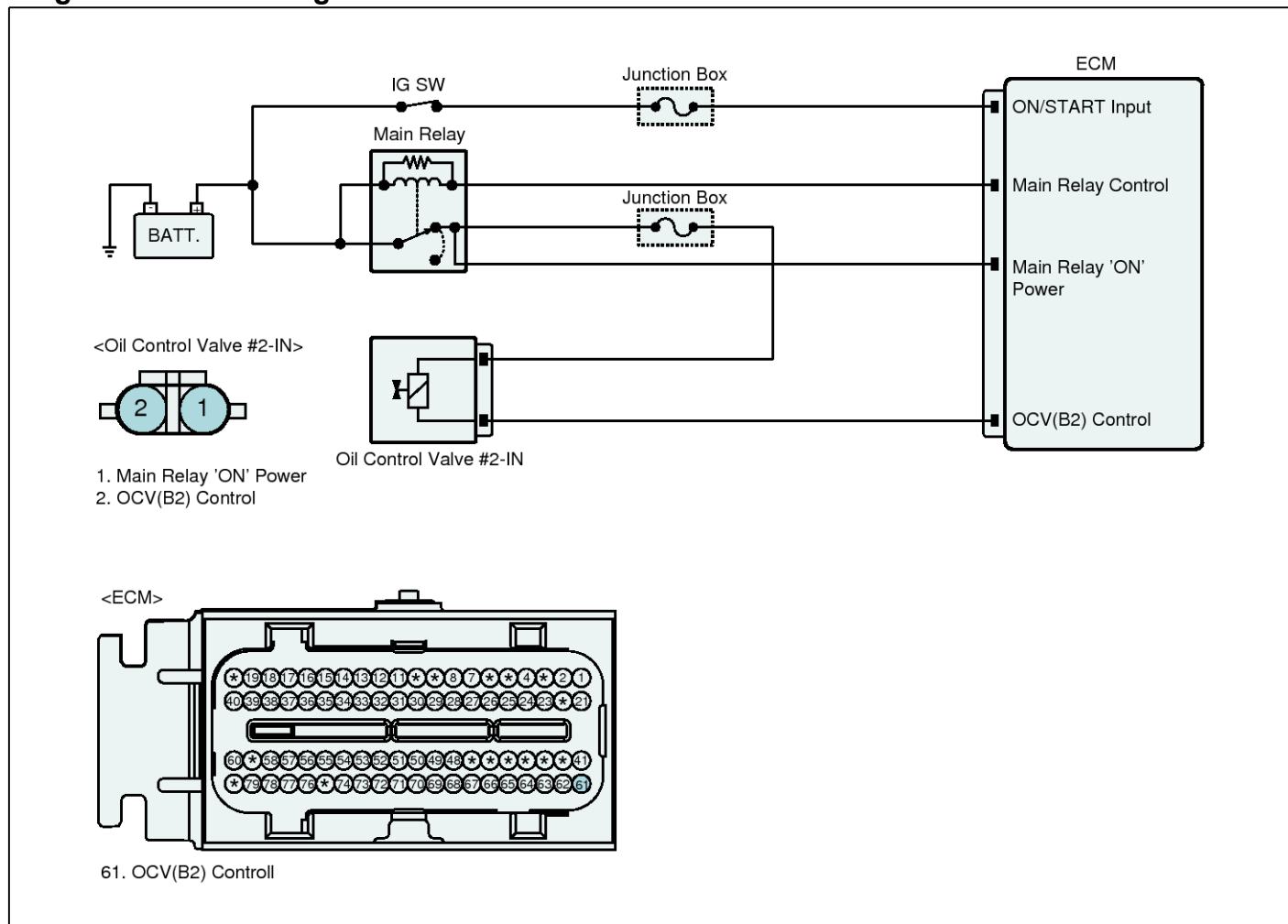
Specification

OCV	Specification
Coil Resistance (Ω)	6.7 ~ 7.7 (20℃)

Engine Control System

FL-159

Diagnostic Circuit Diagram



SBHFL9506L

Signal Waveform & Data

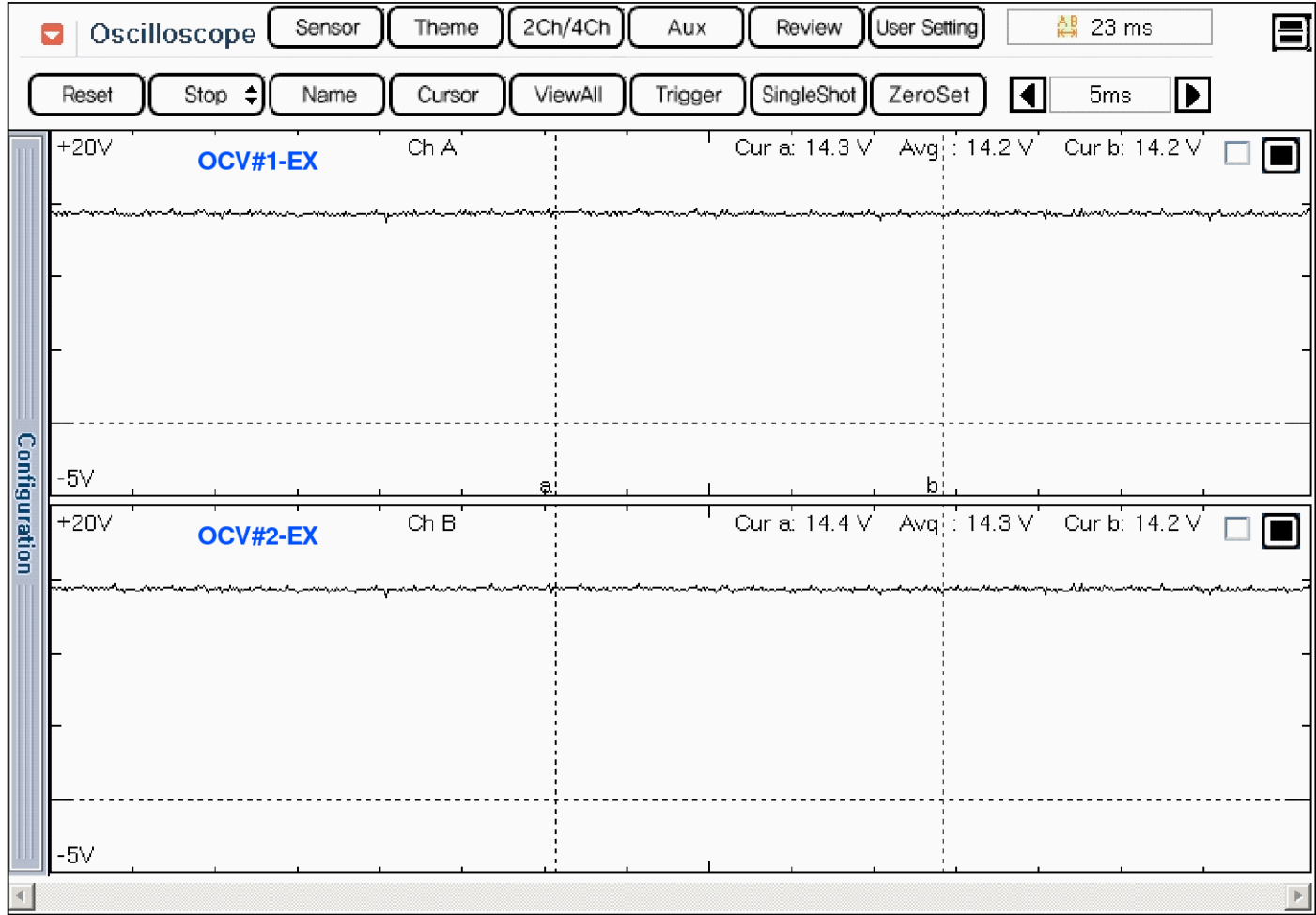


Fig.1

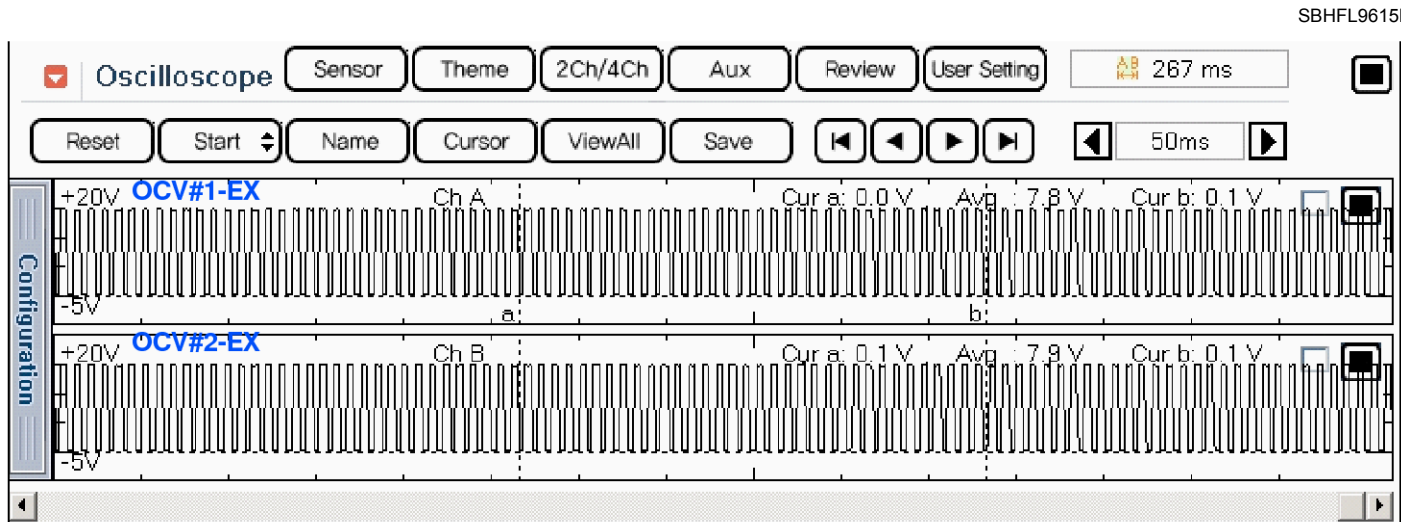
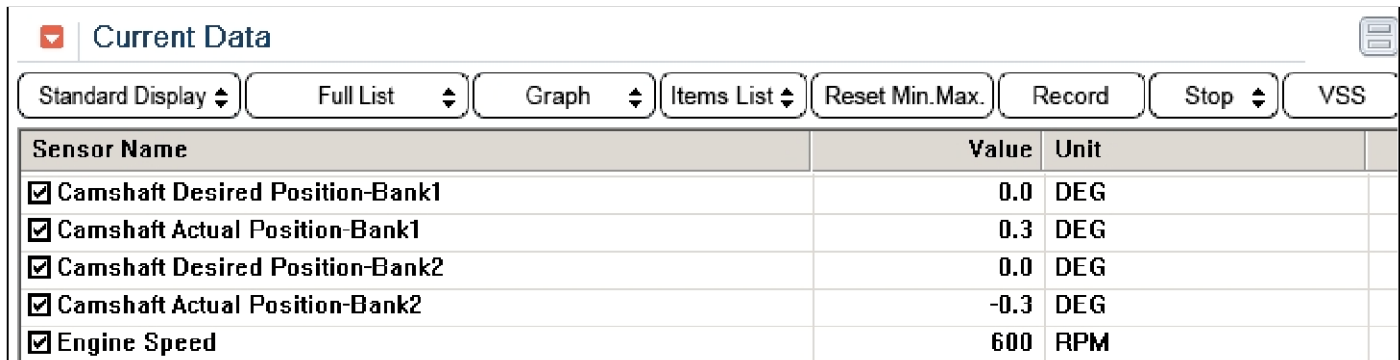


Fig.2

Engine Control System

FL-161

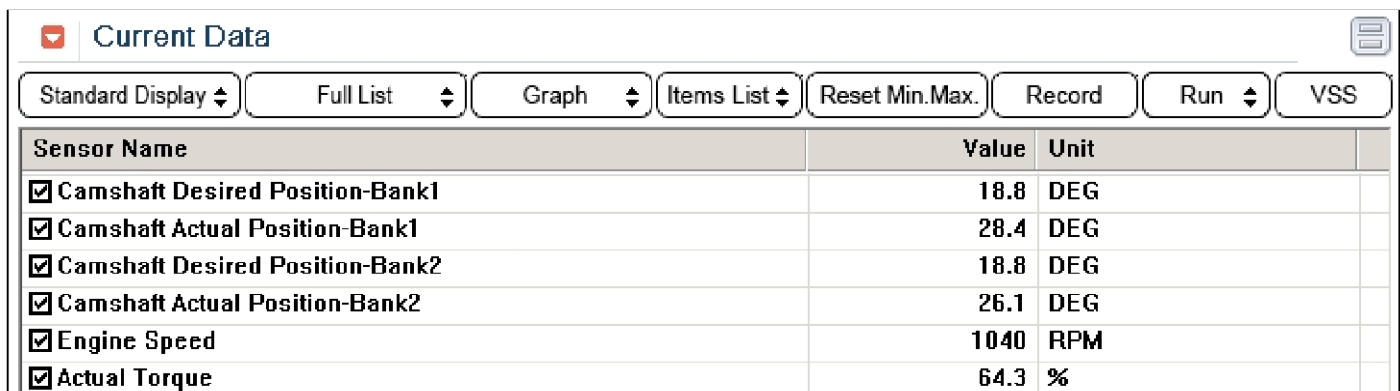


A screenshot of a Scantool software interface showing 'Current Data'. The interface includes a top bar with a red square icon and the text 'Current Data'. Below this is a row of buttons: 'Standard Display', 'Full List', 'Graph', 'Items List', 'Reset Min.Max.', 'Record', 'Stop', and 'VSS'. The main data area is a table with three columns: 'Sensor Name', 'Value', and 'Unit'. The table contains five rows of data, all with checkboxes in the first column. The data is as follows:

Sensor Name	Value	Unit
☒ Camshaft Desired Position-Bank1	0.0	DEG
☒ Camshaft Actual Position-Bank1	0.3	DEG
☒ Camshaft Desired Position-Bank2	0.0	DEG
☒ Camshaft Actual Position-Bank2	-0.3	DEG
☒ Engine Speed	600	RPM

Fig.3

SBHFL9603L



A screenshot of a Scantool software interface showing 'Current Data'. The interface includes a top bar with a red square icon and the text 'Current Data'. Below this is a row of buttons: 'Standard Display', 'Full List', 'Graph', 'Items List', 'Reset Min.Max.', 'Record', 'Run', and 'VSS'. The main data area is a table with three columns: 'Sensor Name', 'Value', and 'Unit'. The table contains six rows of data, all with checkboxes in the first column. The data is as follows:

Sensor Name	Value	Unit
☒ Camshaft Desired Position-Bank1	18.8	DEG
☒ Camshaft Actual Position-Bank1	28.4	DEG
☒ Camshaft Desired Position-Bank2	18.8	DEG
☒ Camshaft Actual Position-Bank2	26.1	DEG
☒ Engine Speed	1040	RPM
☒ Actual Torque	64.3	%

Fig.4

SBHFL9604L

Fig 1) Normal waveform of OCV at idle.

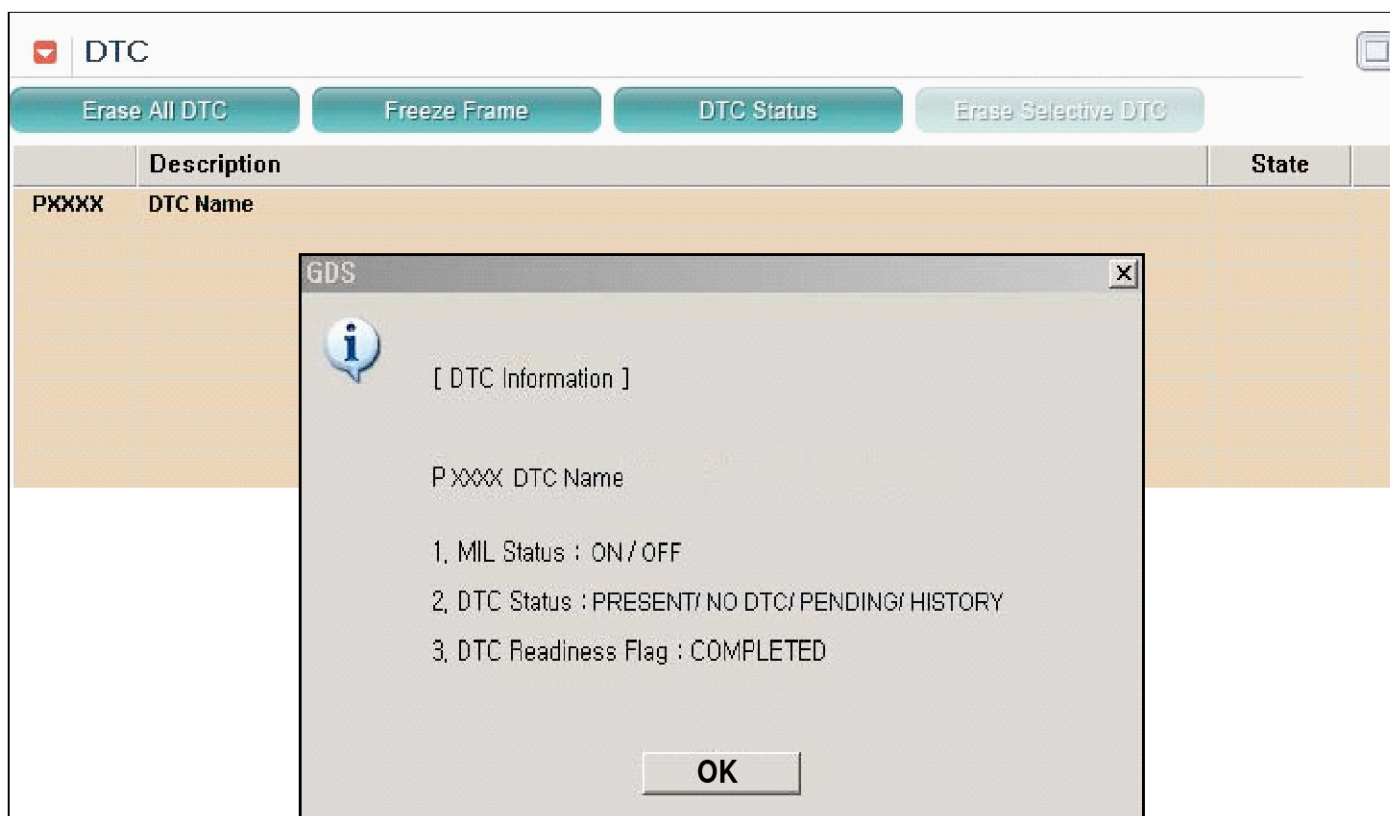
Fig 2) Normal waveform of OCV at acceleration. (3500rpm)

Fig 3) Normal data of IN-CVVT at idle.

Fig 4) Normal data of IN-CVVT at acceleration with load.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Power Circuit Inspection" as follow.

Power Circuit Inspection

Check voltage

- IG "OFF" and disconnect OCV connector.
- IG "ON".
- Measure voltage between power terminal of OCV harness connector and chassis ground.

NOTICE

Be careful not to change the connectors for Bank1 and Bank2

Specification : B+

- Is the measured voltage within specification ?

YES ► Go to "Control Circuit Inspection" procedure.

NO ► Check that Fuse between Main Relay and OCV is open.
 ► Check open between main relay and OCV.
 ► Check short to ground between Main Relay and OCV.
 ► Repair or replace as necessary go to "Verification of Vehicle Repair" procedure.

Engine Control System

FL-163

Control Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect OCV connector.
2. IG "ON".
3. Measure voltage between control terminal of OCV harness connector and chassis ground.

Specification : Approx. below 1V

4. Is the measured voltage within specification ?

YES ▶ Go to "System Inspection" procedure.

NO ▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

System Inspection

■ Visual Inspection

1. Check oil level and oil cleanness is O.K.
2. Check OCV is contaminated.
3. Check that any oil leakage is occurred around OCV.
4. Has a problem been found ?

YES ▶ Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" procedure.

Component Inspection

■ Check OCV resistance

1. IG "OFF" and disconnect OCV connector.
2. Measure resistance between power and signal terminals of OCV. (Component Side)

Specification : 6.7 ~ 7.7 Ω

3. Is the measured resistance within specification?

YES ▶ Go to "Check CAM PHASER with actuation test" as follows.

NO ▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

■ Check CAM PHASER with actuation test

1. Connect scantool and IG "ON"
2. Select "CAM PHASER INTAKE BANK 1" on the Actuation Test
3. Select "OIL CONTROL VALVE" on the Actuation Test
4. Activates "CAM PHASER INTAKE BANK 1" by pressing "START" button
5. Activates "OIL CONTROL VALVE" by pressing "START" button
6. Repeat this procedure 4 or 5 times to ensure CAM PHASER and valve control solenoid reliability

Actuation Test

Test Items

A/C Compressor Relay

Fuel Pump Control

Immobilizer Lamp

Canister Shut Off Valve Clocked

Canister Purge Valve

Oil Control Valve

Ignition Coil-#1

Ignition Coil-#2

Ignition Coil-#3

Ignition Coil-#4

Duration

Until Stop Button

Conditions

IG, ON/ENG, OFF

Result

Start

Stop

SBHFL9606L

Actuation Test

Test Items
Injector-Cylinder 6
Fan PWM
ETC Motor
Variable Intake Manifold 1
Cam Phaser Intake Bank1
Cam Phaser Intake Bank2
Spark Advance/Retard
CAM Phaser Exhaust Bank 1
CAM Phaser Exhaust Bank 2

Duration

Until Stop Button

Conditions

ENG. RUN

Result

Success

Start

Stop

SBHFL9607L

7. Has a problem been found ?

YES ▶ Substitute with a known - good CVVT or O-CV and check for proper operation. If the problem is corrected, replace CVVT or OCV and go to "Verification of Vehicle Repair" procedure.

NO ▶ Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

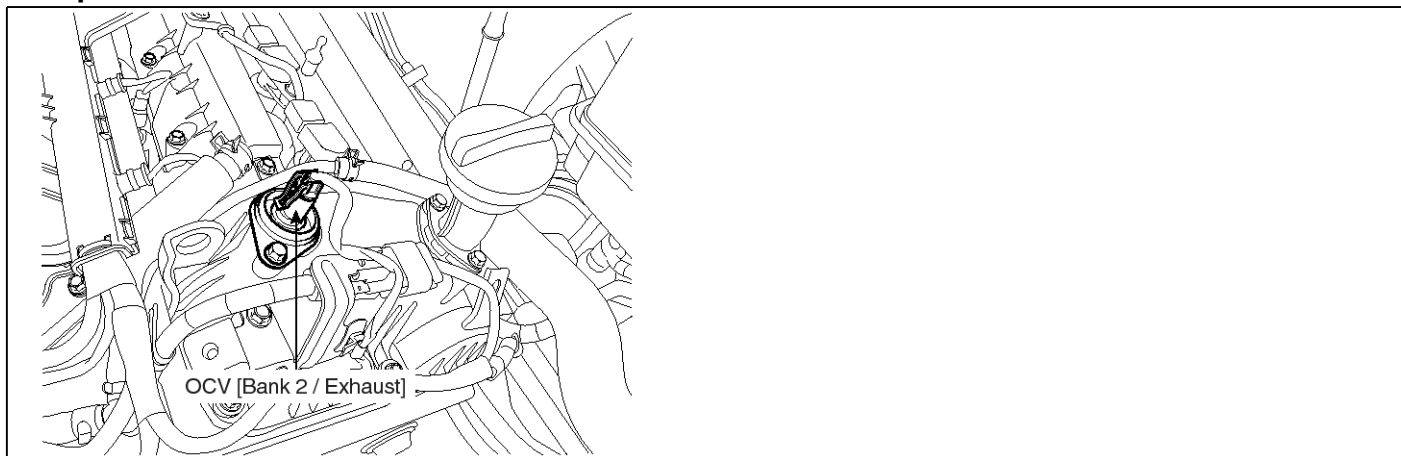
NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-165

P0029 Exhaust Valve Control Solenoid Circuit Range/Performance (Bank 2)

Component Location



SBHFL9322L

General Description

The CVVT (Continuously Variable Valve Timing) system is installed to the chain sprocket of the intake camshaft. This system controls the intake camshaft to provide the optimal valve timing for every driving condition. The ECM controls the Oil Control Valve(OCV), based on the signals output from mass air flow, throttle position and engine coolant temperature. The CVVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft becomes optimal, and the engine torque improves, fuel economy improves, exhaust emissions decrease under overall driving conditions.

DTC Description

ECM monitors OCV stuck while cam sinal is normally generating and Valve cleaning is not in progress .

If the CAM Acutal Position is too high or low and Difference between Cam Actual Positionand Desire Position is higher than 20° ECM determines that a fault exists and a DTC is stored.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		• Determines if oil control valve is stuck	• Oil Pressure Loss • OCV seizure
Enable Conditions		• Valve cleaning not in progress • CAM signal is normally generating	
Threshold value	Case 1	• Cam Actual Position > 50 CAD and Difference between CAM Actual Position and Desire Position > 20 CAD	
	Case 2	• Cam Actual Position < 5 CAD and Difference between CAM Actual Position and Desire Position > 20 CAD	
Diagnosis Time		• Continuous (Within 1min.)	
MIL On Condition		• 2 Driving Cycles	

Specification

OCV	Specification
Coil Resistance (Ω)	6.7 ~ 7.7 (20℃)

FL-168

Fuel System

Current Data			
Standard Display ▾	Full List ▾	Graph ▾	Items List ▾
Reset Min.Max.		Record	Stop ▾
VSS			
Sensor Name	Value	Unit	
☐ EX-Cam Bank1 Desired Position	0	DEG	
☐ EX-Cam Bank1 Actual Position	0	DEG	
☐ EX-Cam Bank2 Desired Position	0	DEG	
☐ EX-Cam Bank2 Actual Position	0	DEG	
☐ EX-Cam Phaser 1 Duty Cycle	0	%	
☐ EX-Cam Phaser 2 Duty Cycle	0	%	

Fig.3

SBHFL9610L

Sensor Name	Value	Unit	
☒ Camshaft Control	ON	-	
☒ Engine Speed	3840	RPM	
☒ EX-Cam Bank1 Actual Position	-15	DEG	
☒ EX-Cam Bank1 Desired Position	-14	DEG	
☒ EX-Cam Bank2 Desired Position	-14	DEG	
☒ EX-Cam Bank2 Actual Position	-15	DEG	
☒ EX-Cam Phaser 1 Duty Cycle	43	%	
☒ EX-Cam Phaser 2 Duty Cycle	44	%	

Fig.4

SBHFL9611L

Engine Control System

FL-169

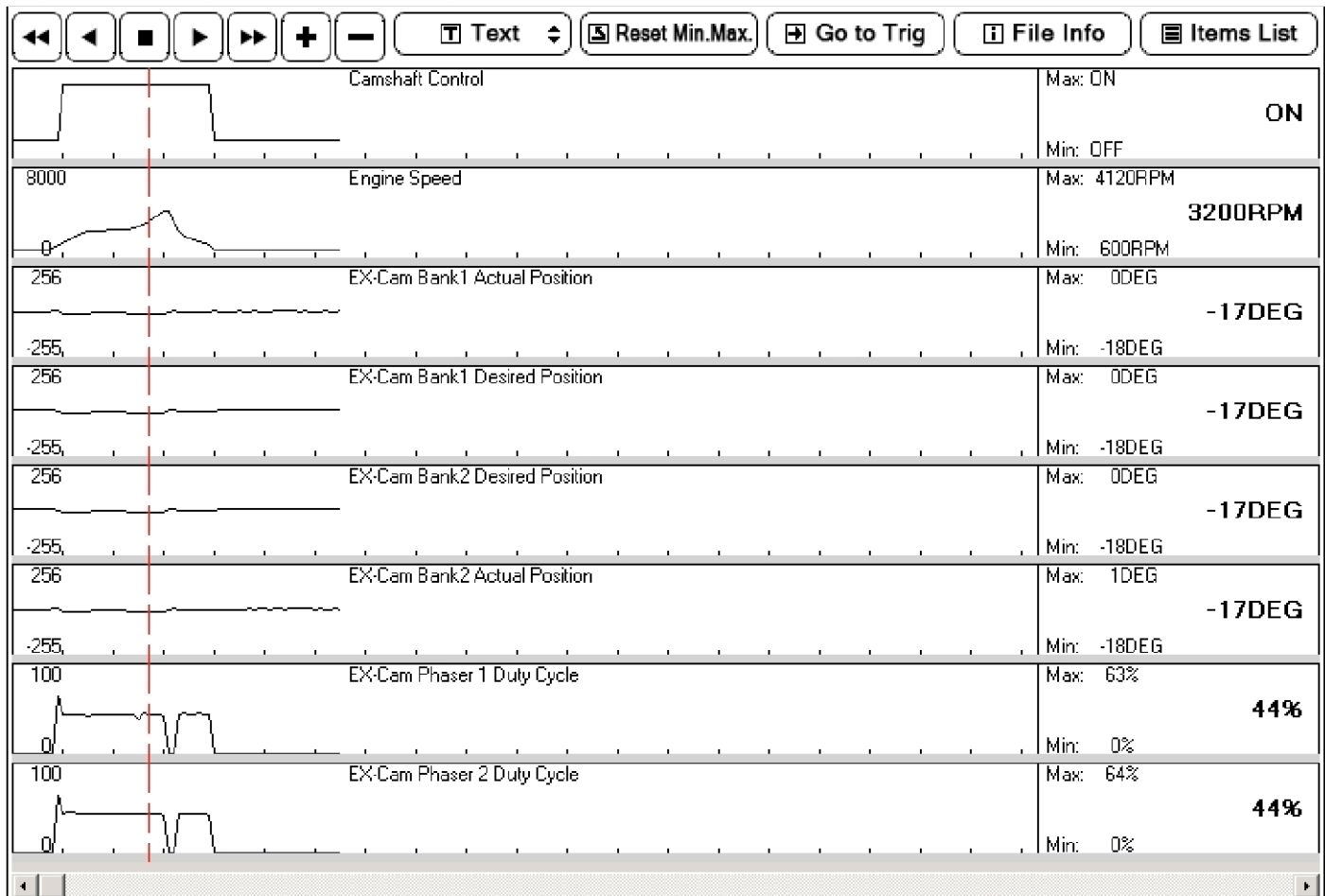


Fig.5

SBHFL9612L

Fig 1) Normal waveform of OCV at idle.

Fig 2) Normal waveform of OCV at acceleration. (3500rpm)

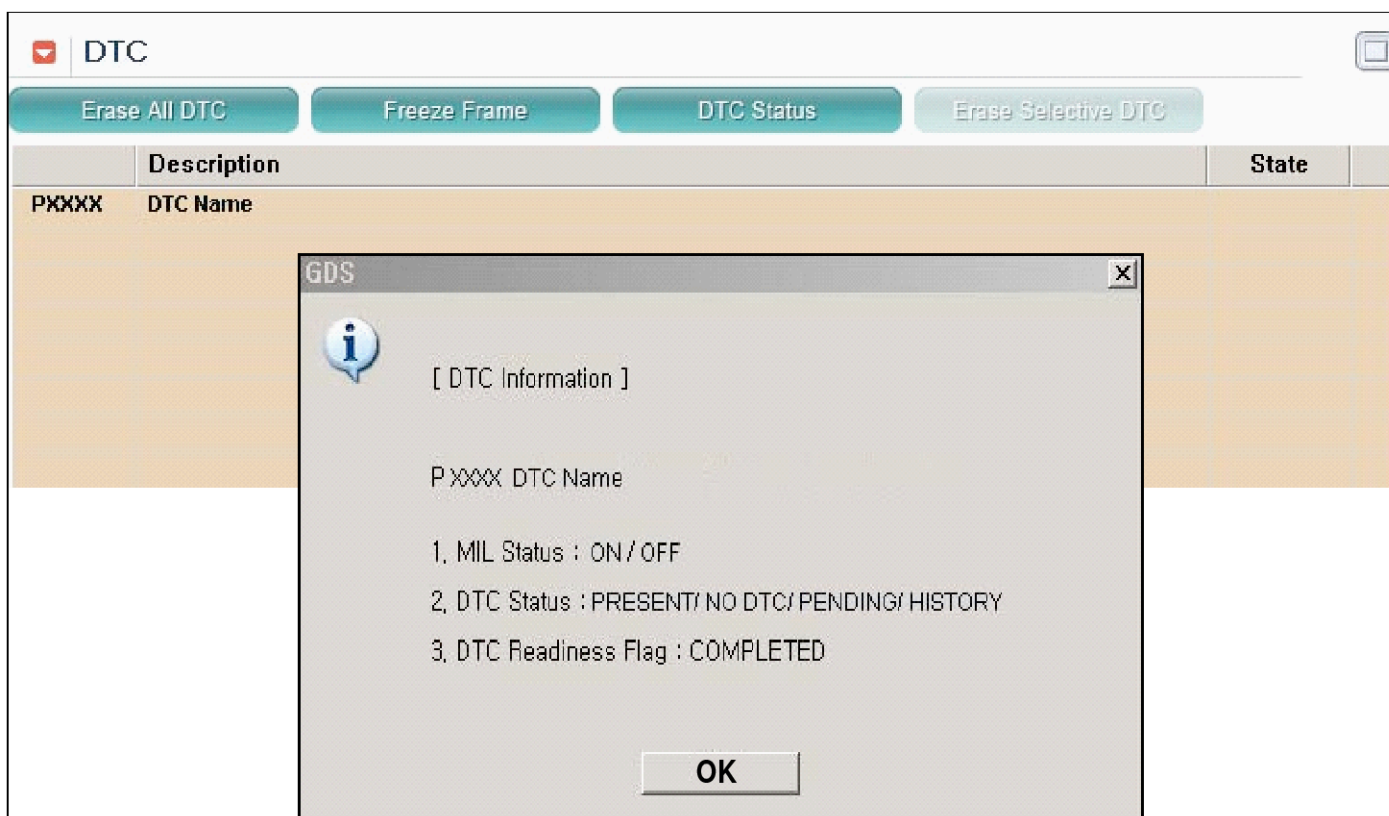
Fig 3) Normal data of IN-CVVT at idle.

Fig 4) Normal data of EX-CVVT at acceleration.

Fig 5) Normal graph of EX-CVVT at acceleration.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Power Circuit Inspection" as follow.

Power Circuit Inspection

Check voltage

- IG "OFF" and disconnect OCV connector.
- IG "ON".
- Measure voltage between power terminal of OCV harness connector and chassis ground.

NOTICE

Be careful not to change the connectors for Bank1 and Bank2

Specification : B+

- Is the measured voltage within specification ?

YES ► Go to "Control Circuit Inspection" procedure.

NO ► Check that Fuse between Main Relay and OCV is open.
 ► Check open between main relay and OCV.
 ► Check short to ground between Main Relay and OCV.
 ► Repair or replace as necessary go to "Verification of Vehicle Repair" procedure.

Engine Control System

FL-171

Control Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect OCV connector.
2. IG "ON".
3. Measure voltage between control terminal of OCV harness connector and chassis ground.

Specification : Approx. below 1V

4. Is the measured voltage within specification ?

YES ▶ Go to "System Inspection" procedure.

NO ▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

System Inspection

■ Visual Inspection

1. Check oil level and oil cleanness is O.K.
2. Check OCV is contaminated.
3. Check that any oil leakage is occurred around OCV.
4. Has a problem been found ?

YES ▶ Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" procedure.

Component Inspection

■ Check OCV resistance

1. IG "OFF" and disconnect OCV connector.
2. Measure resistance between power and signal terminals of OCV. (Component Side)

Specification : 6.7 ~ 7.7 Ω

3. Is the measured resistance within specification?

YES ▶ Go to "Check CAM PHASER with actuation test" as follows.

NO ▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

■ Check CAM PHASER with actuation test

1. Connect scantool and IG "ON"
2. Select "CAM PHASER EXHAUST BANK 2" on the Actuation Test
3. Select "OIL CONTROL VALVE" on the Actuation Test
4. Activates "CAM PHASER EXHAUST BANK 2" by pressing "START" button
5. Activates "OIL CONTROL VALVE" by pressing "START" button
6. Repeat this procedure 4 or 5 times to ensure CAM PHASER and valve control solenoid reliability

Actuation Test

Test Items

A/C Compressor Relay

Fuel Pump Control

Immobilizer Lamp

Canister Shut Off Valve Clocked

Canister Purge Valve

Oil Control Valve

Ignition Coil-#1

Ignition Coil-#2

Ignition Coil-#3

Ignition Coil-#4

Duration

Until Stop Button

Conditions

IG, ON/ENG, OFF

Result

Start

Stop

SBHFL9606L

Actuation Test

Test Items
Injector-Cylinder 6
Fan PWM
ETC Motor
Variable Intake Manifold 1
Cam Phaser Intake Bank1
Cam Phaser Intake Bank2
Spark Advance/Retard
CAM Phaser Exhaust Bank 1
CAM Phaser Exhaust Bank 2

Duration

Until Stop Button

Conditions

ENG. RUN

Result

Success

Start

Stop

SBHFL9607L

7. Has a problem been found ?

YES ▶ Substitute with a known - good CVVT or O-CV and check for proper operation. If the problem is corrected, replace CVVT or OCV and go to "Verification of Vehicle Repair" procedure.

NO ▶ Fault is intermittent. Drive the vehicle to meet the enable condition for the DTC. and Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

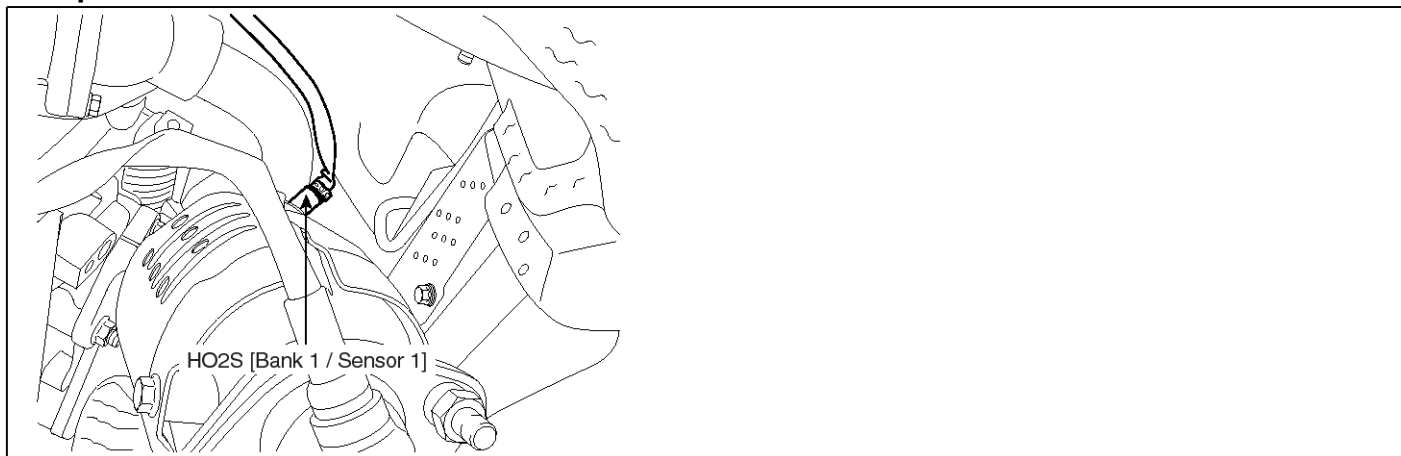
NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-173

P0030 HO2S Heater Control Circuit (Bank 1 / Sensor 1)

Component Location



SBHFL9311L

General Description

The normal operating temperature of the HO2S(Heated Oxygen Sensor) ranges from 350 to 850°C(662 to 1562°F). The HO2S heater greatly decreases the amount of time required for fuel control to become active. The ECM provides a pulse width modulated control circuit to adjust current through the heater. When the HO2S is cold, the value of the resistance is low and the current in the circuit is high. On the contrary, if the temperature in the resistor of the sensor rises, the current drops gradually.

DTC Description

Checking current from HO2S under detecting condition,if the heater current is below a certain threshold for more than predetermine time, ECM sets P0030. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Monitor the current through the heater	• Poor Connection • HO2S(B1/S1) • ECM
Enable Conditions	• Engine Running > 60 sec • Heater Duty Cycle > 40% • Max. Duty Cycle - Min. Duty Cycle < 5%	
Threshold value	• Filtered Heater Current < threshold value	
Diagnosis Time	• Continuous (More than 2.5 second failure for every 5 second test)	
MIL On Condition	• 2 Driving Cycles	

Specification

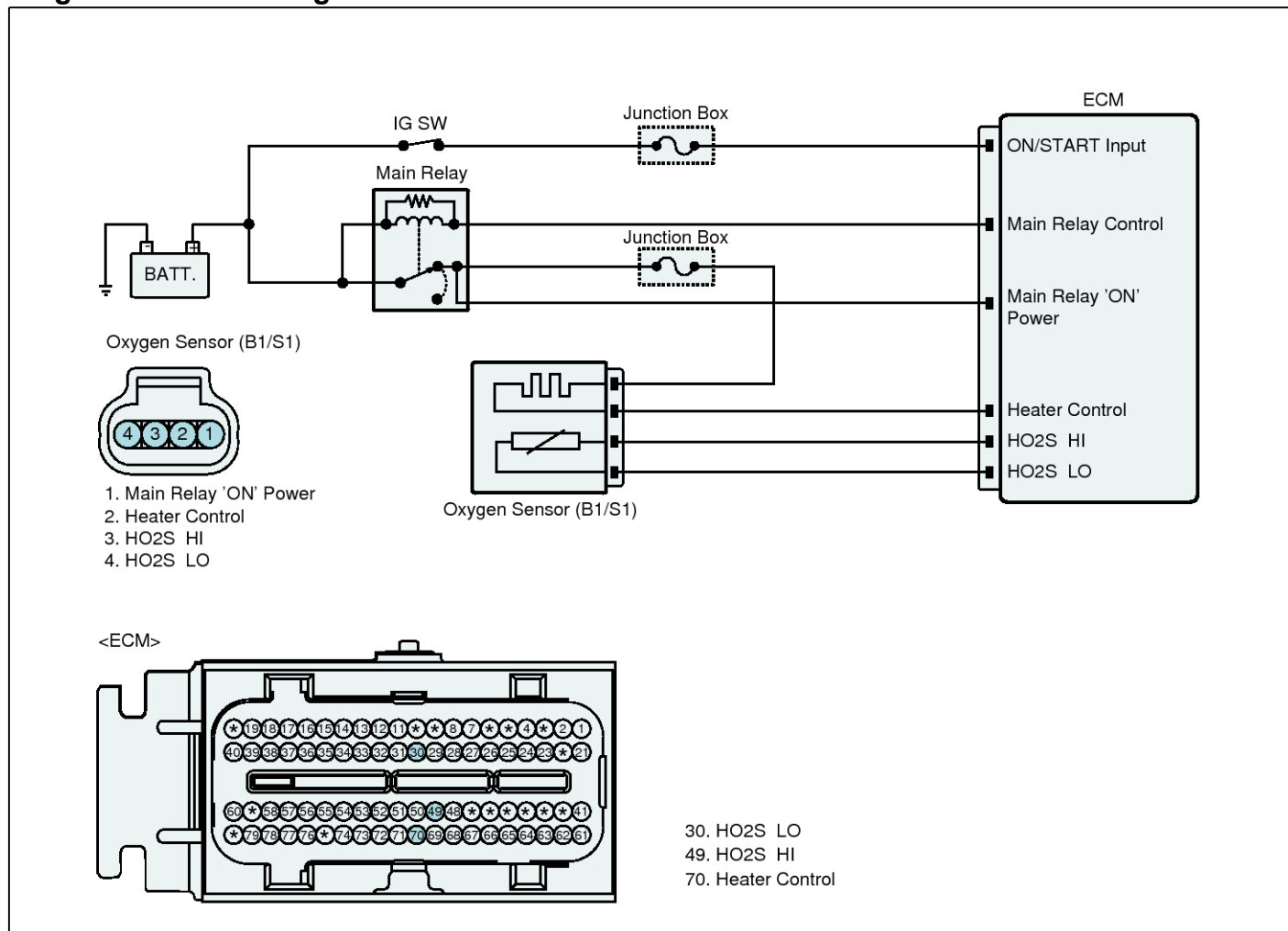
(Reference only)

Condition	Current(A)
Heater Current at 13.5V, 450 °C(842°F) Exhaust	0.52 ± 0.1

FL-174

Fuel System

Diagnostic Circuit Diagram



SBHFL9508L

Signal Waveform & Data

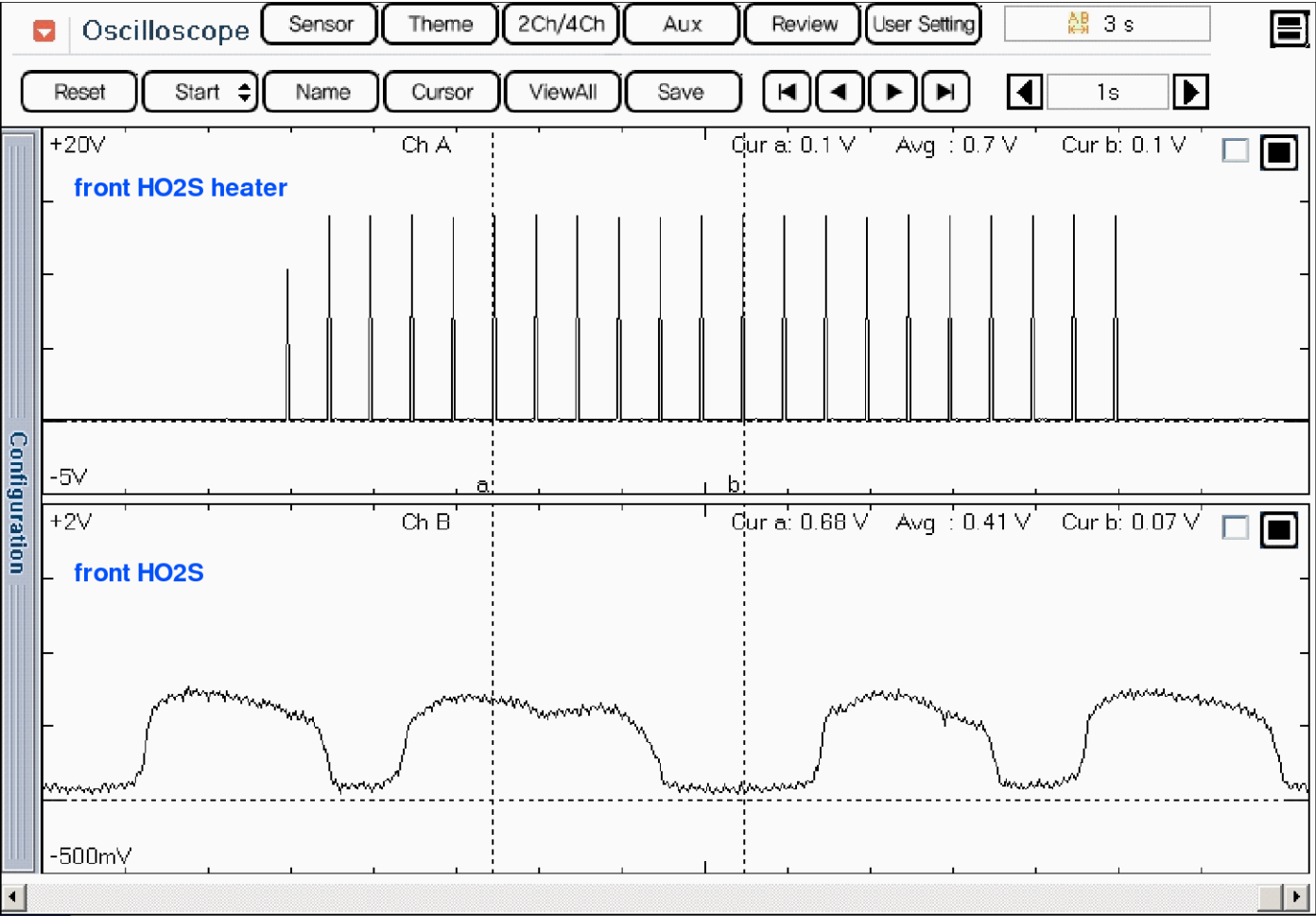


Fig.1

SBHFL9617L

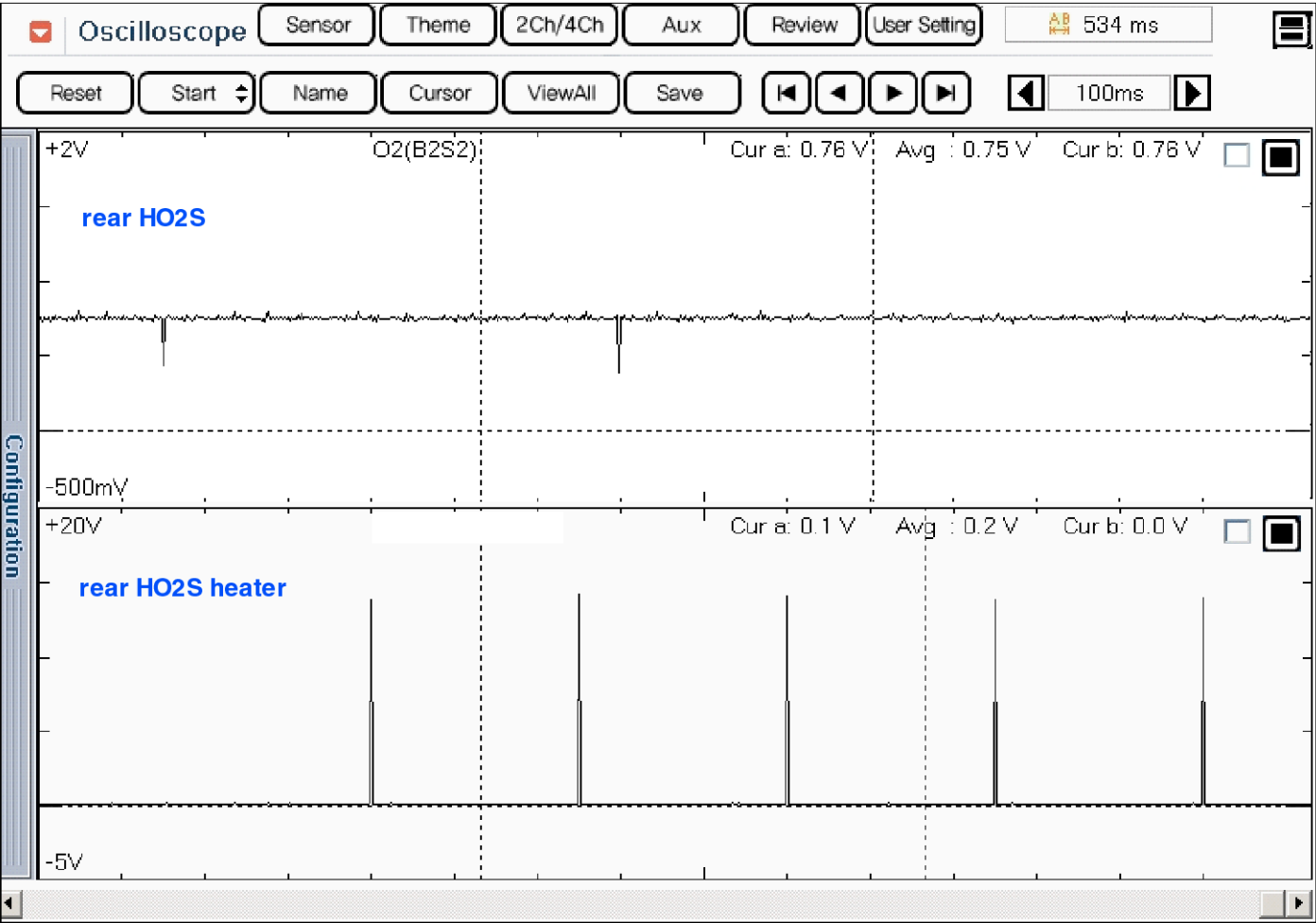


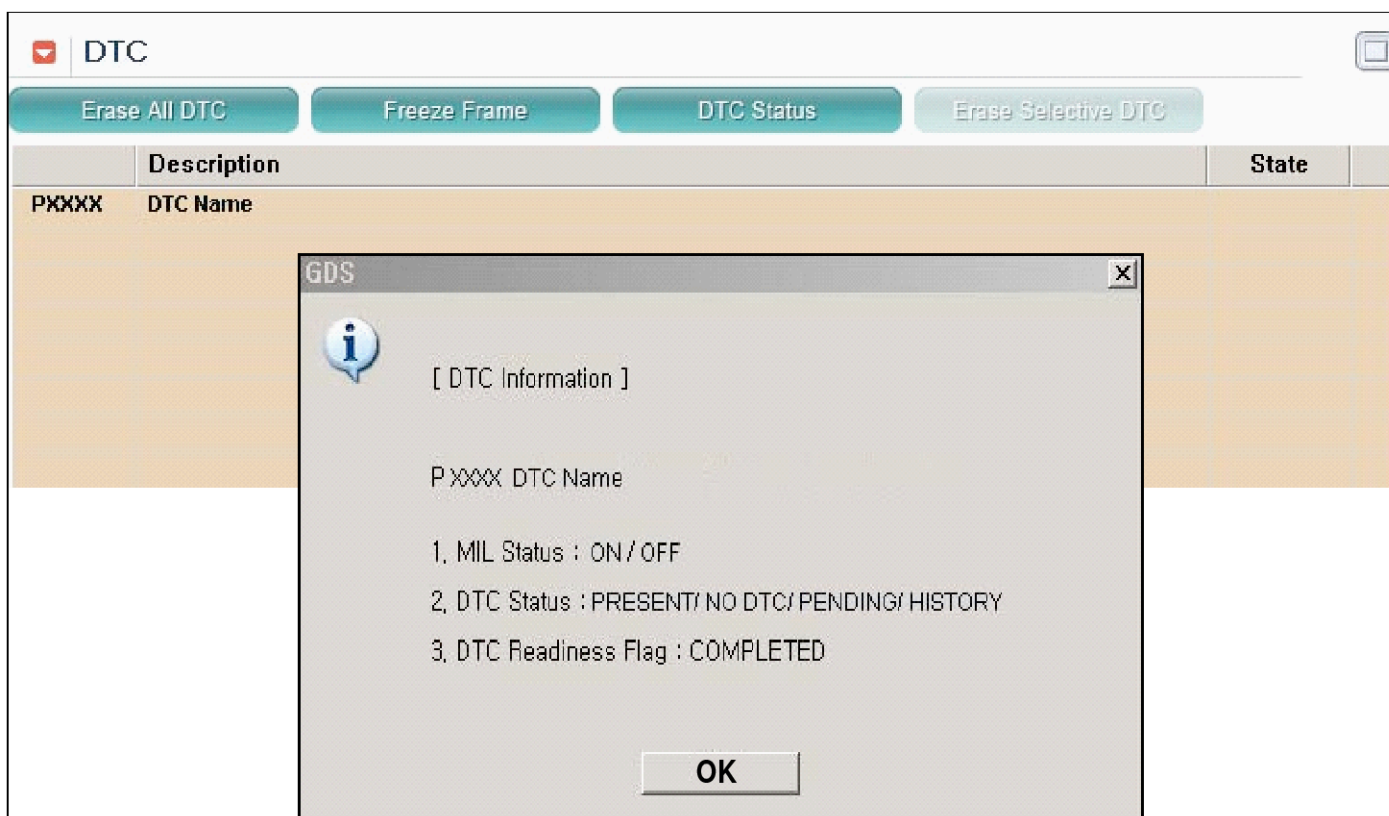
Fig.2

SBHFL9618L

Sensor Name	Value	Unit
☒ Oxygen Sensor Heater Duty-Bank1/Sensor1	0.5	A
☒ Oxygen Sensor Heater Duty-Bank1/Sensor1	97	%
☒ Oxygen Sensor Heater Duty-Bank1/Sensor2	0.5	A
☒ Oxygen Sensor Heater Duty-Bank2/Sensor1	0.5	A
☒ Oxygen Sensor Heater Duty-Bank1/Sensor2	100	%
☒ Oxygen Sensor Heater Duty-Bank2/Sensor1	97	%
☒ Oxygen Sensor Heater Duty-Bank2/Sensor2	0.6	A
☒ Oxygen Sensor Heater Duty-Bank2/Sensor2	100	%

Fig.3

SBHFL9619L



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Component Inspection" procedure.

Component Inspection

■ Check HO2S(B1/S1) Heater resistance

1. IG "OFF" and disconnect HO2S(B1/S1) connector
2. Measure resistance between power and control terminals of HO2S(B1/S1) heater(Component Side)

Specification : 8.1 ~ 11.1 Ω at 21°C(69.8°F)

3. Is the measured resistance within specification?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Engine Control System

FL-179

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

FL-180

Fuel System

P0031 HO2S Heater Control Circuit Low (Bank 1 / Sensor 1)

Component Location

Refer to DTC P0030 : HO2S Heater Control Circuit (Bank 1/Sensor 1)

General Description

Refer to DTC P0030 : HO2S Heater Control Circuit (Bank 1/Sensor 1)

DTC Description

If the ECM detects short to ground or open in heater under detecting conditions, ECM sets P0031. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Detects a short to ground or open	- Poor Connection - Open in Power Circuit - Open or short to ground in control circuit - HO2S(B1/S1) - ECM
Enable Conditions	- No disabling Faults - Engine Running $11V \leq \text{Battery Voltage} \leq 16V$	
Threshold value	Short to ground or open circuit	
Diagnosis Time	Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	2 Driving Cycles	

Specification

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21°C(69.8°F)

Diagnostic Circuit Diagram

Refer to DTC P0030 : HO2S Heater Control Circuit (Bank 1/Sensor 1)

Signal Waveform & Data

Refer to DTC P0030 : HO2S Heater Control Circuit (Bank 1/Sensor 1)

Monitor Scantool Data

Refer to DTC P0030 : HO2S Heater Control Circuit (Bank 1/Sensor 1)

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Power Circuit Inspection " procedure

Power Circuit Inspection

■ Check voltage

- IG "OFF" & Disconnect HO2S(B1/S1) connector.
- IG "ON".
- Measure voltage between power terminal of HO2S(B1/S1) heater harness connector and chassis ground.

Specification : B+

- Is the measured voltage within specification ?

YES ► Go to " Control Circuit Inspection " procedure.

NO ► Repair open or short to ground in HO2S(B1/S1) Heater power circuit then, go to "Verification of Vehicle Repair" procedure.

Control Circuit Inspection

■ Check short to ground

- IG "OFF" & Disconnect HO2S(B1/S1) connector.
- Measure resistance between control terminal of HO2S(B1/S1) heater harness connector and chassis ground.

Engine Control System

FL-181

Specification : Infinite

3. Is the measured resistance within specification ?

YES ▶ Go to " Control Circuit Inspection " procedure.

NO ▶ Repair short to ground in HO2S (B1/S1) heater control circuit and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect HO2S(B1/S1) and ECM connector.
2. Measure resistance between control terminal of HO2S(B1/S1) heater harness connector and heater control terminal of ECM harness connector.

Specification : Approx. below 1Ω

3. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in HO2S(B1/S1) heater control circuit and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check HO2S(B1/S1) Heater resistance

1. IG "OFF" and disconnect HO2S(B1/S1) connector
2. Measure resistance between power and control terminals of HO2S(B1/S1) heater(Component Side)

Specification : 8.1 ~ 11.1 Ω at 21°C(69.8°F)

3. Is the measured resistance within specification?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0030 : HO2S Heater Control Circuit (Bank 1/Sensor 1)

FL-182

Fuel System

P0032 HO2S Heater Control Circuit High (Bank 1 / Sensor 1)

Component Location

Refer to DTC P0030 : HO2S Heater Control Circuit (Bank 1/Sensor 1)

General Description

Refer to DTC P0030 : HO2S Heater Control Circuit (Bank 1/Sensor 1)

DTC Description

If the ECM detects short to battery in heater under detecting conditions, ECM sets P0032. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Detects a short to battery	- Poor Connection - Short to battery in control circuit - HO2S(B1/S1) - ECM
Enable Conditions	- No disabling Faults - Engine Running $11V \leq \text{Battery Voltage} \leq 16V$	
Threshold value	Short to battery	
Diagnosis Time	Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	2 Driving Cycles	

Specification

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21°C(69.8°F)

Diagnostic Circuit Diagram

Refer to DTC P0030 : HO2S Heater Control Circuit (Bank 1/Sensor 1)

Signal Waveform & Data

Refer to DTC P0030 : HO2S Heater Control Circuit (Bank 1/Sensor 1)

Monitor Scantool Data

Refer to DTC P0030 : HO2S Heater Control Circuit (Bank 1/Sensor 1)

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Control Circuit Inspection " procedure.

Control Circuit Inspection

■ Check voltage

- IG "OFF" & Disconnect HO2S(B1/S1) connector.
- IG "ON".
- Measure voltage between control terminal of HO2S(B1/S1) heater harness connector and chassis ground.

Specification : Approx. 0 V

- Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short to battery in HO2S(B1/S1) Heater control circuit and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check HO2S(B1/S1) Heater resistance

- IG "OFF" and disconnect HO2S(B1/S1) connector
- Measure resistance between power and control terminals of HO2S(B1/S1) heater(Component Side)

Specification : 8.1 ~ 11.1 Ω at 21°C(69.8°F)

Engine Control System

FL-183

3. Is the measured resistance within specification?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

 NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0030 : HO2S Heater Control Circuit (Bank 1/Sensor 1)

FL-184

Fuel System

P0036 HO2S Heater Control Circuit (Bank 1 / Sensor 2)

Component Location



SBHFL9312L

General Description

The normal operating temperature of the HO2S(Heated Oxygen Sensor) ranges from 350 to 850°C(662 to 1562°F). The HO2S heater greatly decreases the amount of time required for fuel control to become active. The ECM provides a pulse width modulated control circuit to adjust current through the heater. When the HO2S is cold, the value of the resistance is low and the current in the circuit is high. On the contrary, if the temperature in the resistor of the sensor rises, the current drops gradually.

DTC Description

Checking current from HO2S under detecting condition,if the heater current is below a certain threshold for more than predetermine time, ECM sets P0036. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Monitor the current through the heater	• Poor Connection • HO2S(B1/S2) • ECM
Enable Conditions	• Engine Running > 60 sec. • Heater Duty Cycle > 40% • Max. Duty Cycle - Min. Duty Cycle < 5%	
Threshold value	• Filtered Heater Current < threshold value	
Diagnosis Time	• Continuous (More than 2.5 second failure for every 5 second test)	
MIL On Condition	• 2 Driving Cycles	

Specification

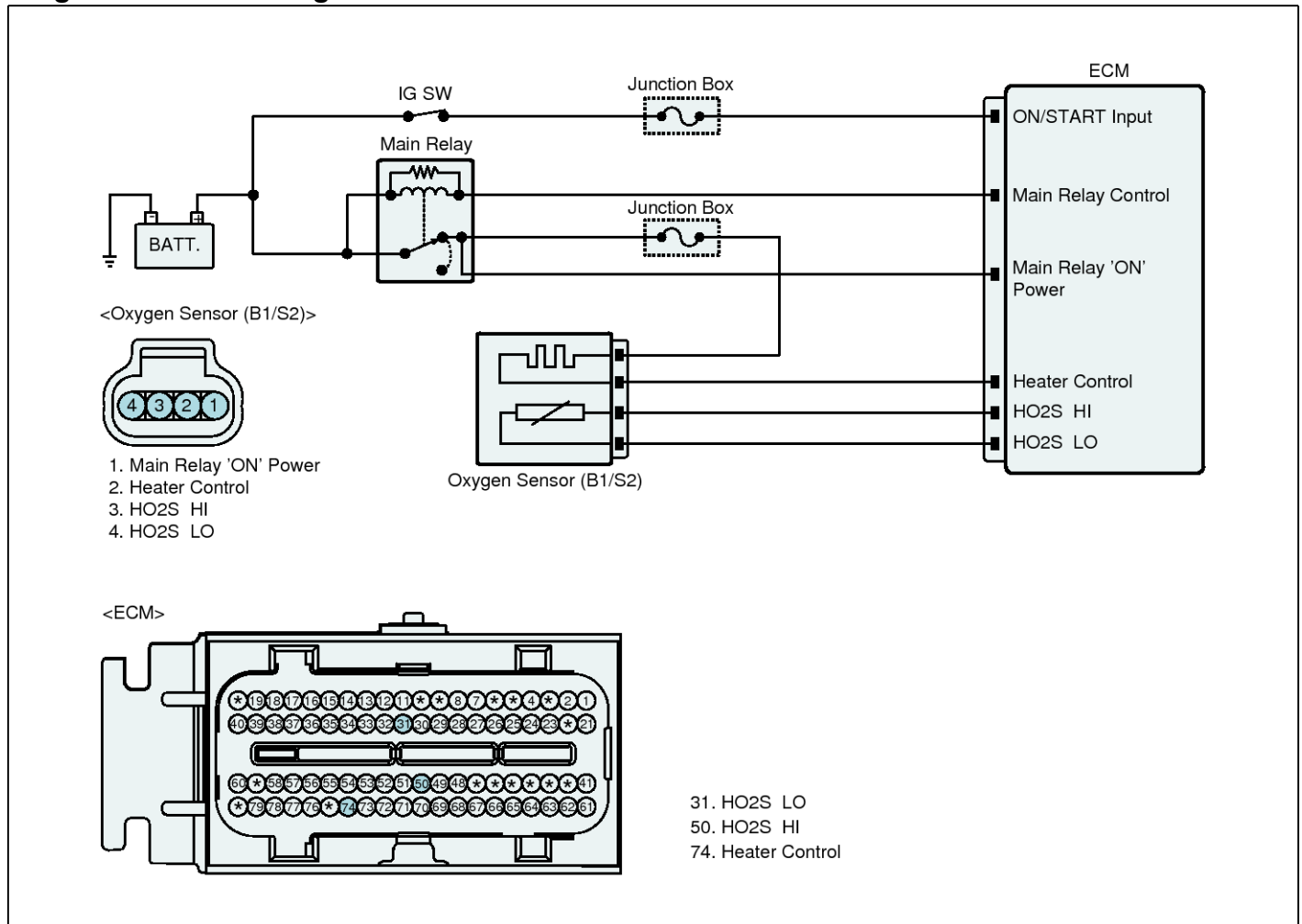
(Reference only)

Condition	Current(A)
Heater Current at 13.5V, 450 °C(842°F) Exhaust	0.52 ± 0.1

Engine Control System

FL-185

Diagnostic Circuit Diagram



SBHFL9509L

Signal Waveform & Data

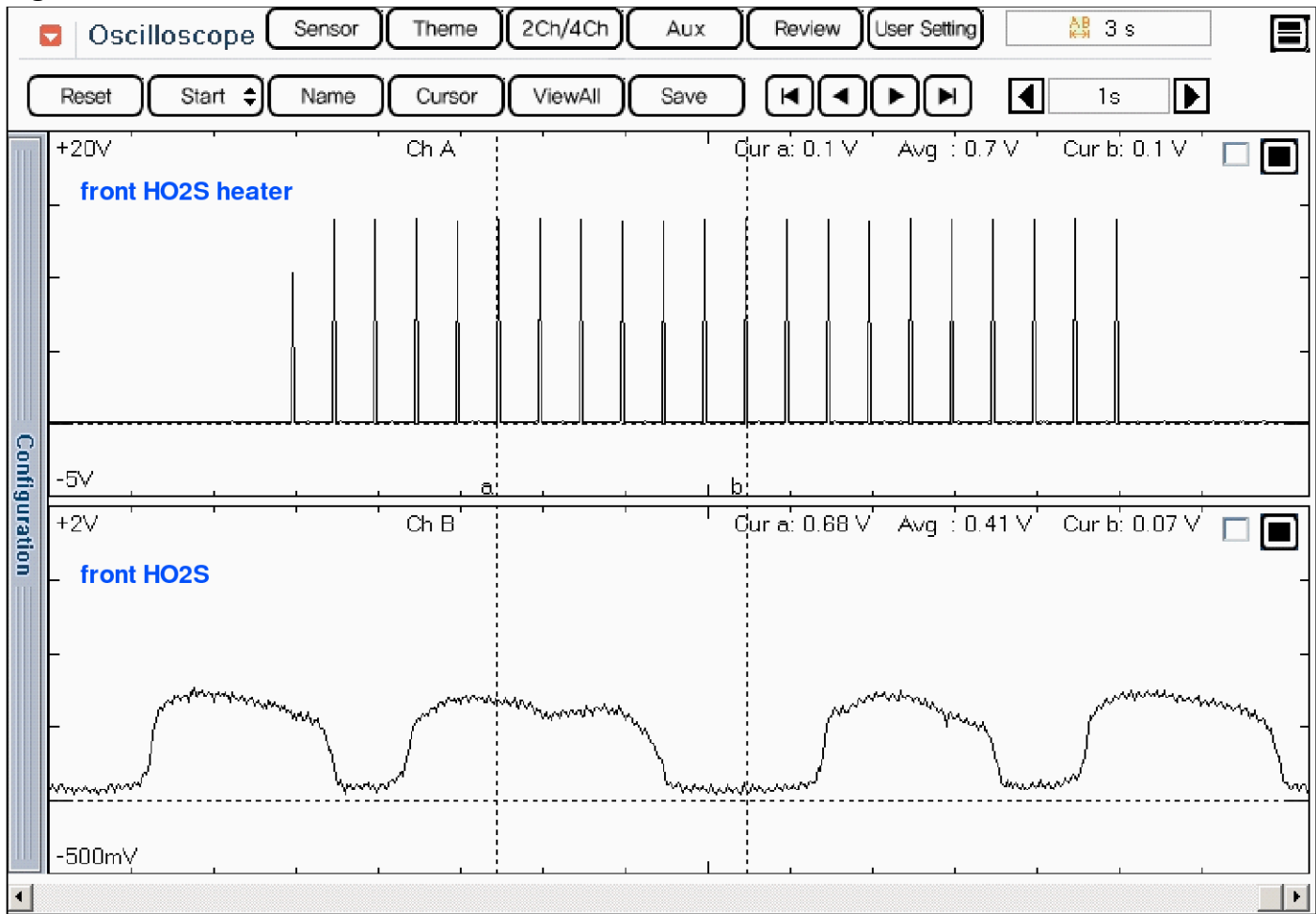


Fig.1

SBHFL9617L

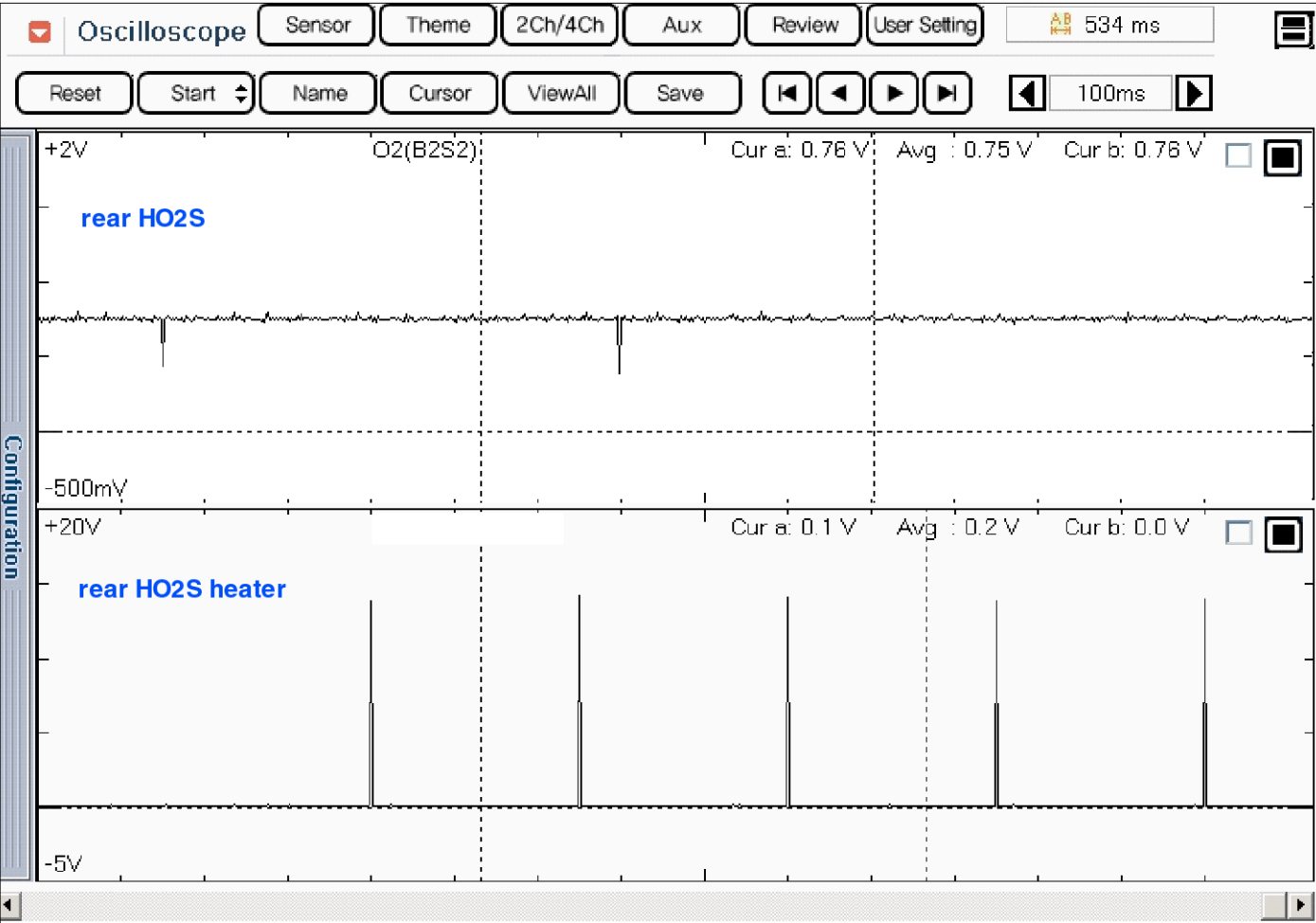


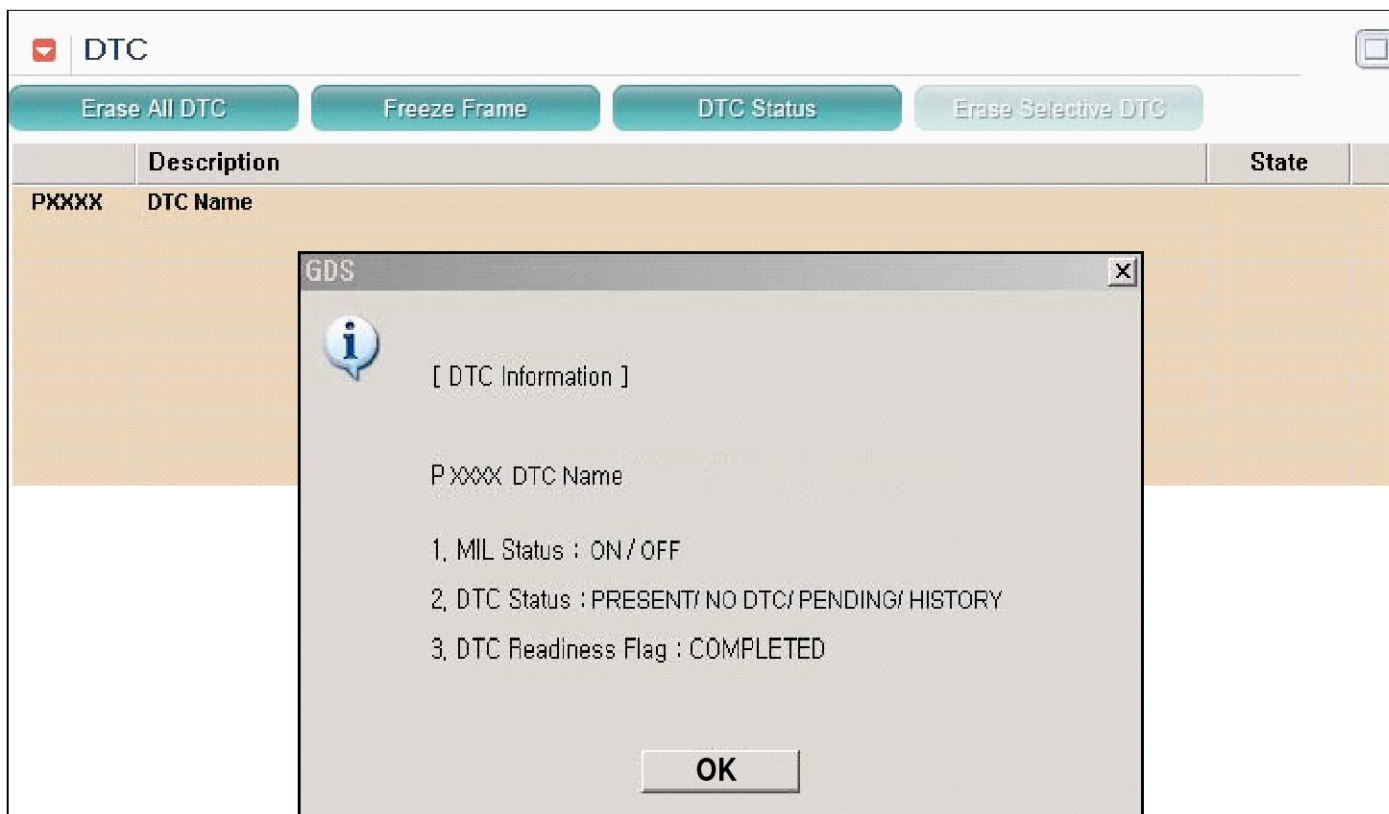
Fig.2

SBHFL9618L

Sensor Name	Value	Unit
☒ Oxygen Sensor Heater Duty-Bank1/Sensor1	0.5	A
☒ Oxygen Sensor Heater Duty-Bank1/Sensor1	97	%
☒ Oxygen Sensor Heater Duty-Bank1/Sensor2	0.5	A
☒ Oxygen Sensor Heater Duty-Bank2/Sensor1	0.5	A
☒ Oxygen Sensor Heater Duty-Bank1/Sensor2	100	%
☒ Oxygen Sensor Heater Duty-Bank2/Sensor1	97	%
☒ Oxygen Sensor Heater Duty-Bank2/Sensor2	0.6	A
☒ Oxygen Sensor Heater Duty-Bank2/Sensor2	100	%

Fig.3

SBHFL9619L



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ▶ Go to "Terminal and Connector inspection" procedure.

NO ▶ Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" procedure.

Component Inspection

Check HO2S(B1/S2) Heater resistance

1. IG "OFF" and disconnect HO2S(B1/S2) connector
2. Measure resistance between power and control terminals of HO2S(B1/S2) heater(Component Side)

Specification : 8.1 ~ 11.1 Ω at 21℃(69.8°F)

3. Is the measured resistance within specification?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-191

P0037 HO2S Heater Control Circuit Low (Bank 1 / Sensor 2)

Component Location

Refer to DTC P0036 : HO2S Heater Control Circuit (Bank 1/Sensor 2)

General Description

Refer to DTC P0036 : HO2S Heater Control Circuit (Bank 1/Sensor 2)

DTC Description

If the ECM detects short to ground or open in heater under detecting conditions, ECM sets P0037. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Detects a short to ground or open	- Poor Connection - Open in Power Circuit - Open or short to ground in control circuit - HO2S(B1/S2) - ECM
Enable Conditions	- No disabling Faults - Engine Running $11V \leq \text{Battery Voltage} \leq 16V$	
Threshold value	Short to ground or open circuit	
Diagnosis Time	Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	2 Driving Cycles	

Specification

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21°C(69.8°F)

Diagnostic Circuit Diagram

Refer to DTC P0036 : HO2S Heater Control Circuit (Bank 1/Sensor 2)

Signal Waveform & Data

Refer to DTC P0036 : HO2S Heater Control Circuit (Bank 1/Sensor 2)

Monitor Scantool Data

Refer to DTC P0036 : HO2S Heater Control Circuit (Bank 1/Sensor 2)

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Power Circuit Inspection " procedure

Power Circuit Inspection

■ Check voltage

- IG "OFF" & Disconnect HO2S(B1/S2) connector.
- IG "ON".
- Measure voltage between power terminal of HO2S(B1/S2) heater harness connector and chassis ground.

Specification : B+

- Is the measured voltage within specification ?

YES ► Go to " Control Circuit Inspection " procedure.

NO ► Repair open or short to ground in HO2S(B1/S2) Heater power circuit then, go to "Verification of Vehicle Repair" procedure.

Control Circuit Inspection

■ Check short to ground

- IG "OFF" & Disconnect HO2S(B1/S2) connector.
- Measure resistance between control terminal of HO2S(B1/S2) heater harness connector and chassis ground.

FL-192

Fuel System

Specification : Infinite

3. Is the measured resistance within specification ?

YES ▶ Go to " Control Circuit Inspection " procedure.

NO ▶ Repair short to ground in HO2S(B1/S2) heater control circuit and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect HO2S(B1/S2) and ECM connector.
2. Measure resistance between control terminal of HO2S(B1/S2) heater harness connector and heater control terminal of ECM harness connector.

Specification : Approx. below 1Ω

3. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in HO2S(B1/S2) heater control circuit and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check HO2S(B1/S2) Heater resistance

1. IG "OFF" and disconnect HO2S(B1/S2) connector
2. Measure resistance between power and control terminals of HO2S(B1/S2) heater(Component Side)

Specification : 8.1 ~ 11.1 Ω at 21°C(69.8°F)

3. Is the measured resistance within specification?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0036 : HO2S Heater Control Circuit (Bank 1/Sensor 2)

Engine Control System

FL-193

P0038 HO2S Heater Control Circuit High (Bank 1 / Sensor 2)

Component Location

Refer to DTC P0036 : HO2S Heater Control Circuit (Bank 1/Sensor 2)

General Description

Refer to DTC P0036 : HO2S Heater Control Circuit (Bank 1/Sensor 2)

DTC Description

If the ECM detects short to battery in heater under detecting conditions, ECM sets P0038. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Detects a short to battery	- Poor Connection - Short to battery in control circuit - HO2S(B1/S2) - ECM
Enable Conditions	- No disabling Faults - Engine Running $11V \leq \text{Battery Voltage} \leq 16V$	
Threshold value	Short to battery	
Diagnosis Time	Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	2 Driving Cycles	

Specification

Heater	
Resistance (Ω)	$8.1 \sim 11.1 \Omega$ at $21^{\circ}\text{C}(69.8^{\circ}\text{F})$

Diagnostic Circuit Diagram

Refer to DTC P0036 : HO2S Heater Control Circuit (Bank 1/Sensor 2)

Signal Waveform & Data

Refer to DTC P0036 : HO2S Heater Control Circuit (Bank 1/Sensor 2)

Monitor Scantool Data

Refer to DTC P0036 : HO2S Heater Control Circuit (Bank 1/Sensor 2)

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Control Circuit Inspection " procedure.

Control Circuit Inspection

■ Check voltage

- IG "OFF" & Disconnect HO2S(B1/S2) connector.
- IG "ON".
- Measure voltage between control terminal of HO2S(B1/S2) heater harness connector and chassis ground.

Specification : Approx. 0 V

- Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short to battery in HO2S(B1/S2) Heater control circuit and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check HO2S(B1/S2) Heater resistance

- IG "OFF" and disconnect HO2S(B1/S2) connector
- Measure resistance between power and control terminals of HO2S(B1/S2) heater(Component Side)

Specification : $8.1 \sim 11.1 \Omega$ at $21^{\circ}\text{C}(69.8^{\circ}\text{F})$

3. Is the measured resistance within specification?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

 NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

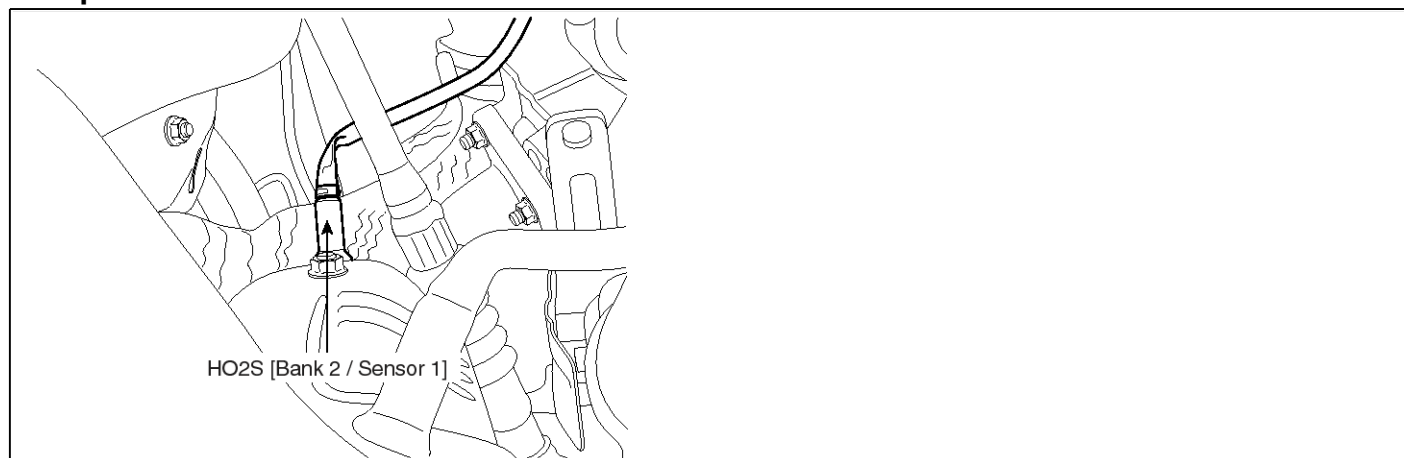
Refer to DTC P0036 : HO2S Heater Control Circuit (Bank 1/Sensor 2)

Engine Control System

FL-195

P0050 HO2S Heater Control Circuit (Bank 2 / Sensor 1)

Component Location



SBHFL9313L

General Description

The normal operating temperature of the HO2S(Heated Oxygen Sensor) ranges from 350 to 850°C(662 to 1562°F). The HO2S heater greatly decreases the amount of time required for fuel control to become active. The ECM provides a pulse width modulated control circuit to adjust current through the heater. When the HO2S is cold, the value of the resistance is low and the current in the circuit is high. On the contrary, if the temperature in the resistor of the sensor rises, the current drops gradually.

DTC Description

Checking current from HO2S under detecting condition,if the heater current is below a certain threshold for more than predetermine time, ECM sets P0050. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

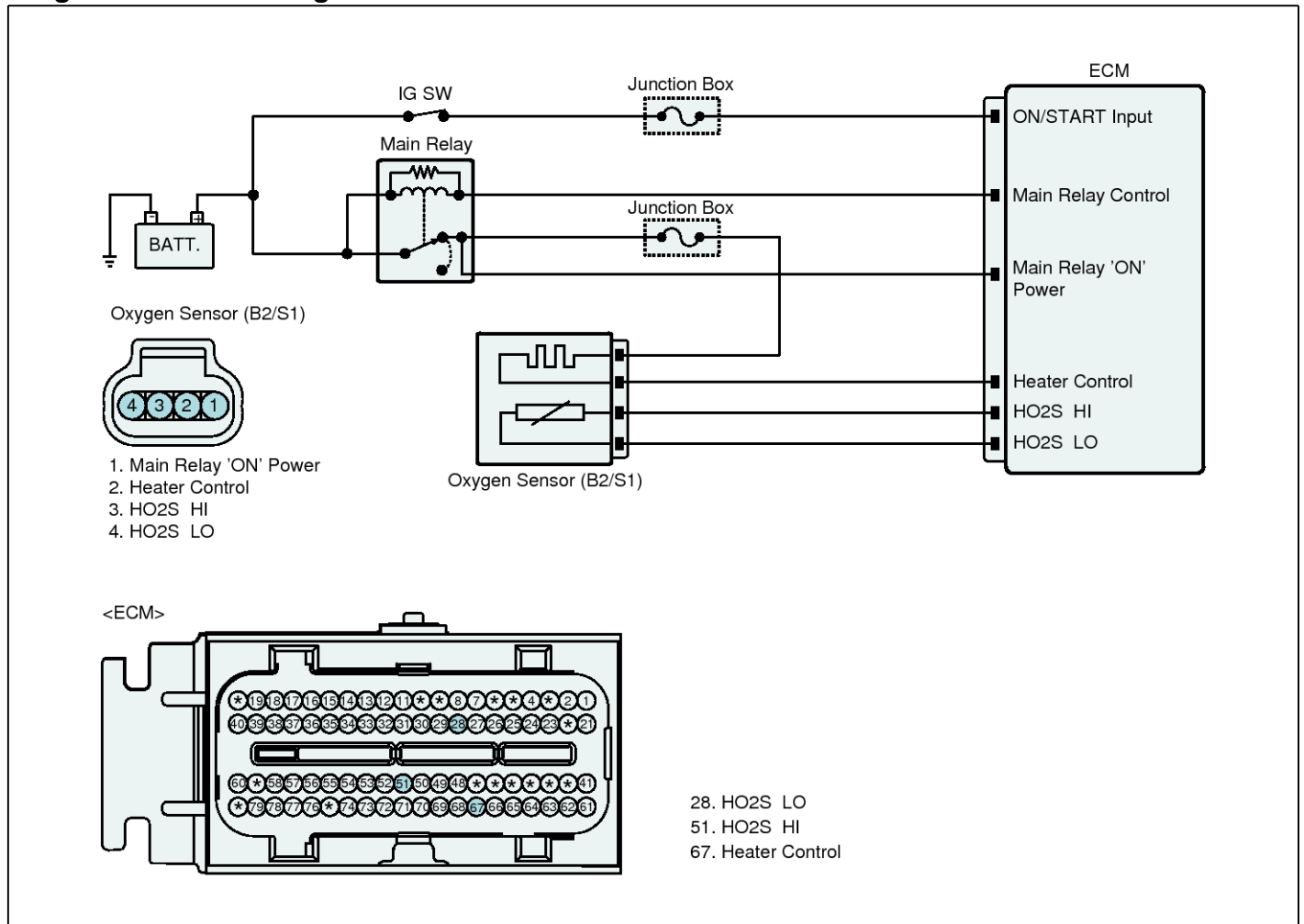
Item	Detecting Condition	Possible Cause
DTC Strategy	• Monitor the current through the heater	• Poor Connection • HO2S(B2/S1) • ECM
Enable Conditions	• Engine Running > 60 sec • Heater Duty Cycle > 40% • Max. Duty Cycle - Min. Duty Cycle < 5%	
Threshold value	• Filtered Heater Current < threshold value	
Diagnosis Time	• Continuous (More than 2.5 second failure for every 5 second test)	
MIL On Condition	• 2 Driving Cycles	

Specification

(Reference only)

Condition	Current(A)
Heater Current at 13.5V, 450 °C(842°F) Exhaust	0.52 ± 0.1

Diagnostic Circuit Diagram



SBHFL9510L

Signal Waveform & Data

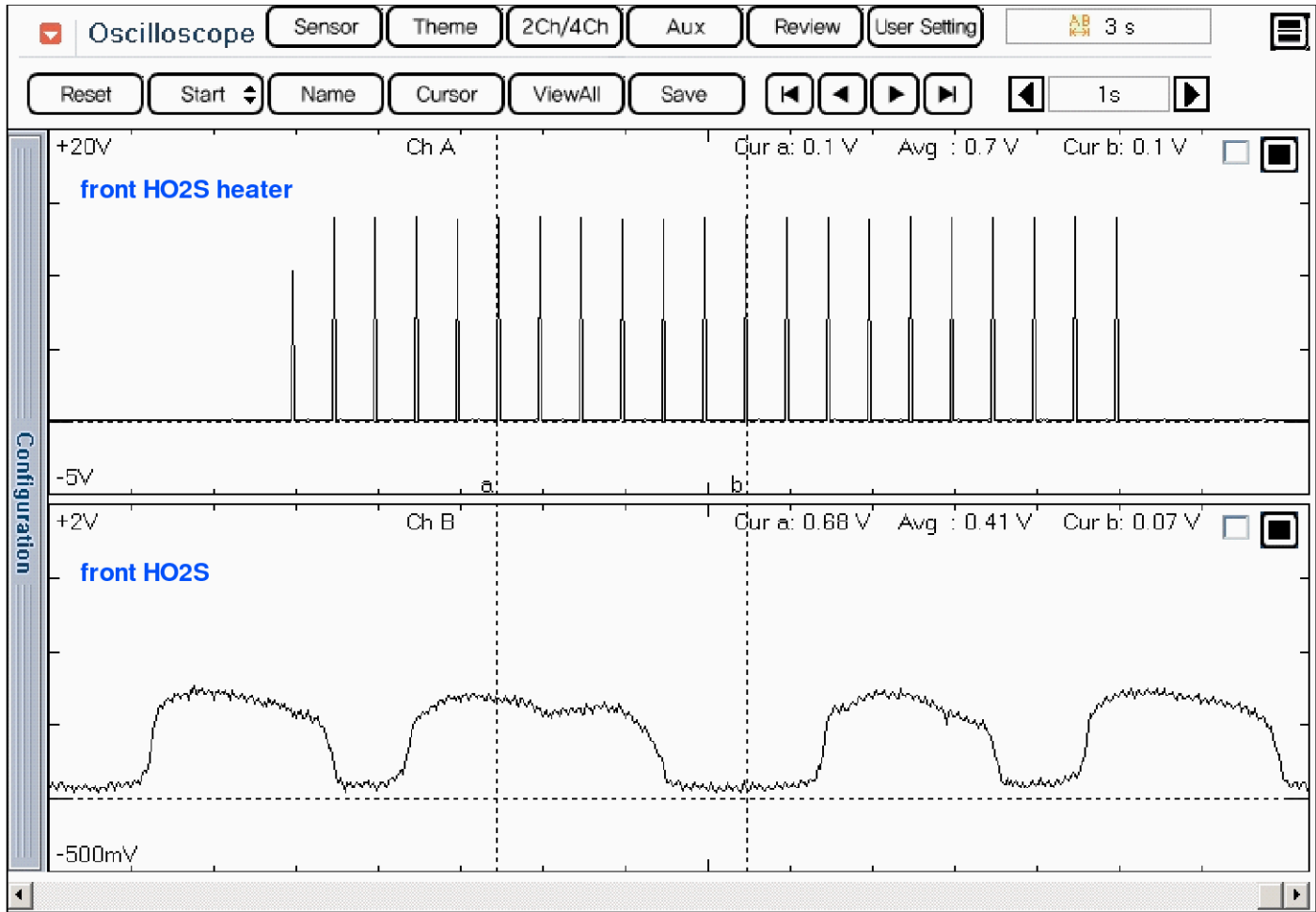


Fig.1

SBHFL9617L

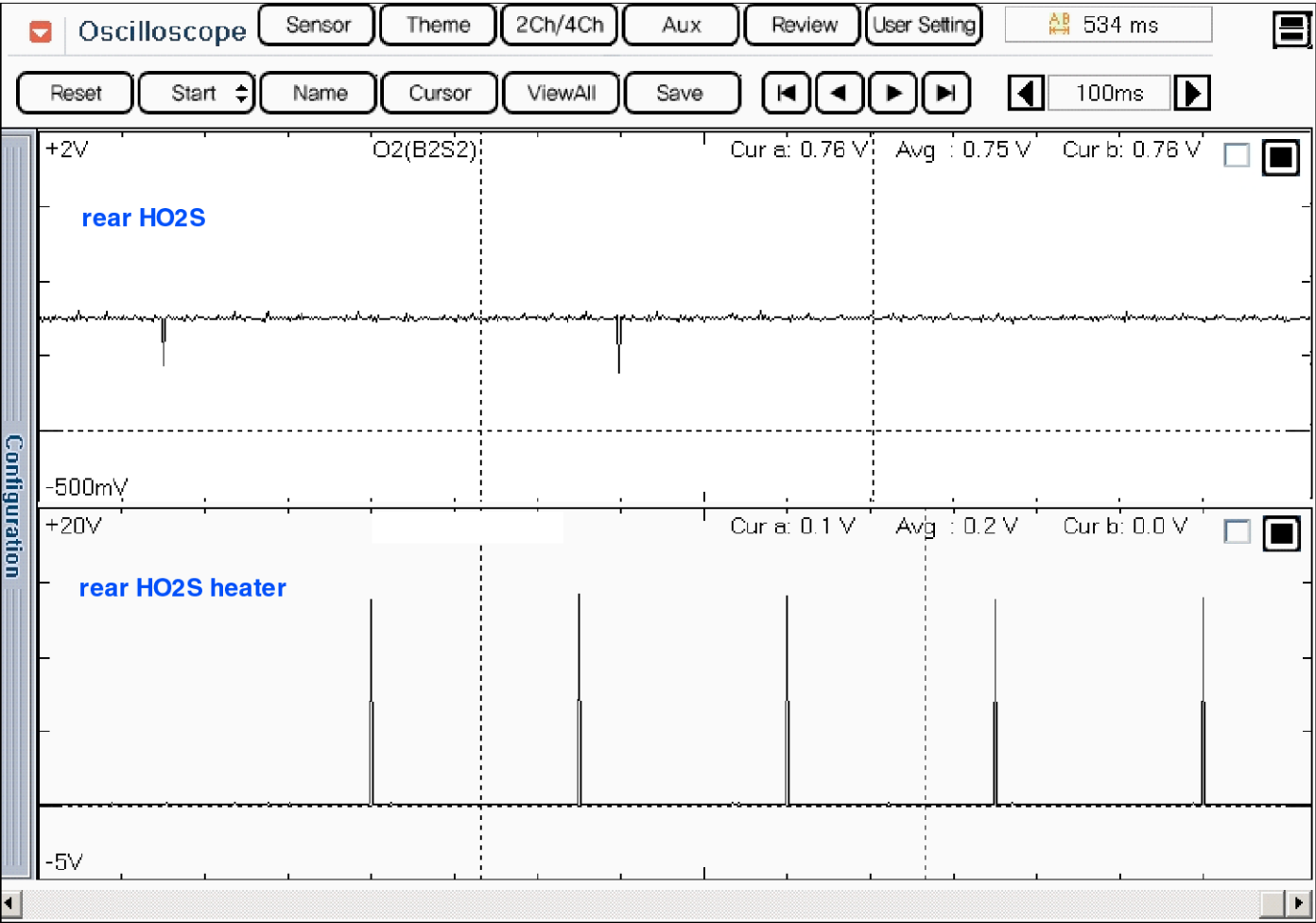


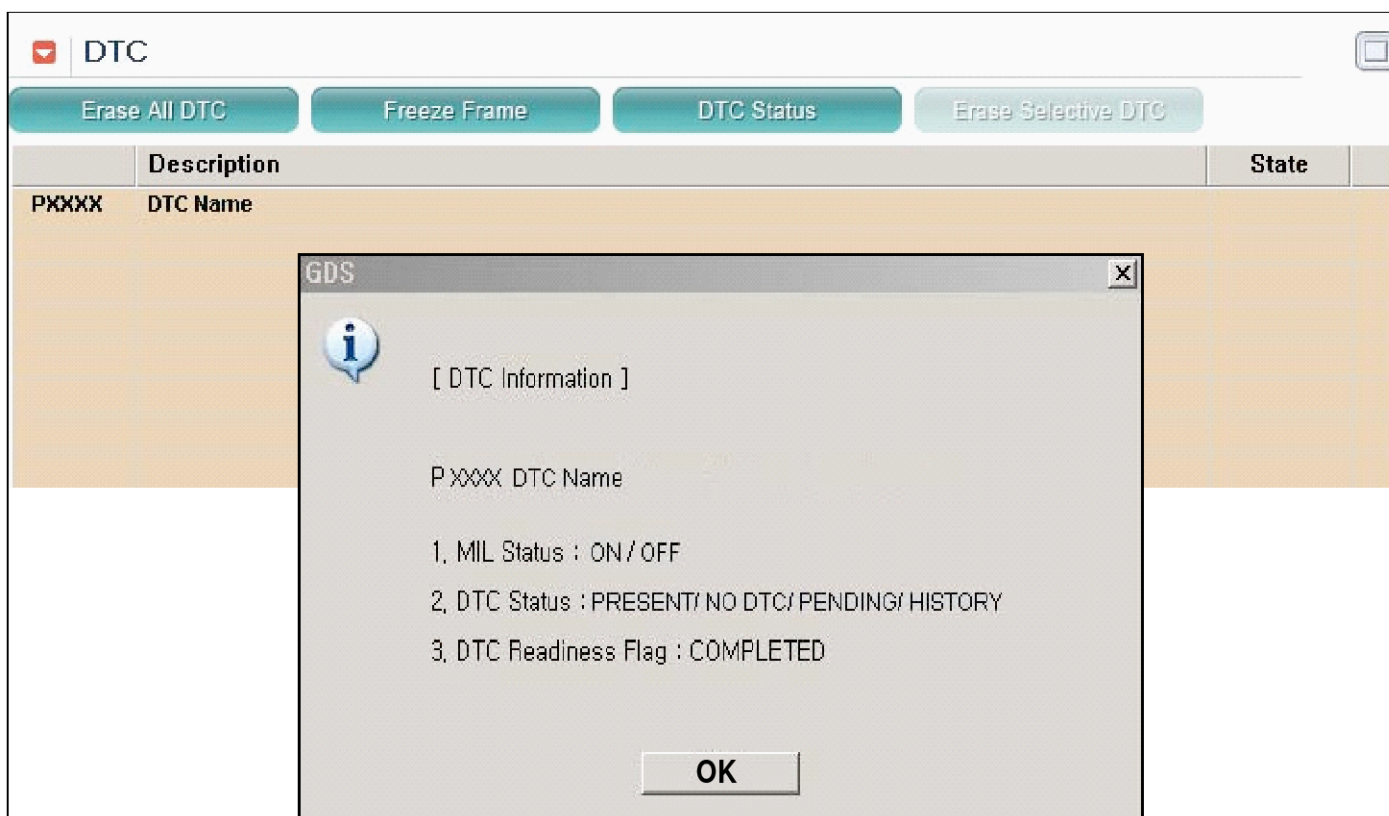
Fig.2

SBHFL9618L

Sensor Name	Value	Unit
☒ Oxygen Sensor Heater Duty-Bank1/Sensor1	0.5	A
☒ Oxygen Sensor Heater Duty-Bank1/Sensor1	97	%
☒ Oxygen Sensor Heater Duty-Bank1/Sensor2	0.5	A
☒ Oxygen Sensor Heater Duty-Bank2/Sensor1	0.5	A
☒ Oxygen Sensor Heater Duty-Bank1/Sensor2	100	%
☒ Oxygen Sensor Heater Duty-Bank2/Sensor1	97	%
☒ Oxygen Sensor Heater Duty-Bank2/Sensor2	0.6	A
☒ Oxygen Sensor Heater Duty-Bank2/Sensor2	100	%

Fig.3

SBHFL9619L



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ▶ Go to "Terminal and Connector inspection" procedure.

NO ▶ Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" procedure.

Component Inspection

■ Check HO2S(B2/S1) Heater resistance

1. IG "OFF" and disconnect HO2S(B2/S1) connector
2. Measure resistance between power and control terminals of HO2S(B2/S1) heater(Component Side)

Specification : 8.1 ~ 11.1 Ω at 21°C(69.8°F)

3. Is the measured resistance within specification?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Engine Control System

FL-201

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

FL-202

Fuel System

P0051 HO2S Heater Control Circuit Low (Bank 2 / Sensor 1)

Component Location

Refer to DTC P0050 : HO2S Heater Control Circuit (Bank 2/Sensor 1)

General Description

Refer to DTC P0050 : HO2S Heater Control Circuit (Bank 2/Sensor 1)

DTC Description

If the ECM detects short to ground or open in heater under detecting conditions, ECM sets P0051. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Detects a short to ground or open	- Poor Connection - Open in Power Circuit - Open or short to ground in control circuit - HO2S(B2/S1) - ECM
Enable Conditions	- No disabling Faults - Engine Running $11V \leq \text{Battery Voltage} \leq 16V$	
Threshold value	Short to ground or open circuit	
Diagnosis Time	Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	2 Driving Cycles	

Specification

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21°C(69.8°F)

Diagnostic Circuit Diagram

Refer to DTC P0050 : HO2S Heater Control Circuit (Bank 2/Sensor 1)

Signal Waveform & Data

Refer to DTC P0050 : HO2S Heater Control Circuit (Bank 2/Sensor 1)

Monitor Scantool Data

Refer to DTC P0050 : HO2S Heater Control Circuit (Bank 2/Sensor 1)

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Power Circuit Inspection " procedure

Power Circuit Inspection

■ Check voltage

- IG "OFF" & Disconnect HO2S(B2/S1) connector.
- IG "ON".
- Measure voltage between power terminal of HO2S(B2/S1) heater harness connector and chassis ground.

Specification : B+

- Is the measured voltage within specification ?

YES ► Go to " Control Circuit Inspection " procedure.

NO ► Repair open or short to ground in HO2S(B2/S1) Heater power circuit then, go to "Verification of Vehicle Repair" procedure.

Control Circuit Inspection

■ Check short to ground

- IG "OFF" & Disconnect HO2S(B2/S1) connector.
- Measure resistance between control terminal of HO2S(B2/S1) heater harness connector and chassis ground.

Engine Control System

FL-203

Specification : Infinite

3. Is the measured resistance within specification ?

YES ▶ Go to " Control Circuit Inspection " procedure.

NO ▶ Repair short to ground in HO2S(B2/S1) heater control circuit and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect HO2S(B2/S1) and ECM connector.
2. Measure resistance between control terminal of HO2S(B2/S1) heater harness connector and heater control terminal of ECM harness connector.

Specification : Approx. below 1Ω

3. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in HO2S(B2/S1) heater control circuit and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check HO2S(B2/S1) Heater resistance

1. IG "OFF" and disconnect HO2S(B2/S1) connector
2. Measure resistance between power and control terminals of HO2S(B2/S1) heater(Component Side)

Specification : 8.1 ~ 11.1 Ω at 21°C(69.8°F)

3. Is the measured resistance within specification?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0050 : HO2S Heater Control Circuit (Bank 2/Sensor 1)

FL-204

Fuel System

P0052 HO2S Heater Control Circuit High (Bank 2 / Sensor 1)

Component Location

Refer to DTC P0050 : HO2S Heater Control Circuit (Bank 2/Sensor 1)

General Description

Refer to DTC P0050 : HO2S Heater Control Circuit (Bank 2/Sensor 1)

DTC Description

If the ECM detects short to battery in heater under detecting conditions, ECM sets P0052. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Detects a short to battery	- Poor Connection - Short to battery in control circuit - HO2S(B2/S1) - ECM
Enable Conditions	- No disabling Faults - Engine Running $11V \leq \text{Battery Voltage} \leq 16V$	
Threshold value	Short to battery	
Diagnosis Time	Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	2 Driving Cycles	

Specification

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21°C(69.8°F)

Diagnostic Circuit Diagram

Refer to DTC P0050 : HO2S Heater Control Circuit (Bank 2/Sensor 1)

Signal Waveform & Data

Refer to DTC P0050 : HO2S Heater Control Circuit (Bank 2/Sensor 1)

Monitor Scantool Data

Refer to DTC P0050 : HO2S Heater Control Circuit (Bank 2/Sensor 1)

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Control Circuit Inspection " procedure.

Control Circuit Inspection

■ Check voltage

- IG "OFF" & Disconnect HO2S(B2/S1) connector.
- IG "ON".
- Measure voltage between control terminal of HO2S(B2/S1) heater harness connector and chassis ground.

Specification : Approx. 0 V

- Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short to battery in HO2S(B2/S1) Heater control circuit and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check HO2S(B2/S1) Heater resistance

- IG "OFF" and disconnect HO2S(B2/S1) connector
- Measure resistance between power and control terminals of HO2S(B2/S1) heater(Component Side)

Specification : 8.1 ~ 11.1 Ω at 21°C(69.8°F)

Engine Control System

FL-205

3. Is the measured resistance within specification?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

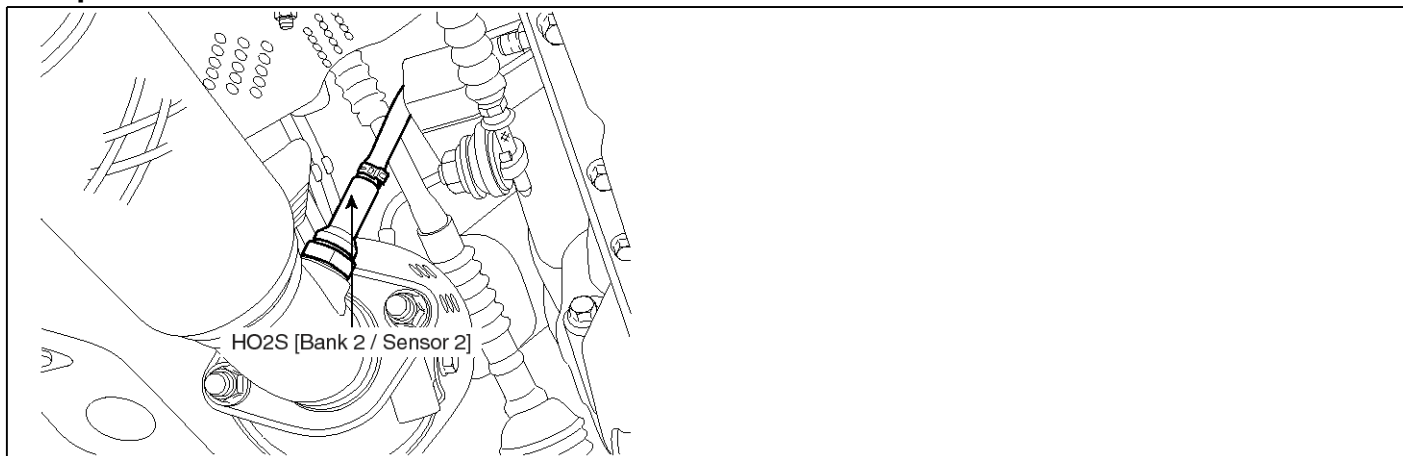
Refer to DTC P0050 : HO2S Heater Control Circuit (Bank 2/Sensor 1)

FL-206

Fuel System

P0056 HO2S Heater Control Circuit (Bank 2 / Sensor 2)

Component Location



SBHFL9314L

General Description

The normal operating temperature of the HO2S(Heated Oxygen Sensor) ranges from 350 to 850°C(662 to 1562°F). The HO2S heater greatly decreases the amount of time required for fuel control to become active. The ECM provides a pulse width modulated control circuit to adjust current through the heater. When the HO2S is cold, the value of the resistance is low and the current in the circuit is high. On the contrary, if the temperature in the resistor of the sensor rises, the current drops gradually.

DTC Description

Checking current from HO2S under detecting condition,if the heater current is below a certain threshold for more than predetermine time, ECM sets P0056. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Monitor the current through the heater	• Poor Connection • HO2S(B2/S2) • ECM
Enable Conditions	• Engine Running > 60 sec • Heater Duty Cycle > 40% • Max. Duty Cycle - Min. Duty Cycle < 5%	
Threshold value	• Filtered Heater Current < threshold value	
Diagnosis Time	• Continuous (More than 2.5 second failure for every 5 second test)	
MIL On Condition	• 2 Driving Cycles	

Specification

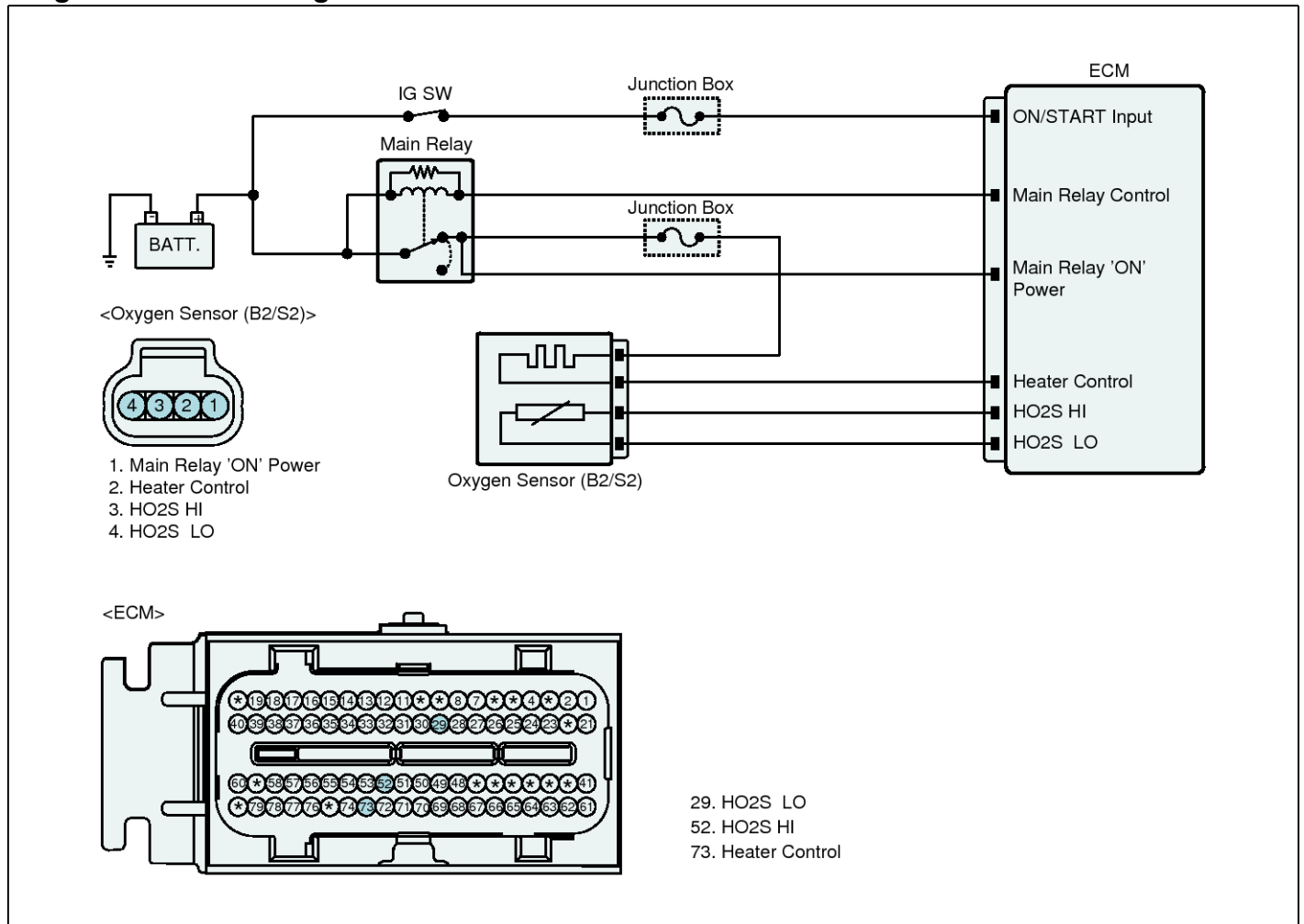
(Reference only)

Condition	Current(A)
Heater Current at 13.5V, 450 °C(842°F) Exhaust	0.52 ± 0.1

Engine Control System

FL-207

Diagnostic Circuit Diagram



SBHFL9511L

Signal Waveform & Data

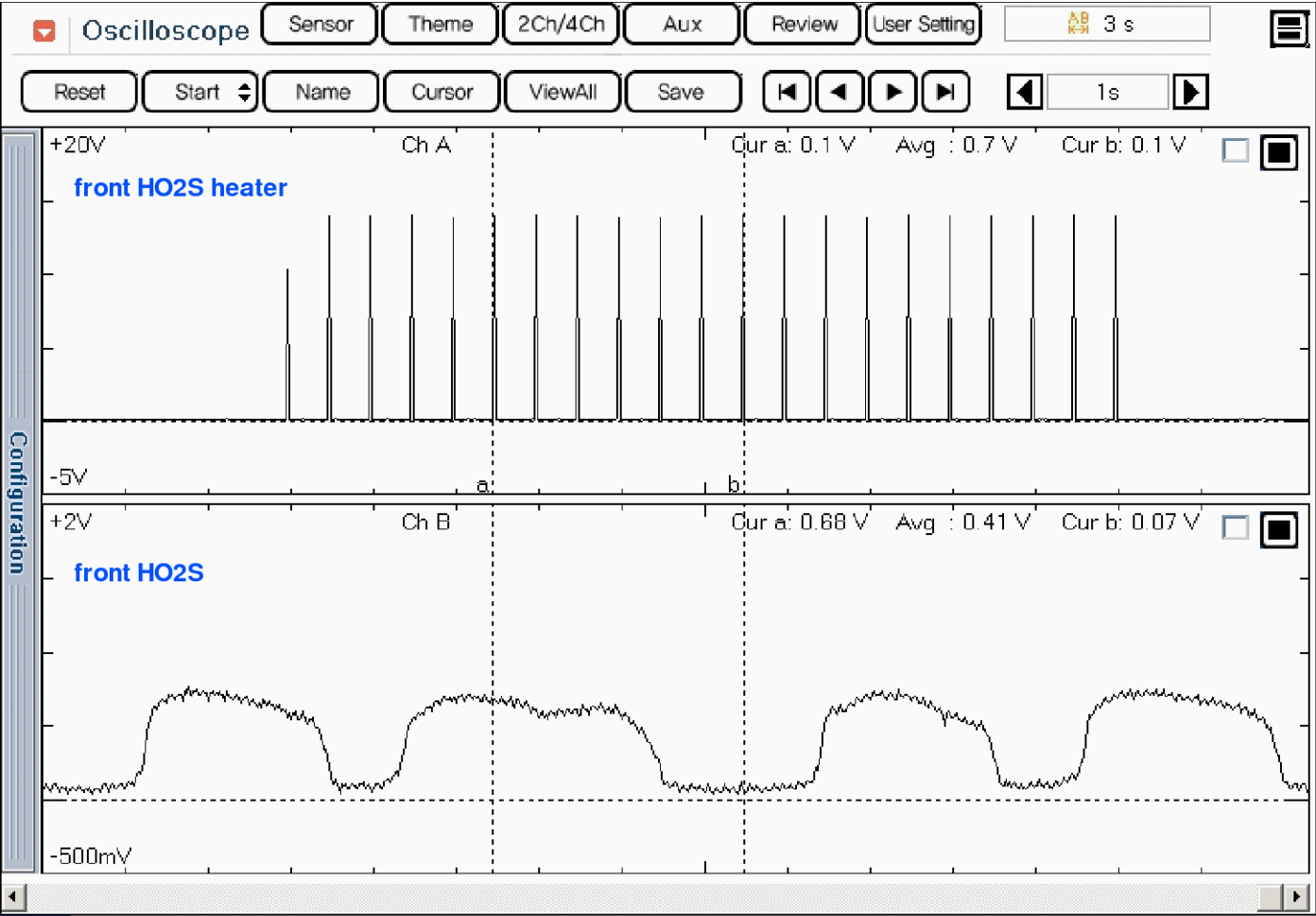


Fig.1

SBHFL9617L

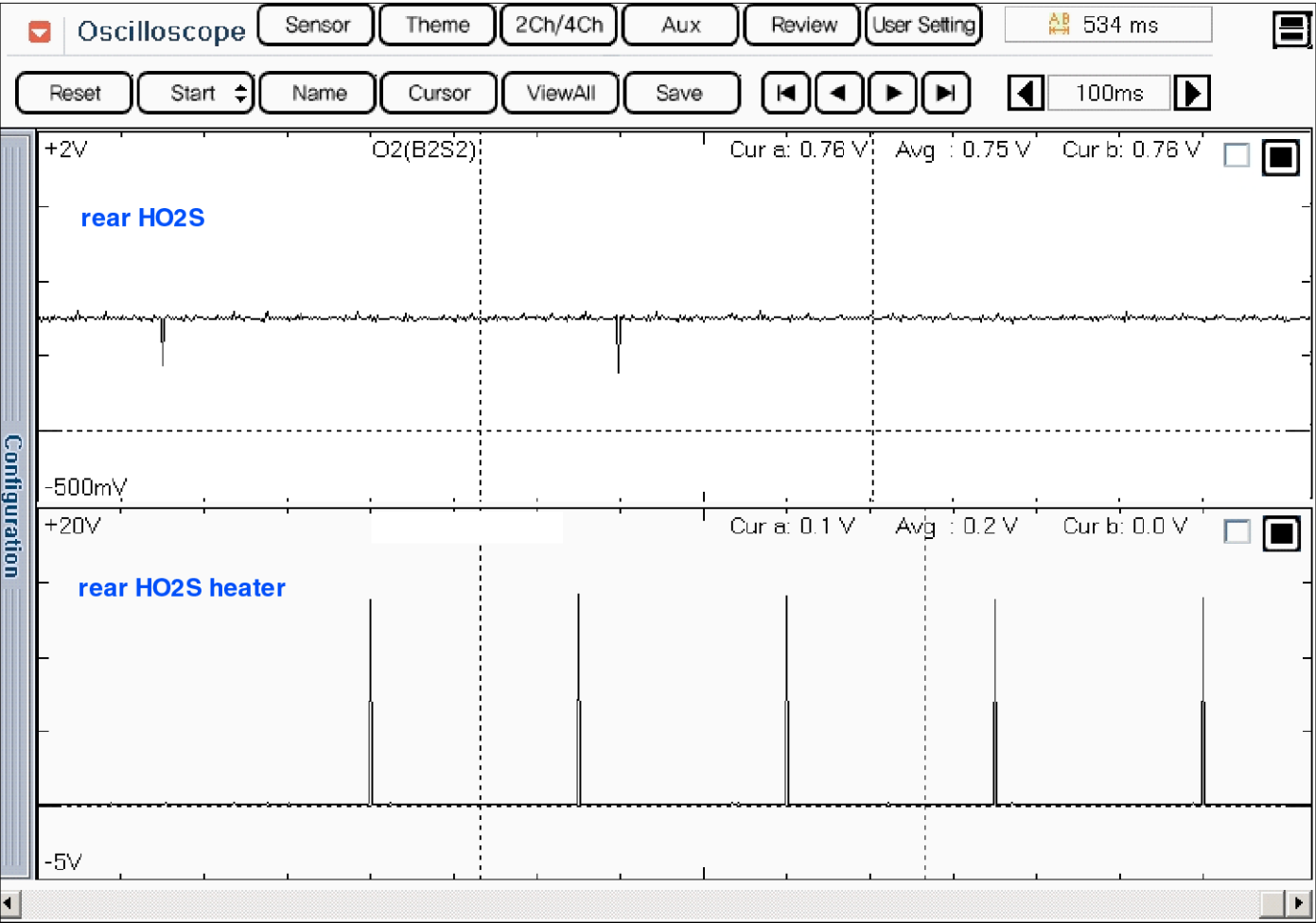


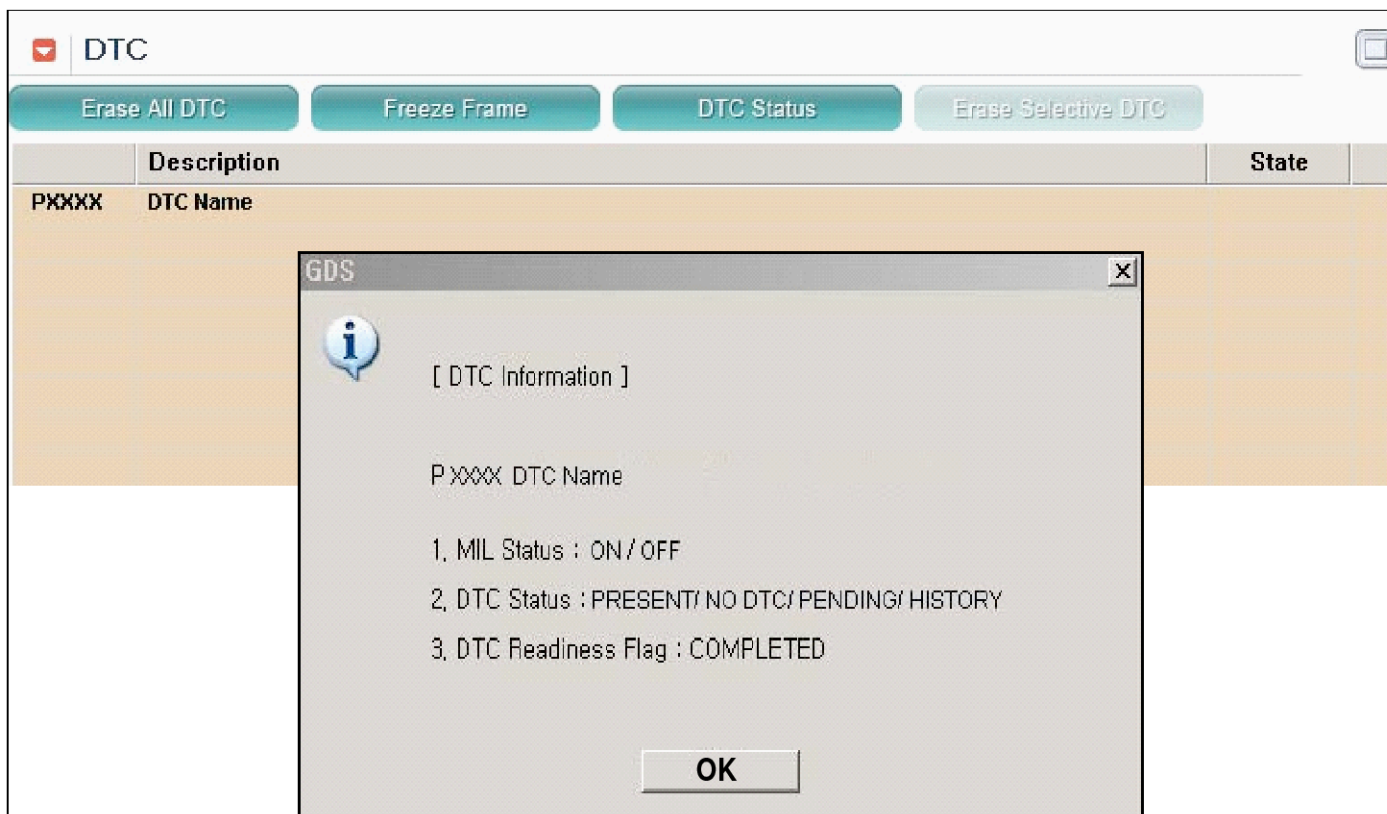
Fig.2

SBHFL9618L

Sensor Name	Value	Unit
☒ Oxygen Sensor Heater Duty-Bank1/Sensor1	0.5	A
☒ Oxygen Sensor Heater Duty-Bank1/Sensor1	97	%
☒ Oxygen Sensor Heater Duty-Bank1/Sensor2	0.5	A
☒ Oxygen Sensor Heater Duty-Bank2/Sensor1	0.5	A
☒ Oxygen Sensor Heater Duty-Bank1/Sensor2	100	%
☒ Oxygen Sensor Heater Duty-Bank2/Sensor1	97	%
☒ Oxygen Sensor Heater Duty-Bank2/Sensor2	0.6	A
☒ Oxygen Sensor Heater Duty-Bank2/Sensor2	100	%

Fig.3

SBHFL9619L



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Component Inspection" procedure.

Component Inspection

Check HO2S(B2/S2) Heater resistance

- IG "OFF" and disconnect HO2S(B2/S2) connector
- Measure resistance between power and control terminals of HO2S(B2/S2) heater(Component Side)

Specification : 8.1 ~ 11.1 Ω at 21°C(69.8°F)

- Is the measured resistance within specification?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-213

P0057 HO2S Heater Control Circuit Low (Bank 2 / Sensor 2)

Component Location

Refer to DTC P0056 : HO2S Heater Control Circuit (Bank 2/Sensor 2)

General Description

Refer to DTC P0056 : HO2S Heater Control Circuit (Bank 2/Sensor 2)

DTC Description

If the ECM detects short to ground or open in heater under detecting conditions, ECM sets P0057. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Detects a short to ground or open	- Poor Connection - Open in Power Circuit - Open or short to ground in control circuit - HO2S(B2/S2) - ECM
Enable Conditions	- No disabling Faults - Engine Running $11V \leq \text{Battery Voltage} \leq 16V$	
Threshold value	Short to ground or open circuit	
Diagnosis Time	Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	2 Driving Cycles	

Specification

Heater	
Resistance (Ω)	$8.1 \sim 11.1 \Omega$ at $21^{\circ}\text{C}(69.8^{\circ}\text{F})$

Diagnostic Circuit Diagram

Refer to DTC P0056 : HO2S Heater Control Circuit (Bank 2/Sensor 2)

Signal Waveform & Data

Refer to DTC P0056 : HO2S Heater Control Circuit (Bank 2/Sensor 2)

Monitor Scantool Data

Refer to DTC P0056 : HO2S Heater Control Circuit (Bank 2/Sensor 2)

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Power Circuit Inspection " procedure

Power Circuit Inspection

■ Check voltage

- IG "OFF" & Disconnect HO2S(B2/S2) connector.
- IG "ON".
- Measure voltage between power terminal of HO2S(B2/S2) heater harness connector and chassis ground.

Specification : B+

- Is the measured voltage within specification ?

YES ► Go to " Control Circuit Inspection " procedure.

NO ► Repair open or short to ground in HO2S(B2/S2) Heater power circuit then, go to "Verification of Vehicle Repair" procedure.

Control Circuit Inspection

■ Check short to ground

- IG "OFF" & Disconnect HO2S(B2/S2) connector.
- Measure resistance between control terminal of HO2S(B2/S2) heater harness connector and chassis ground.

FL-214

Fuel System

Specification : Infinite

3. Is the measured resistance within specification ?

YES ▶ Go to " Control Circuit Inspection " procedure.

NO ▶ Repair short to ground in HO2S(B2/S2) heater control circuit and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect HO2S(B2/S2) and ECM connector.
2. Measure resistance between control terminal of HO2S(B2/S2) heater harness connector and heater control terminal of ECM harness connector.

Specification : Approx. below 1Ω

3. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in HO2S(B2/S2) heater control circuit and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check HO2S(B2/S2) Heater resistance

1. IG "OFF" and disconnect HO2S(B2/S2) connector
2. Measure resistance between power and control terminals of HO2S(B2/S2) heater(Component Side)

Specification : 8.1 ~ 11.1 Ω at 21°C(69.8°F)

3. Is the measured resistance within specification?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0056 : HO2S Heater Control Circuit (Bank 2/Sensor 2)

Engine Control System

FL-215

P0058 HO2S Heater Control Circuit High (Bank 2 / Sensor 2)

Component Location

Refer to DTC P0056 : HO2S Heater Control Circuit (Bank 2/Sensor 2)

General Description

Refer to DTC P0056 : HO2S Heater Control Circuit (Bank 2/Sensor 2)

DTC Description

If the ECM detects short to battery in heater under detecting conditions, ECM sets P0058. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Detects a short to battery	- Poor Connection - Short to battery in control circuit - HO2S(B2/S2) - ECM
Enable Conditions	- No disabling Faults - Engine Running $11V \leq \text{Battery Voltage} \leq 16V$	
Threshold value	Short to battery	
Diagnosis Time	Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	2 Driving Cycles	

Specification

Heater	
Resistance (Ω)	8.1 ~ 11.1 Ω at 21°C(69.8°F)

Diagnostic Circuit Diagram

Refer to DTC P0056 : HO2S Heater Control Circuit (Bank 2/Sensor 2)

Signal Waveform & Data

Refer to DTC P0056 : HO2S Heater Control Circuit (Bank 2/Sensor 2)

Monitor Scantool Data

Refer to DTC P0056 : HO2S Heater Control Circuit (Bank 2/Sensor 2)

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Control Circuit Inspection " procedure.

Control Circuit Inspection

■ Check voltage

- IG "OFF" & Disconnect HO2S(B2/S2) connector.
- IG "ON".
- Measure voltage between control terminal of HO2S(B2/S2) heater harness connector and chassis ground.

Specification : Approx. 0 V

- Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short to battery in HO2S(B2/S2) Heater control circuit and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check HO2S(B2/S2) Heater resistance

- IG "OFF" and disconnect HO2S(B2/S2) connector
- Measure resistance between power and control terminals of HO2S(B2/S2) heater(Component Side)

Specification : 8.1 ~ 11.1 Ω at 21°C(69.8°F)

FL-216

Fuel System

3. Is the measured resistance within specification?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

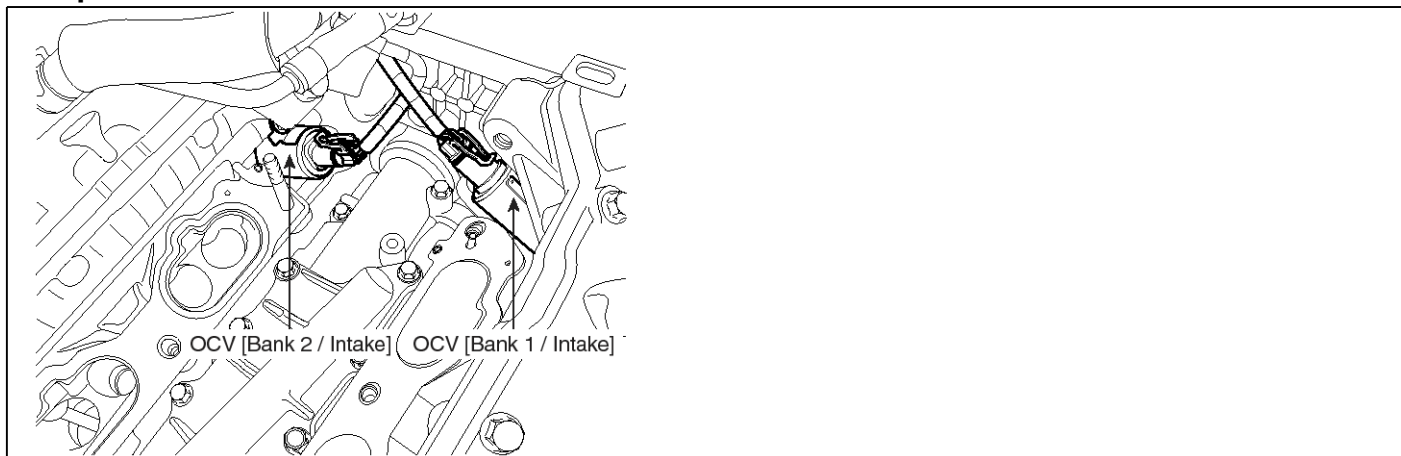
Refer to DTC P0056 : HO2S Heater Control Circuit (Bank 2/Sensor 2)

Engine Control System

FL-217

P0076 Intake Valve Control Solenoid Circuit-Low (Bank 1)

Component Location



SBHFL9320L

General Description

The CVVT (Continuously Variable Valve Timing) system is installed to the chain sprocket of the intake camshaft. This system controls the intake camshaft to provide the optimal valve timing for every driving condition. The ECM controls the Oil Control Valve(OCV), based on the signals output from mass air flow, throttle position and engine coolant temperature. The CVVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft becomes optimal, and the engine torque improves, fuel economy improves, exhaust emissions decrease under overall driving conditions.

DTC Description

When the enable condition is satisfied The ECM checks that high and low outputs (Voltage level) are observed when OCVs are commanded. When a OCV output failure is detected, the appropriate fail counter is incremented.

If the failure threshold is exceeded 5 seconds during one diagnostic test(10 second),the test is failed and DTC is stored.

MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Detects a short to ground or open	• Poor Connection • Open in Power circuit • Open or short to ground in Control Circuit • OCV • ECM
Enable Conditions	• No disabling Faults Present • Engine Running • $11V \leq \text{Battery Voltage} \leq 16V$	
Threshold value	• Short to ground or open circuit	
Diagnosis Time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	• 2 Driving Cycles	

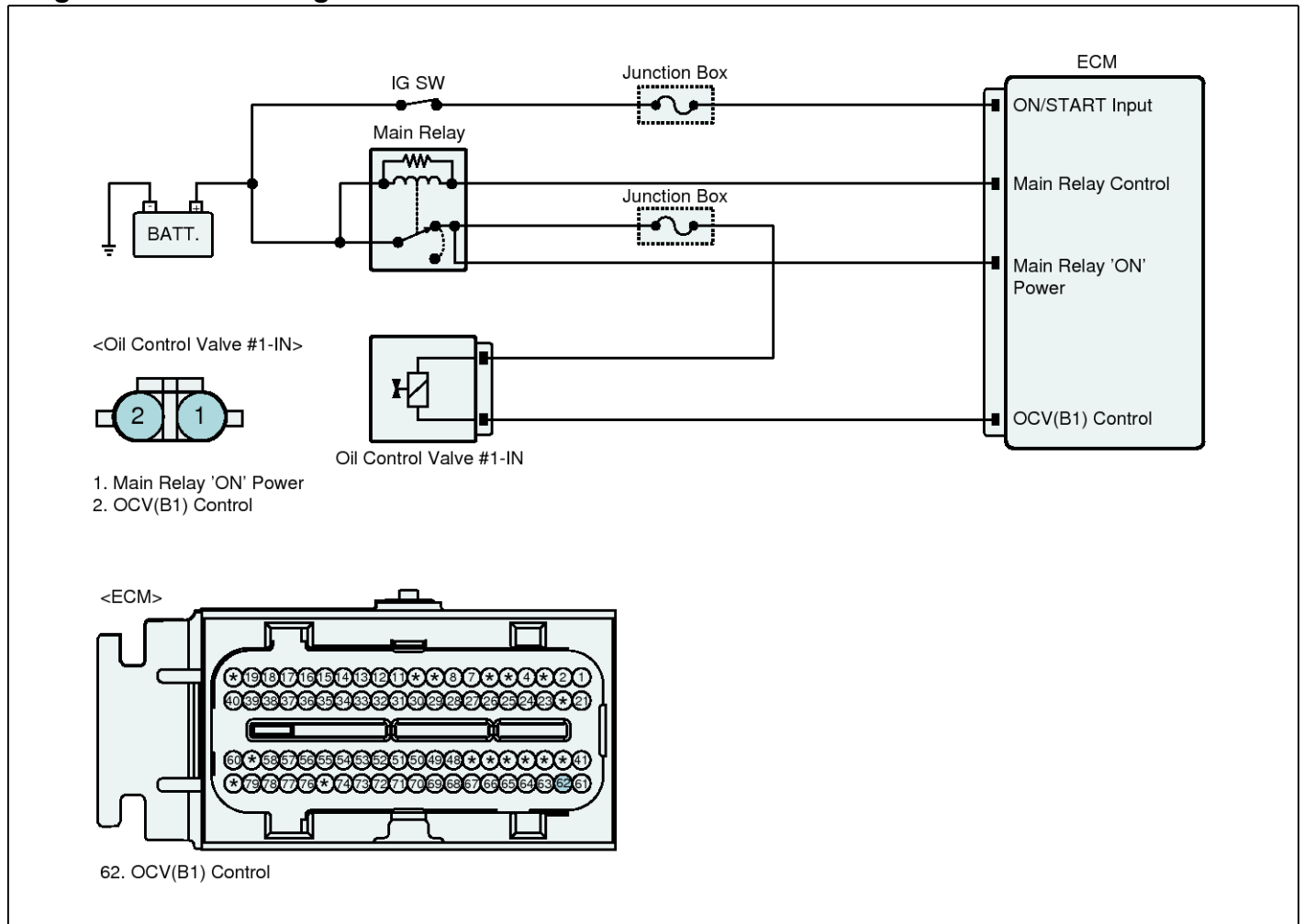
Specification

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

FL-218

Fuel System

Diagnostic Circuit Diagram



SBHFL9500L

Signal Waveform & Data

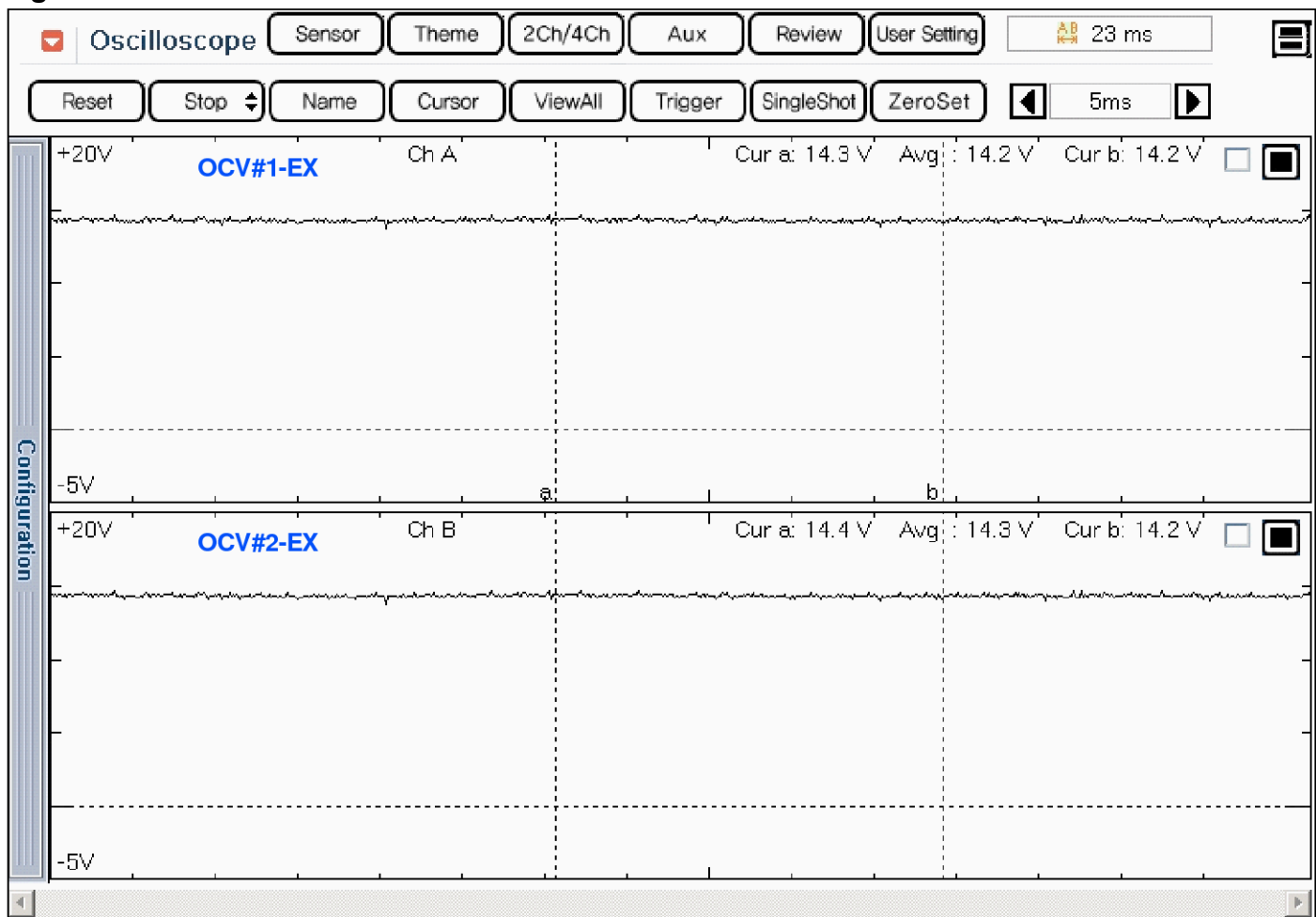


Fig.1

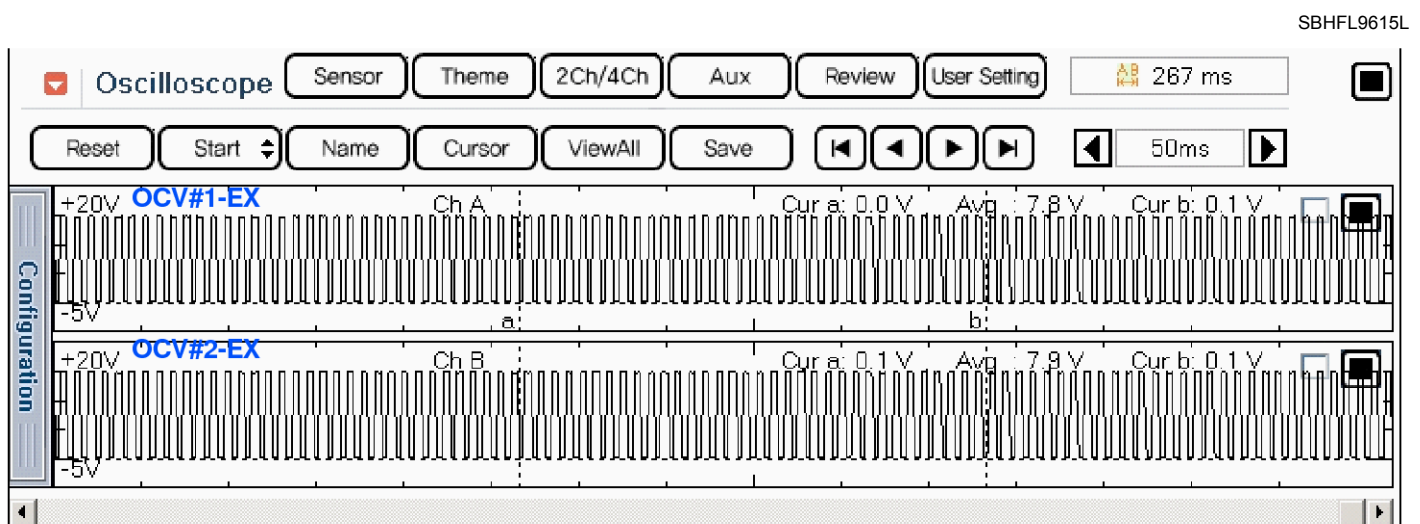


Fig.2

Fig 1) Normal waveform of OCV at idle.

Fig 2) Normal waveform of OCV at acceleration.
(3500rpm)

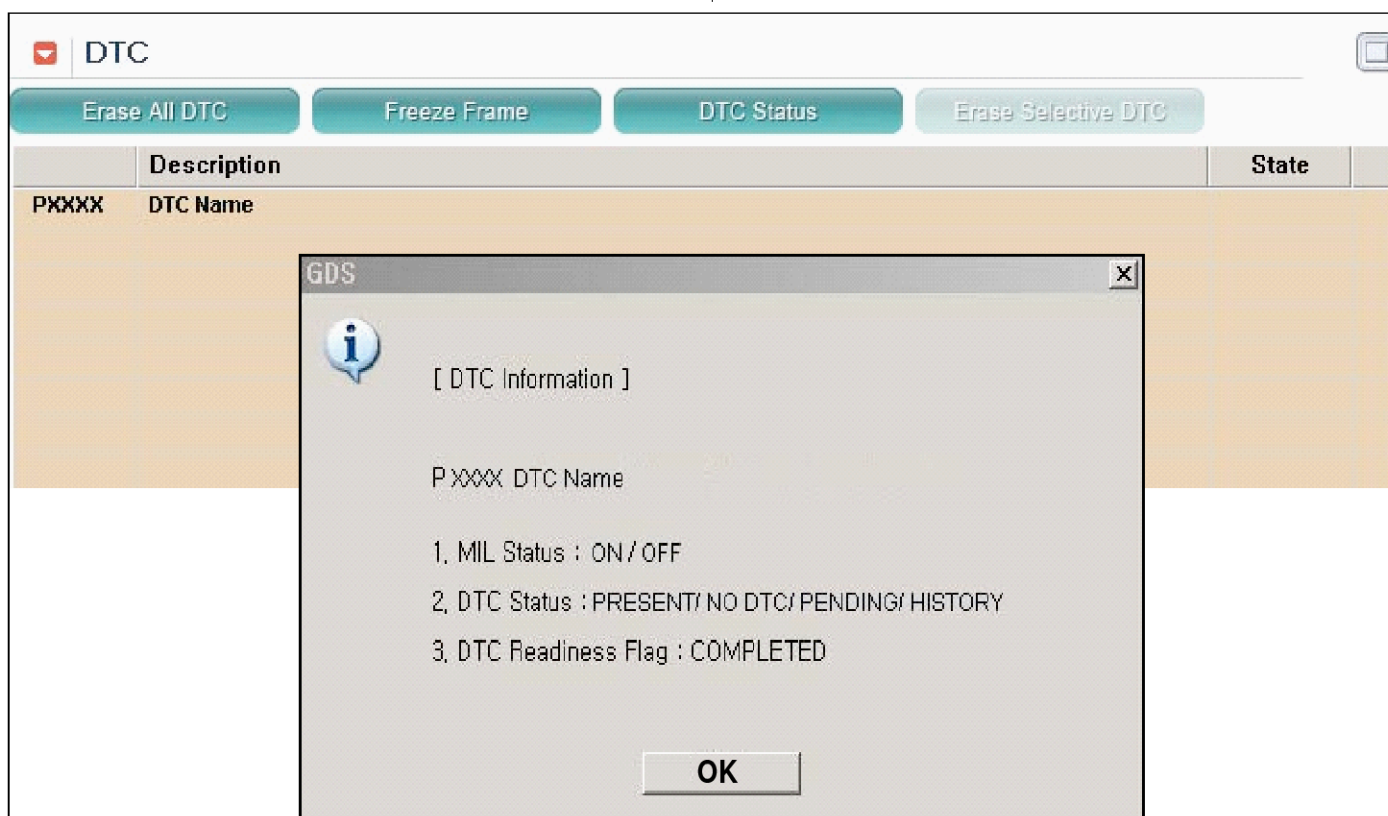
FL-220

Fuel System

The oil control valve is commanded by a pulse-with-modulated signal from the engine control unit. A duty cycle of zero commands the cam phaser to its default position. A duty cycle of 100% commands the cam phaser to its maximum phased position. When the phaser must be controlled to an intermediate position, the duty cycle is maintained in the region of the 'hold position'. This is a medium duty cycle, usually between 35% and 65%, depending on temperature and voltage conditions.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?
YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure.
NO ► Go to "Power Circuit Inspection" as follow.

Engine Control System

FL-221

Power Circuit Inspection

■ Check voltage

1. IG "OFF" & Disconnect OCV connector.
2. IG "ON".
3. Measure voltage between power terminal of OCV harness connector and chassis ground.

Specification : B+

4. Is the measured voltage within specification ?

YES ▶ Go to "Control Circuit Inspection" procedure.

NO ▶ Check fuse between Main Relay and OCV is open or not installed.
▶ Check open in power circuit between Main Relay and OCV power circuit.
▶ Check short to ground in power circuit between Main Relay and OCV power circuit.
▶ Repair or replace as necessary go to "Verification of Vehicle Repair" procedure.

Control Circuit Inspection

■ Check resistance

1. IG "OFF" and disconnect OCV and ECM connector.
2. Measure resistance between control terminal of OCV harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification ?

YES ▶ Go to "Check open in harness" as follows .

NO ▶ Repair short to ground in OCV control circuit and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect OCV and ECM connector.
2. Measure resistance between control terminal of OCV harness connector and OCV control terminal of ECM harness connector.

Specification : Approx. below 1Ω

3. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in OCV control circuit and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check OCV resistance

1. IG "OFF" and disconnect OCV connector.
2. Measure resistance between power and signal terminals of OCV. (Component Side)

Specification : 6.7 ~ 7.7 Ω

3. Is the measured resistance within specification?

YES ▶ Go to "OCV Actuation Test" as follows.

NO ▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

■ OCV Actuation Test

1. Connect scantool and IG "ON"
2. Select "OIL CONTROL VALVE" on the Actuation Test
3. Activates "OIL CONTROL VALVE" by pressing "START" button
(Should hear a faint click from Oil Control solenoid Valve)
4. Repeat this procedure 4 or 5 times to ensure oil control solenoid valve reliability

Actuation Test

Test Items

A/C Compressor Relay

Fuel Pump Control

Immobilizer Lamp

Canister Shut Off Valve Clocked

Canister Purge Valve

Oil Control Valve

Ignition Coil-#1

Ignition Coil-#2

Ignition Coil-#3

Ignition Coil-#4

Duration

Until Stop Button

Conditions

IG. ON/ENG.OFF

Result

Start

Stop

SBHFL9606L

5. Does OCV generate click sound during acutation test ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

NO ▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-223

P0077 Intake Valve Control Solenoid Circuit-High (Bank 1)

Component Location

Refer to DTC P0076 : Intake Valve Control Solenoid Circuit-Low (Bank 1)

General Description

Refer to DTC P0076 : Intake Valve Control Solenoid Circuit-Low (Bank 1)

DTC Description

When the enable condition is satisfied The ECM checks that high and low outputs (Voltage level) are observed when OCVs are commanded. When a OCV output failure is detected, the appropriate fail counter is incremented.

If the failure threshold is exceeded 5 seconds during one diagnostic test(10 second),the test is failed and DTC is stored.

MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Detects a short to battery	• Poor Connection • Short to battery in Control Circuit • OCV • ECM
Enable Conditions	• No disabling Faults Present • Engine Running • $11V \leq \text{Battery Voltage} \leq 16V$	
Threshold value	• Short to battery	
Diagnosis Time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	• 2 Driving Cycles	

Specification

Refer to DTC P0076 : Intake Valve Control Solenoid Circuit-Low (Bank 1)

Diagnostic Circuit Diagram

Refer to DTC P0076 : Intake Valve Control Solenoid Circuit-Low (Bank 1)

Signal Waveform & Data

Refer to DTC P0076 : Intake Valve Control Solenoid Circuit-Low (Bank 1)

Monitor Scantool Data

Refer to DTC P0076 : Intake Valve Control Solenoid Circuit-Low (Bank 1)

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Control Circuit Inspection " procedure.

Control Circuit Inspection

■ Check short to battery in harness

1. IG "OFF" & Disconnect OCV connector.
2. Measure resistance between power and control terminals of OCV harness connector.

Specification : Infinite

3. Is the measured resistance within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Repair short to battery in OCV control circuit and go to "Verification of Vehicle Repair" procedure.

FL-224

Fuel System

Component Inspection

■ Check OCV resistance

1. IG "OFF" and disconnect OCV connector.
2. Measure resistance between power and signal terminals of OCV. (Component Side)

Specification : 6.7 ~ 7.7 Ω

3. Is the measured resistance within specification?

YES ▶ Go to "OCV Actuation Test" as follows.

NO ▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

■ OCV Actuation Test

1. Connect scantool and IG "ON"
2. Select "OIL CONTROL VALVE" on the Actuation Test
3. Activates "OIL CONTROL VALVE" by pressing "START" button
(Should hear a faint click from Oil Control solenoid Valve)
4. Repeat this procedure 4 or 5 times to ensure oil control solenoid valve reliability

☒ **Actuation Test**

Test Items
A/C Compressor Relay
Fuel Pump Control
Immobilizer Lamp
Canister Shut Off Valve Clocked
Canister Purge Valve
Oil Control Valve
Ignition Coil-#1
Ignition Coil-#2
Ignition Coil-#3
Ignition Coil-#4

● Duration

Until Stop Button

● Conditions

IG. ON/ENG.OFF

● Result

Start

Stop

SBHFL9606L

5. Does OCV generate click sound during acutation test ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

NO ▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

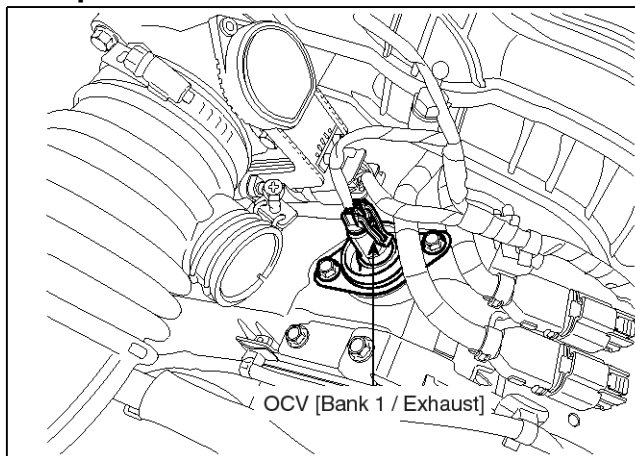
Refer to DTC P0076 : Intake Valve Control Solenoid Circuit-Low (Bank 1)

Engine Control System

FL-225

P0079 Exhaust Valve Control Solenoid Circuit Low (Bank 1)

Component Location



SBHFL9321L

General Description

The CVVT (Continuously Variable Valve Timing) system is installed to the chain sprocket of the intake camshaft. This system controls the intake camshaft to provide the optimal valve timing for every driving condition. The ECM controls the Oil Control Valve(OCV), based on the signals output from mass air flow, throttle position and engine coolant temperature. The CVVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft becomes optimal, and the engine torque improves, fuel economy improves, exhaust emissions decrease under overall driving conditions.

DTC Description

When the enable condition is satisfied The ECM checks that high and low outputs (Voltage level) are observed when OCVs are commanded. When a OCV output failure is detected, the appropriate fail counter is incremented.

If the failure threshold is exceeded 5 seconds during one diagnostic test(10 second),the test is failed and DTC is stored.

MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Detects a short to ground or open	• Poor Connection • Open in Power circuit • Open or short to ground in Control Circuit • OCV • ECM
Enable Conditions	• No disabling Faults Present • Engine Running • $11V \leq \text{Battery Voltage} \leq 16V$	
Threshold value	• Short to ground or open circuit	
Diagnosis Time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	• 2 Driving Cycles	

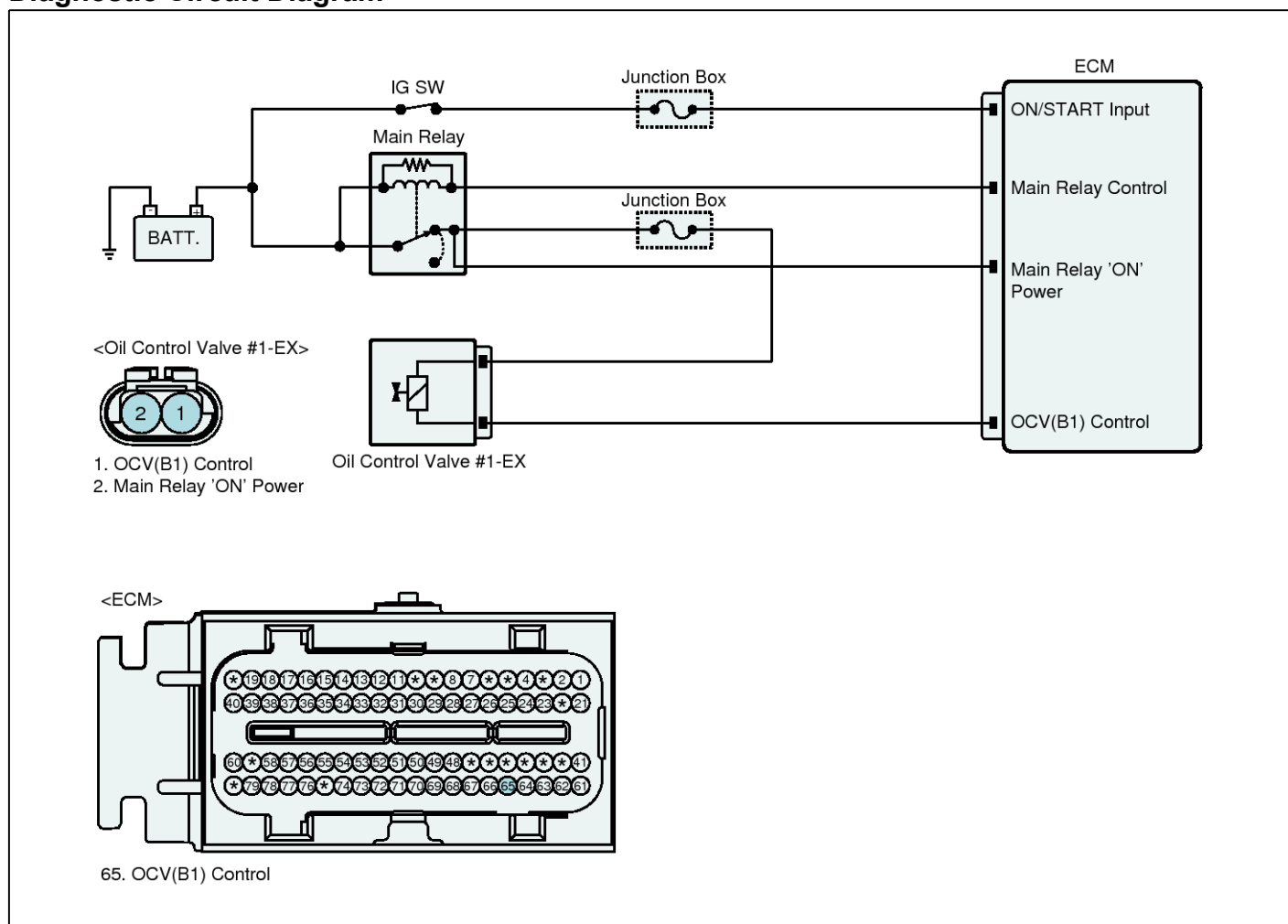
Specification

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

FL-226

Fuel System

Diagnostic Circuit Diagram



SBHFL9501L

Signal Waveform & Data

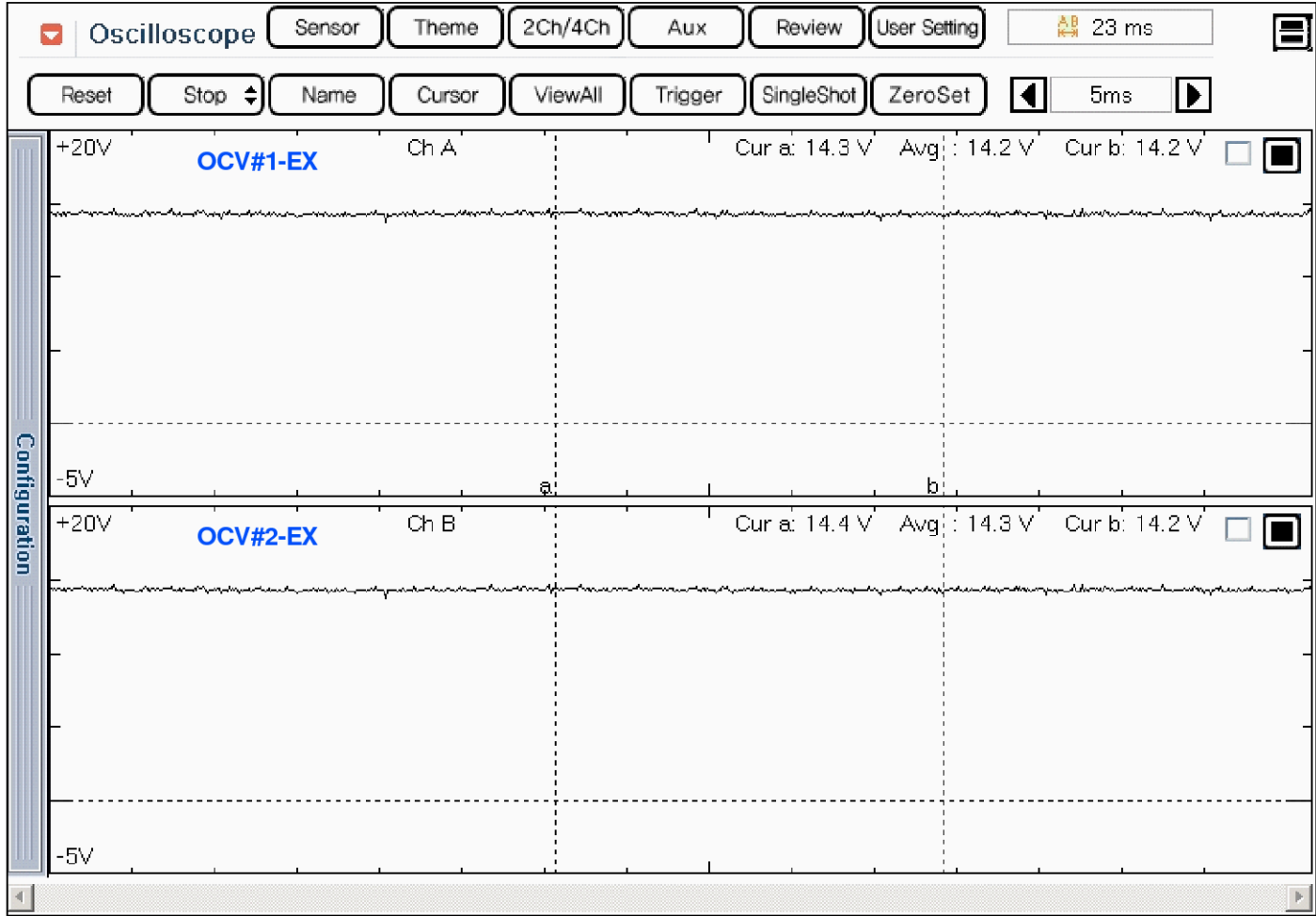


Fig.1

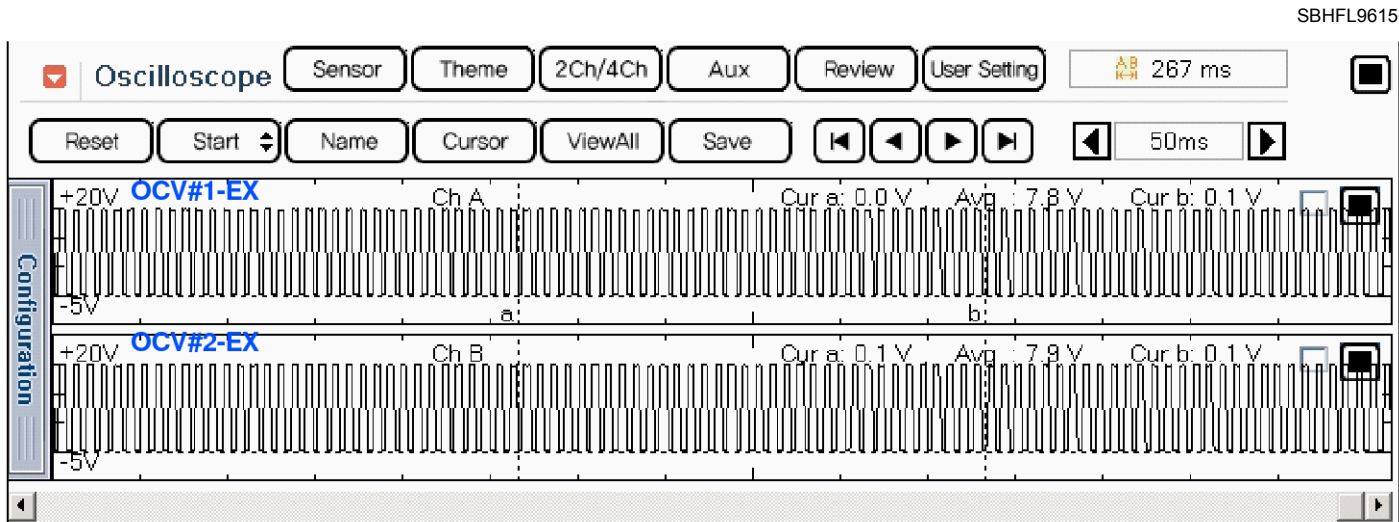


Fig.2

SBHFL9615L

SBHFL9616L

FL-228

Fuel System

Current Data			
Standard Display ▾	Full List ▾	Graph ▾	Items List ▾
Reset Min.Max.		Record	Stop ▾
VSS			
Sensor Name	Value	Unit	
☐ EX-Cam Bank1 Desired Position	0	DEG	
☐ EX-Cam Bank1 Actual Position	0	DEG	
☐ EX-Cam Bank2 Desired Position	0	DEG	
☐ EX-Cam Bank2 Actual Position	0	DEG	
☐ EX-Cam Phaser 1 Duty Cycle	0	%	
☐ EX-Cam Phaser 2 Duty Cycle	0	%	

Fig.3

SBHFL9610L

Sensor Name	Value	Unit	
☒ Camshaft Control	ON	-	
☒ Engine Speed	3840	RPM	
☒ EX-Cam Bank1 Actual Position	-15	DEG	
☒ EX-Cam Bank1 Desired Position	-14	DEG	
☒ EX-Cam Bank2 Desired Position	-14	DEG	
☒ EX-Cam Bank2 Actual Position	-15	DEG	
☒ EX-Cam Phaser 1 Duty Cycle	43	%	
☒ EX-Cam Phaser 2 Duty Cycle	44	%	

Fig.4

SBHFL9611L

Engine Control System

FL-229

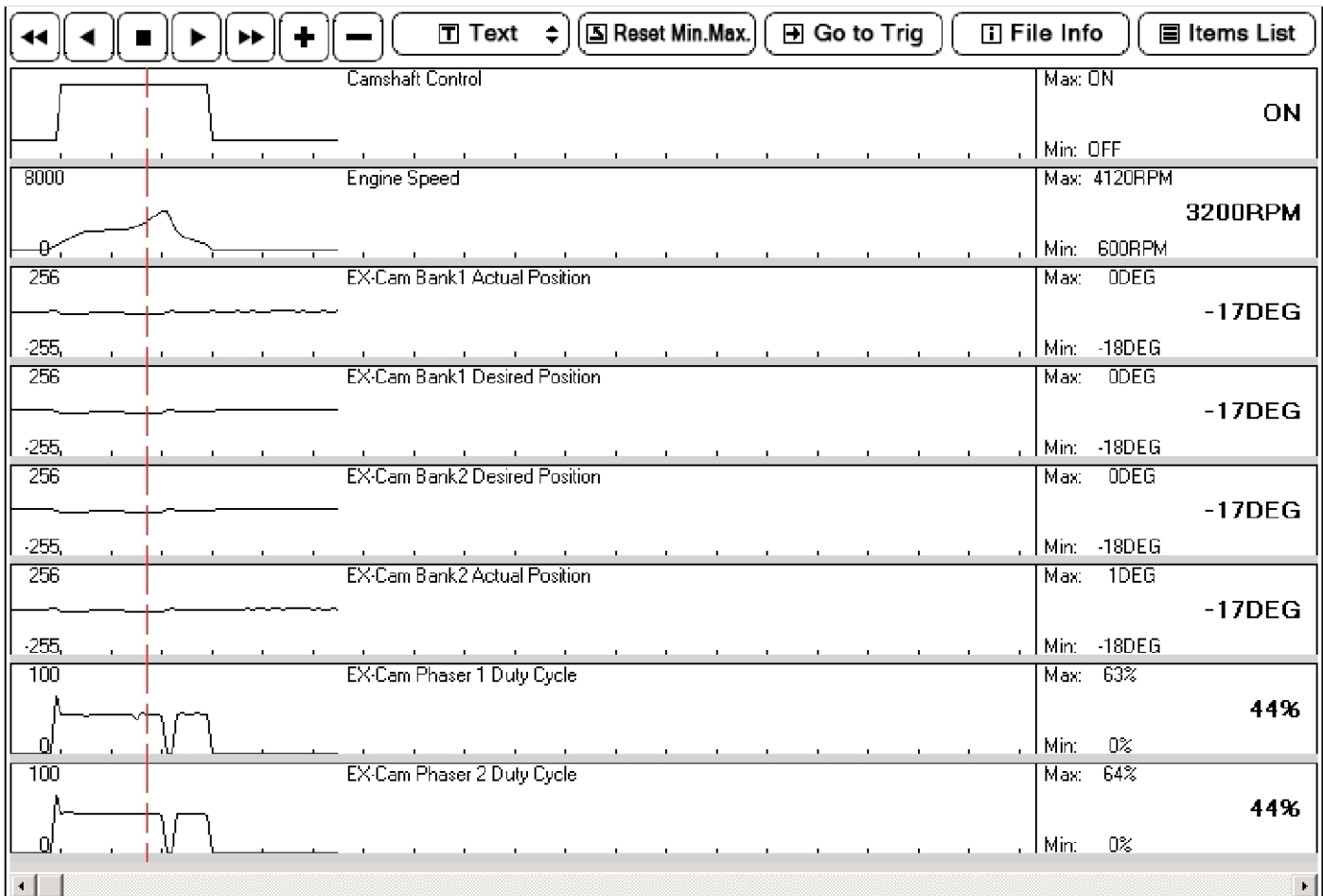


Fig.5

SBHFL9612L

Fig 1) Normal waveform of OCV at idle.

Fig 2) Normal waveform of OCV at acceleration. (3500rpm)

Fig 3) Normal data of EX-CVVT at idle.

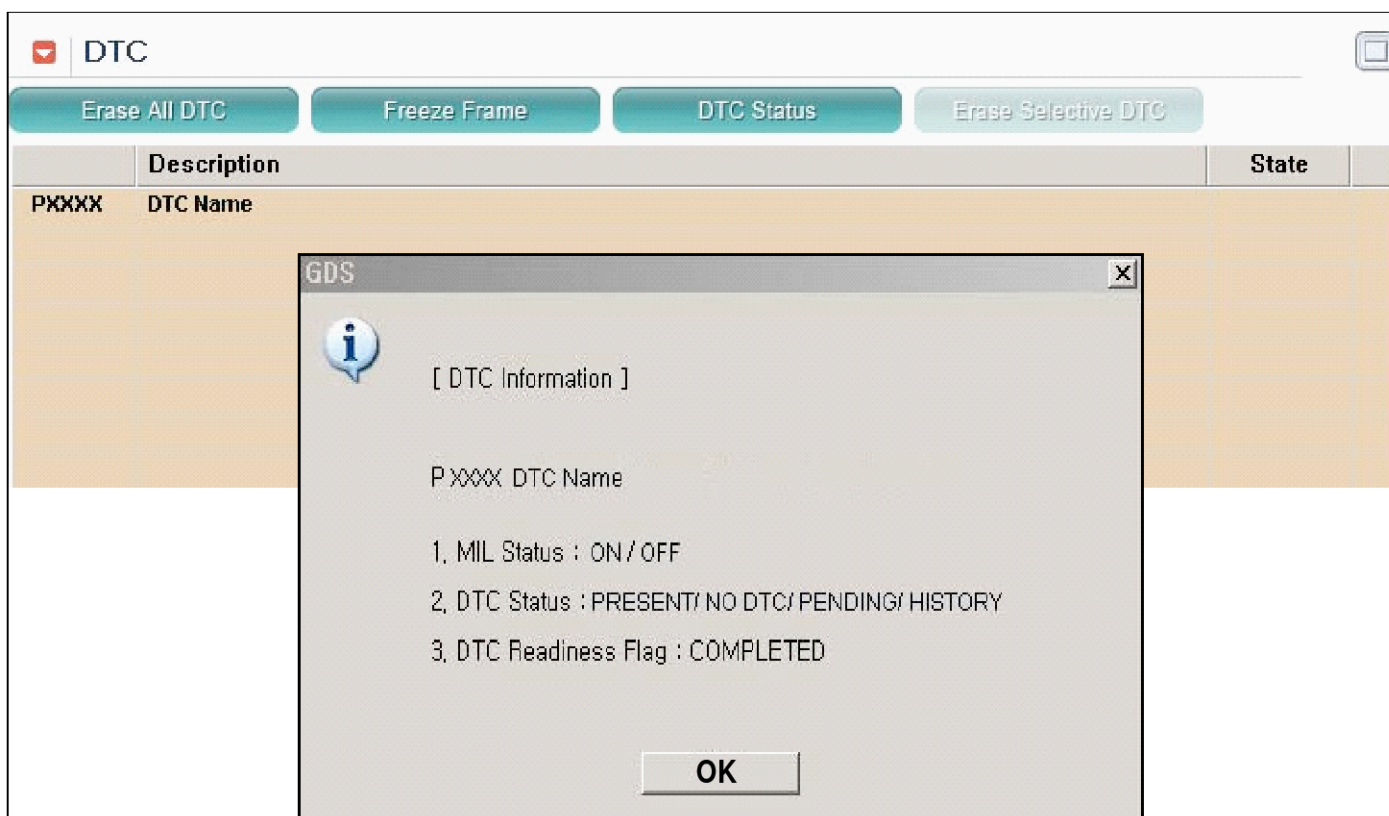
Fig 4) Normal data of EX-CVVT at acceleration.

Fig 5) Normal graph of EX-CVVT at acceleration.

The oil control valve is commanded by a pulse-with-modulated signal from the engine control unit. A duty cycle of zero commands the cam phaser to its default position. A duty cycle of 100% commands the cam phaser to its maximum phased position. When the phaser must be controlled to an intermediate position, the duty cycle is maintained in the region of the 'hold position'. This is a medium duty cycle, usually between 35% and 65%, depending on temperature and voltage conditions.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Power Circuit Inspection " as follow.

Power Circuit Inspection

■ Check voltage

1. IG "OFF" & Disconnect OCV connector.
2. IG "ON".
3. Measure voltage between power terminal of OCV harness connector and chassis ground.

Specification : B+

4. Is the measured voltage within specification ?

YES ► Go to " Control Circuit Inspection " procedure.

NO ► Check fuse between Main Relay and OCV is open or not installed.
 ► Check open in power circuit between Main Relay and OCV power circuit.
 ► Check short to ground in power circuit between Main Relay and OCV power circuit.
 ► Repair or replace as necessary go to "Verification of Vehicle Repair " procedure.

Engine Control System

FL-231

Control Circuit Inspection

■ Check resistance

1. IG "OFF" and disconnect OCV and ECM connector.
2. Measure resistance between control terminal of OCV harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification ?

YES ▶ Go to "Check open in harness" as follows .

NO ▶ Repair short to ground in OCV control circuit and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect OCV and ECM connector.
2. Measure resistance between control terminal of OCV harness connector and OCV control terminal of ECM harness connector.

Specification : Approx. below 1Ω

3. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in OCV control circuit and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check OCV resistance

1. IG "OFF" and disconnect OCV connector.
2. Measure resistance between power and signal terminals of OCV. (Component Side)

Specification : 6.7 ~ 7.7 Ω

3. Is the measured resistance within specification?

YES ▶ Go to "OCV Actuation Test" as follows.

NO ▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

■ OCV Actuation Test

1. Connect scantool and IG "ON"
2. Select "OIL CONTROL VALVE" on the Actuation Test
3. Activates "OIL CONTROL VALVE" by pressing "START" button
(Should hear a faint click from Oil Control solenoid Valve)
4. Repeat this procedure 4 or 5 times to ensure oil control solenoid valve reliability

 **Actuation Test**

Test Items
A/C Compressor Relay
Fuel Pump Control
Immobilizer Lamp
Canister Shut Off Valve Clocked
Canister Purge Valve
Oil Control Valve
Ignition Coil-#1
Ignition Coil-#2
Ignition Coil-#3
Ignition Coil-#4

Duration

Until Stop Button

Conditions

IG, ON/ENG.OFF

Result

Start

Stop

SBHFL9606L

5. Does OCV generate click sound during acutation test ?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

 NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

NO ► Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-233

P0080 Exhaust Valve Control Solenoid Circuit High (Bank 1)

Component Location

Refer to DTC P0079 : Exhaust Valve Control Solenoid Circuit Low (Bank 1)

General Description

Refer to DTC P0079 : Exhaust Valve Control Solenoid Circuit Low (Bank 1)

DTC Description

When the enable condition is satisfied The ECM checks that high and low outputs (Voltage level) are observed when OCVs are commanded. When a OCV output failure is detected, the appropriate fail counter is incremented.

If the failure threshold is exceeded 5 seconds during one diagnostic test(10 second),the test is failed and DTC is stored.

MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Detects a short to battery	• Poor Connection • Short to battery in Control Circuit • OCV • ECM
Enable Conditions	• No disabling Faults Present • Engine Running • $11V \leq \text{Battery Voltage} \leq 16V$	
Threshold value	• Short to battery	
Diagnosis Time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	• 2 Driving Cycles	

Specification

Refer to DTC P0079 : Exhaust Valve Control Solenoid Circuit Low (Bank 1)

Diagnostic Circuit Diagram

Refer to DTC P0079 : Exhaust Valve Control Solenoid Circuit Low (Bank 1)

Signal Waveform & Data

Refer to DTC P0079 : Exhaust Valve Control Solenoid Circuit Low (Bank 1)

Monitor Scantool Data

Refer to DTC P0079 : Exhaust Valve Control Solenoid Circuit Low (Bank 1)

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Control Circuit Inspection " procedure.

Control Circuit Inspection

■ Check short to battery in harness

1. IG "OFF" & Disconnect OCV connector.
2. Measure resistance between power and control terminals of OCV harness connector.

Specification : Infinite

3. Is the measured resistance within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Repair short to battery in OCV control circuit and go to "Verification of Vehicle Repair" procedure.

FL-234

Fuel System

Component Inspection

■ Check OCV resistance

1. IG "OFF" and disconnect OCV connector.
2. Measure resistance between power and signal terminals of OCV. (Component Side)

Specification : 6.7 ~ 7.7 Ω

3. Is the measured resistance within specification?

YES ▶ Go to "OCV Actuation Test" as follows.

NO ▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

■ OCV Actuation Test

1. Connect scantool and IG "ON"
2. Select "OIL CONTROL VALVE" on the Actuation Test
3. Activates "OIL CONTROL VALVE" by pressing "START" button
(Should hear a faint click from Oil Control solenoid Valve)
4. Repeat this procedure 4 or 5 times to ensure oil control solenoid valve reliability

☒ **Actuation Test**

Test Items
A/C Compressor Relay
Fuel Pump Control
Immobilizer Lamp
Canister Shut Off Valve Clocked
Canister Purge Valve
Oil Control Valve
Ignition Coil-#1
Ignition Coil-#2
Ignition Coil-#3
Ignition Coil-#4

● Duration

Until Stop Button

● Conditions

IG. ON/ENG.OFF

● Result

Start

Stop

SBHFL9606L

5. Does OCV generate click sound during acutation test ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

NO ▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

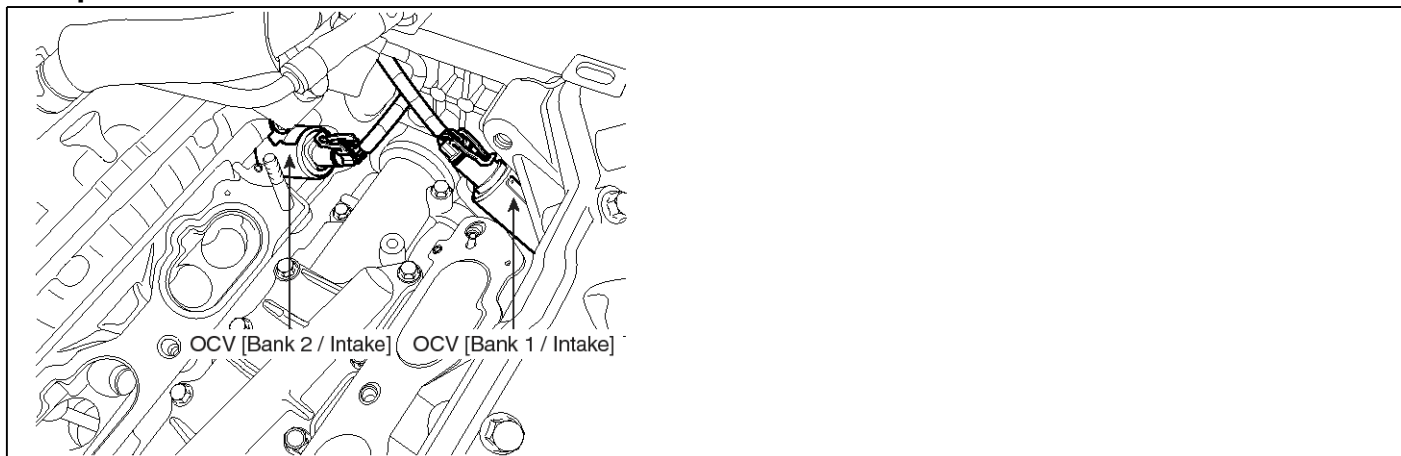
Refer to DTC P0079 : Exhaust Valve Control Solenoid Circuit Low (Bank 1)

Engine Control System

FL-235

P0082 Intake Valve Control Solenoid Circuit-Low (Bank 2)

Component Location



SBHFL9320L

General Description

The CVVT (Continuously Variable Valve Timing) system is installed to the chain sprocket of the intake camshaft. This system controls the intake camshaft to provide the optimal valve timing for every driving condition. The ECM controls the Oil Control Valve(OCV), based on the signals output from mass air flow, throttle position and engine coolant temperature. The CVVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft becomes optimal, and the engine torque improves, fuel economy improves, exhaust emissions decrease under overall driving conditions.

DTC Description

When the enable condition is satisfied The ECM checks that high and low outputs (Voltage level) are observed when OCVs are commanded. When a OCV output failure is detected, the appropriate fail counter is incremented.

If the failure threshold is exceeded 5 seconds during one diagnostic test(10 second),the test is failed and DTC is stored.

MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Detects a short to ground or open	• Poor Connection • Open in Power circuit • Open or short to ground in Control Circuit • OCV • ECM
Enable Conditions	• No disabling Faults Present • Engine Running • $11V \leq \text{Battery Voltage} \leq 16V$	
Threshold value	• Short to ground or open circuit	
Diagnosis Time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	• 2 Driving Cycles	

Specification

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

Signal Waveform & Data

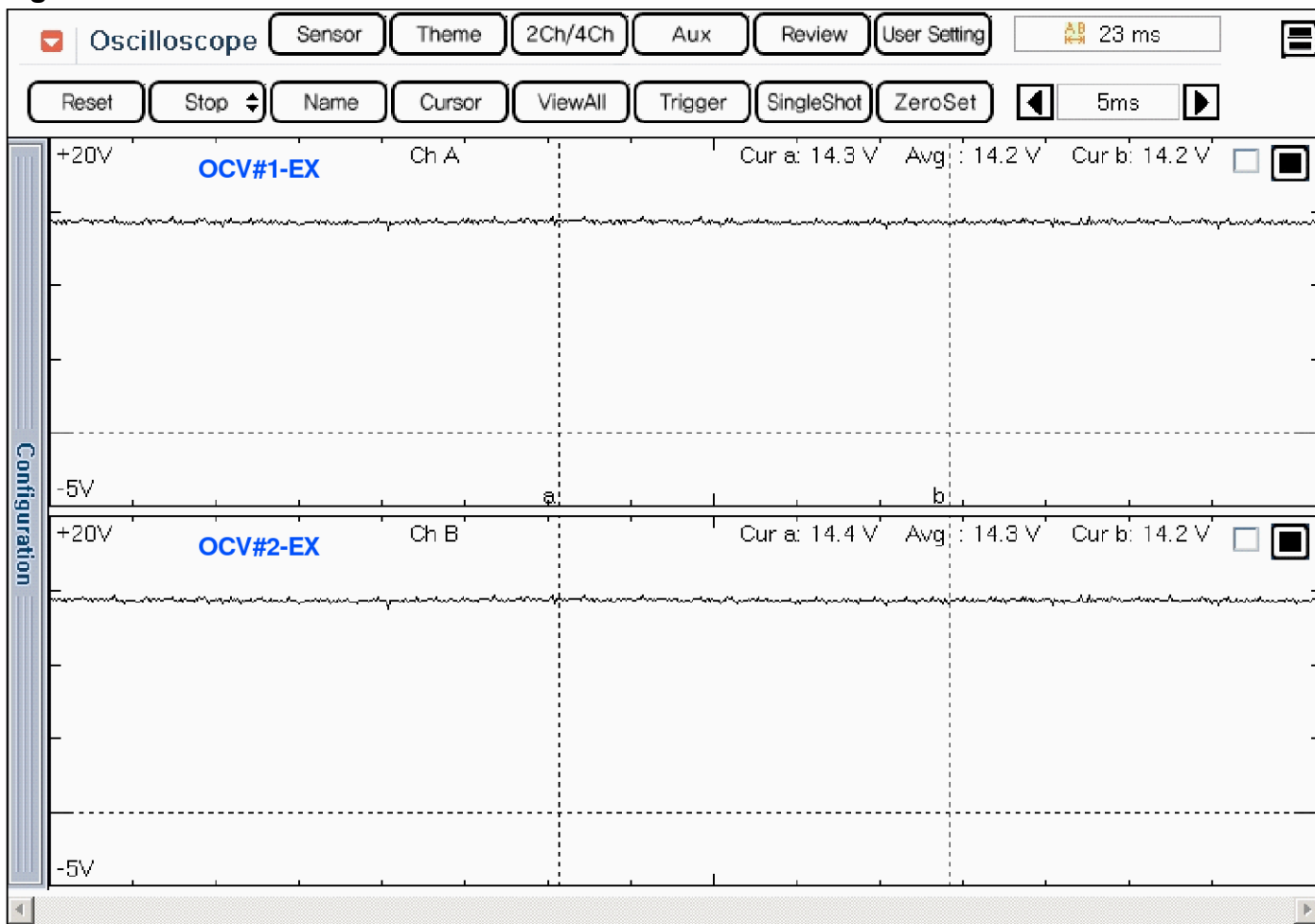


Fig.1

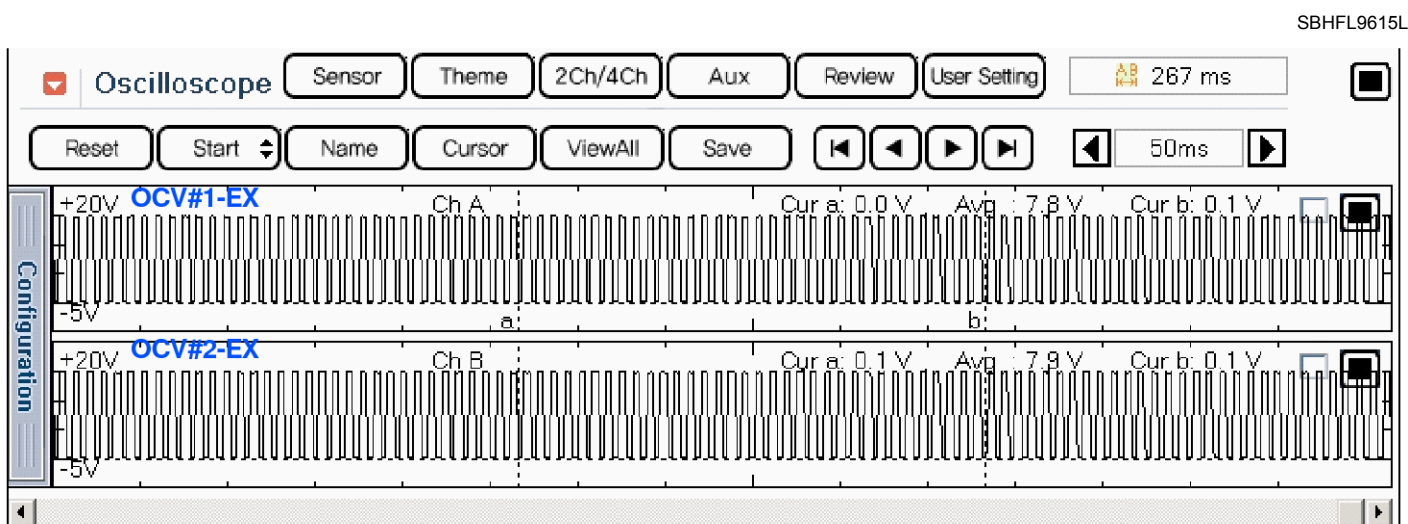


Fig.2

Fig 1) Normal waveform of OCV at idle.

Fig 2) Normal waveform of OCV at acceleration.
(3500rpm)

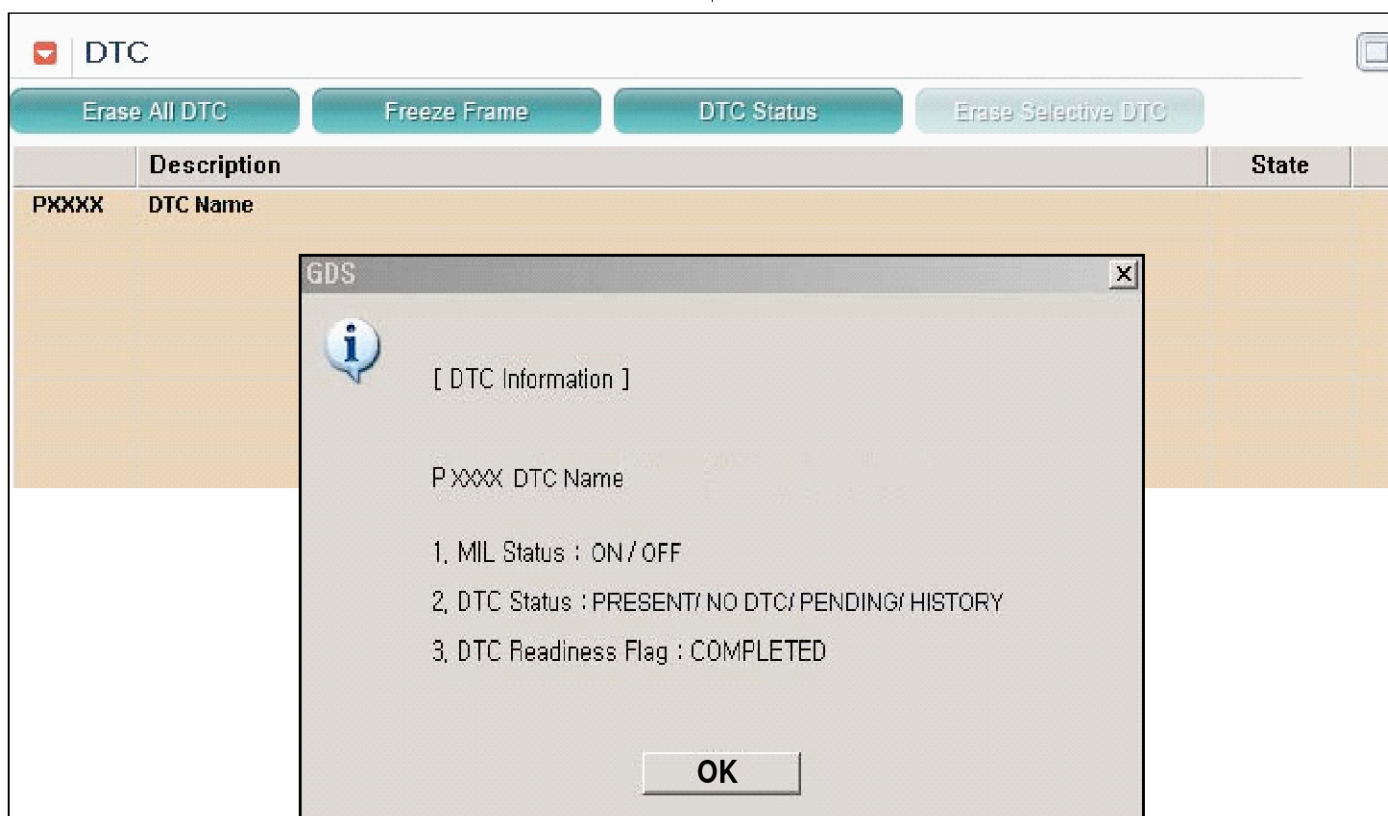
FL-238

Fuel System

The oil control valve is commanded by a pulse-with-modulated signal from the engine control unit. A duty cycle of zero commands the cam phaser to its default position. A duty cycle of 100% commands the cam phaser to its maximum phased position. When the phaser must be controlled to an intermediate position, the duty cycle is maintained in the region of the 'hold position'. This is a medium duty cycle, usually between 35% and 65%, depending on temperature and voltage conditions.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?
YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure.
NO ► Go to "Power Circuit Inspection" as follow.

Engine Control System

FL-239

Power Circuit Inspection

■ Check voltage

1. IG "OFF" & Disconnect OCV connector.
2. IG "ON".
3. Measure voltage between power terminal of OCV harness connector and chassis ground.

Specification : B+

4. Is the measured voltage within specification ?

YES ▶ Go to "Control Circuit Inspection" procedure.

NO ▶ Check fuse between Main Relay and OCV is open or not installed.
▶ Check open in power circuit between Main Relay and OCV power circuit.
▶ Check short to ground in power circuit between Main Relay and OCV power circuit.
▶ Repair or replace as necessary go to "Verification of Vehicle Repair" procedure.

Control Circuit Inspection

■ Check resistance

1. IG "OFF" and disconnect OCV and ECM connector.
2. Measure resistance between control terminal of OCV harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification ?

YES ▶ Go to "Check open in harness" as follows .

NO ▶ Repair short to ground in OCV control circuit and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect OCV and ECM connector.
2. Measure resistance between control terminal of OCV harness connector and OCV control terminal of ECM harness connector.

Specification : Approx. below 1Ω

3. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in OCV control circuit and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check OCV resistance

1. IG "OFF" and disconnect OCV connector.
2. Measure resistance between power and signal terminals of OCV. (Component Side)

Specification : 6.7 ~ 7.7 Ω

3. Is the measured resistance within specification?

YES ▶ Go to "OCV Actuation Test" as follows.

NO ▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

■ OCV Actuation Test

1. Connect scantool and IG "ON"
2. Select "OIL CONTROL VALVE" on the Actuation Test
3. Activates "OIL CONTROL VALVE" by pressing "START" button
(Should hear a faint click from Oil Control solenoid Valve)
4. Repeat this procedure 4 or 5 times to ensure oil control solenoid valve reliability

FL-240

Fuel System

Actuation Test

Test Items

A/C Compressor Relay

Fuel Pump Control

Immobilizer Lamp

Canister Shut Off Valve Clocked

Canister Purge Valve

Oil Control Valve

Ignition Coil-#1

Ignition Coil-#2

Ignition Coil-#3

Ignition Coil-#4

Duration

Until Stop Button

Conditions

IG. ON/ENG.OFF

Result

Start

Stop

SBHFL9606L

5. Does OCV generate click sound during acutation test ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

NO ▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-241

P0083 Intake Valve Control Solenoid Circuit-High (Bank 2)

Component Location

Refer to DTC P0082 : Intake Valve Control Solenoid Circuit-Low (Bank 2)

General Description

Refer to DTC P0082 : Intake Valve Control Solenoid Circuit-Low (Bank 2)

DTC Description

When the enable condition is satisfied The ECM checks that high and low outputs (Voltage level) are observed when OCVs are commanded. When a OCV output failure is detected, the appropriate fail counter is incremented.

If the failure threshold is exceeded 5 seconds during one diagnostic test(10 second),the test is failed and DTC is stored.

MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Detects a short to battery	• Poor Connection • Short to battery in Control Circuit • OCV • ECM
Enable Conditions	• No disabling Faults Present • Engine Running • $11V \leq \text{Battery Voltage} \leq 16V$	
Threshold value	• Short to battery	
Diagnosis Time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	• 2 Driving Cycles	

Specification

Refer to DTC P0082 : Intake Valve Control Solenoid Circuit-Low (Bank 2)

Diagnostic Circuit Diagram

Refer to DTC P0082 : Intake Valve Control Solenoid Circuit-Low (Bank 2)

Signal Waveform & Data

Refer to DTC P0082 : Intake Valve Control Solenoid Circuit-Low (Bank 2)

Monitor Scantool Data

Refer to DTC P0082 : Intake Valve Control Solenoid Circuit-Low (Bank 2)

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Control Circuit Inspection " procedure.

Control Circuit Inspection

■ Check short to battery in harness

1. IG "OFF" & Disconnect OCV connector.
2. Measure resistance between power and control terminals of OCV harness connector.

Specification : Infinite

3. Is the measured resistance within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Repair short to battery in OCV control circuit and go to "Verification of Vehicle Repair" procedure.

FL-242

Fuel System

Component Inspection

■ Check OCV resistance

1. IG "OFF" and disconnect OCV connector.
2. Measure resistance between power and signal terminals of OCV. (Component Side)

Specification : 6.7 ~ 7.7 Ω

3. Is the measured resistance within specification?

YES ▶ Go to "OCV Actuation Test" as follows.

NO ▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

■ OCV Actuation Test

1. Connect scantool and IG "ON"
2. Select "OIL CONTROL VALVE" on the Actuation Test
3. Activates "OIL CONTROL VALVE" by pressing "START" button
(Should hear a faint click from Oil Control solenoid Valve)
4. Repeat this procedure 4 or 5 times to ensure oil control solenoid valve reliability

☒ **Actuation Test**

Test Items
A/C Compressor Relay
Fuel Pump Control
Immobilizer Lamp
Canister Shut Off Valve Clocked
Canister Purge Valve
Oil Control Valve
Ignition Coil-#1
Ignition Coil-#2
Ignition Coil-#3
Ignition Coil-#4

● Duration

Until Stop Button

● Conditions

IG. ON/ENG.OFF

● Result

Start

Stop

SBHFL9606L

5. Does OCV generate click sound during acutation test ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

NO ▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

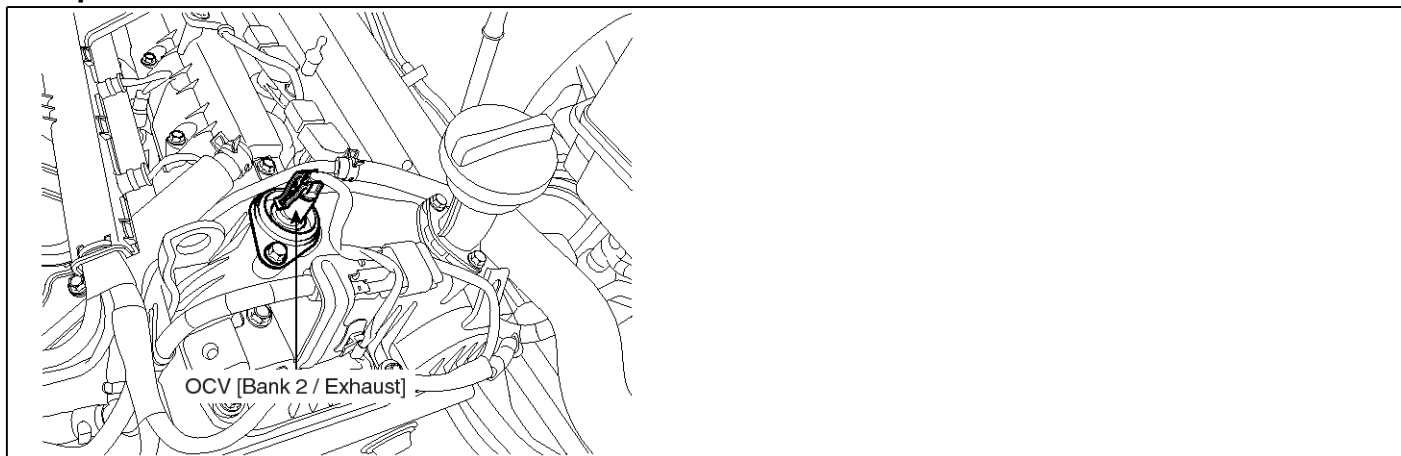
Refer to DTC P0082 : Intake Valve Control Solenoid Circuit-Low (Bank 2)

Engine Control System

FL-243

P0085 Exhaust Valve Control Solenoid Circuit Low (Bank 2)

Component Location



SBHFL9322L

General Description

The CVVT (Continuously Variable Valve Timing) system is installed to the chain sprocket of the intake camshaft. This system controls the intake camshaft to provide the optimal valve timing for every driving condition. The ECM controls the Oil Control Valve(OCV), based on the signals output from mass air flow, throttle position and engine coolant temperature. The CVVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft becomes optimal, and the engine torque improves, fuel economy improves, exhaust emissions decrease under overall driving conditions.

DTC Description

When the enable condition is satisfied The ECM checks that high and low outputs (Voltage level) are observed when OCVs are commanded. When a OCV output failure is detected, the appropriate fail counter is incremented.

If the failure threshold is exceeded 5 seconds during one diagnostic test(10 second),the test is failed and DTC is stored.

MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

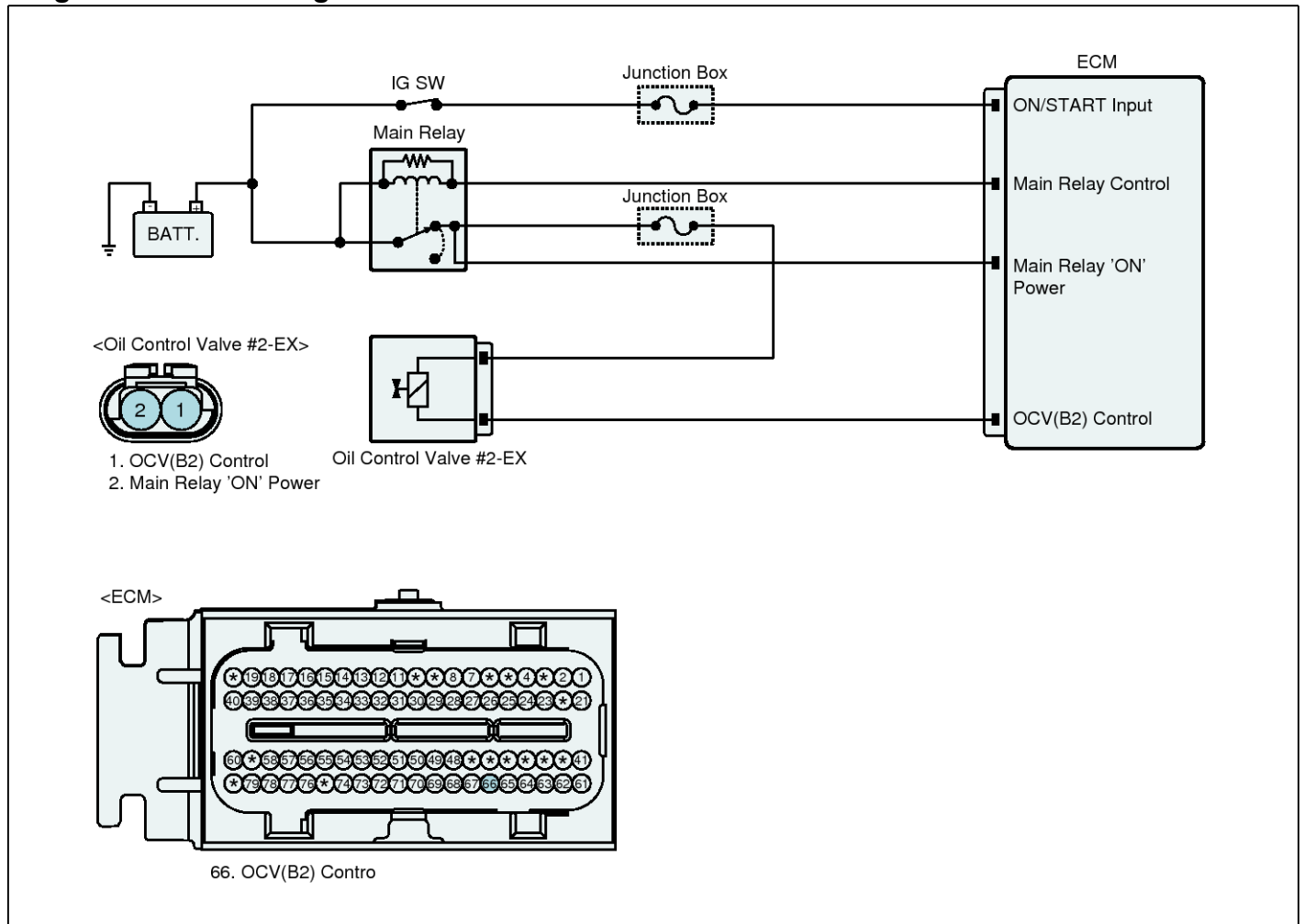
DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Detects a short to ground or open	• Poor Connection • Open in Power circuit • Open or short to ground in Control Circuit • OCV • ECM
Enable Conditions	• No disabling Faults Present • Engine Running • $11V \leq \text{Battery Voltage} \leq 16V$	
Threshold value	• Short to ground or open circuit	
Diagnosis Time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	• 2 Driving Cycles	

Specification

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

Diagnostic Circuit Diagram



Signal Waveform & Data

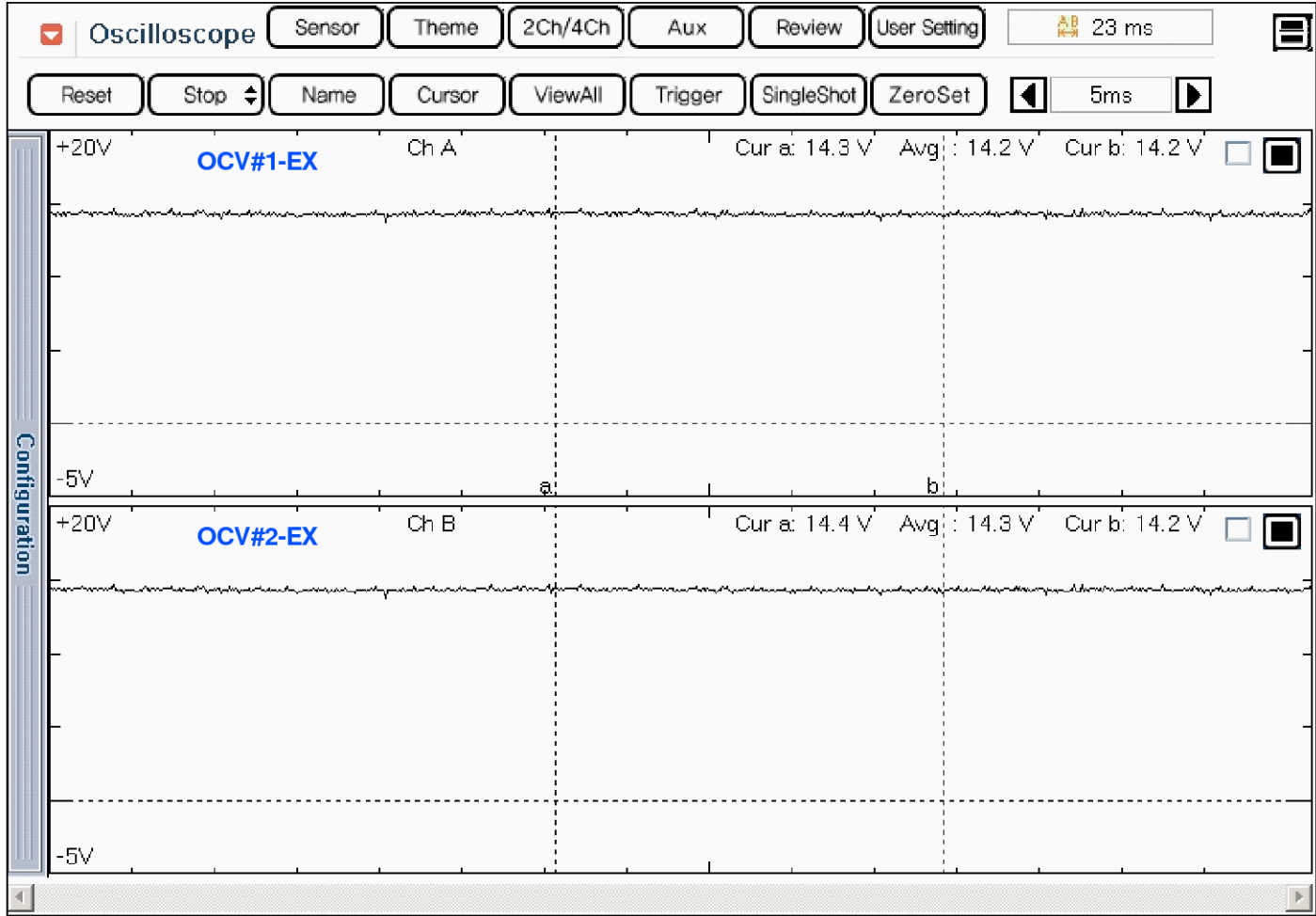


Fig.1

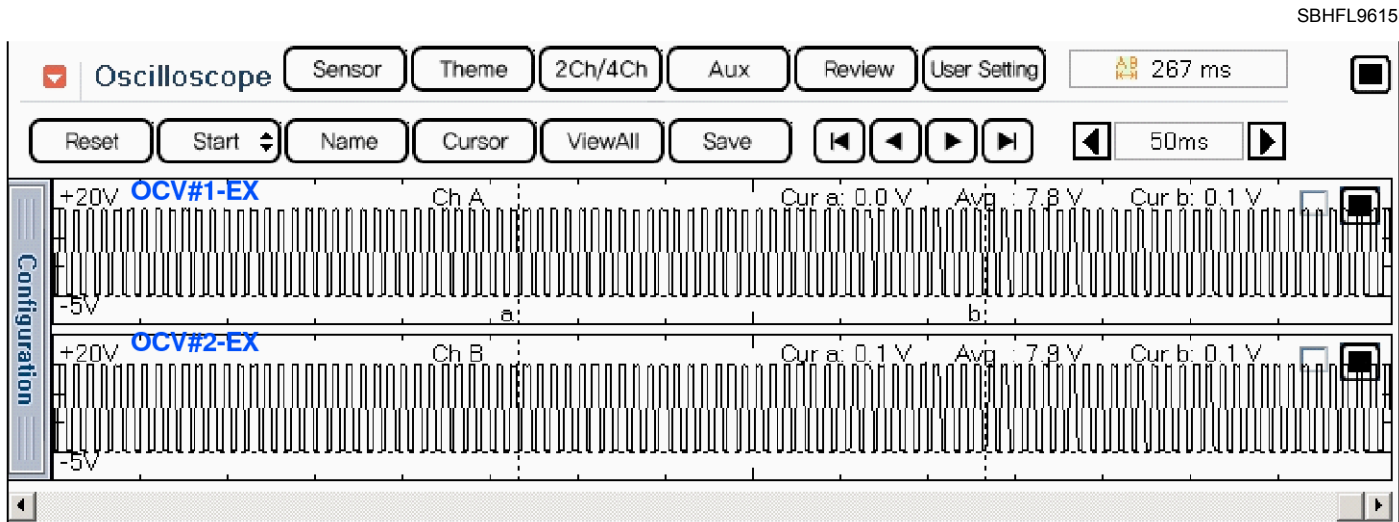


Fig.2

SBHFL9615L

SBHFL9616L

FL-246

Fuel System

Current Data			
Standard Display ▾	Full List ▾	Graph ▾	Items List ▾
Reset Min.Max.		Record	Stop ▾
VSS			
Sensor Name	Value	Unit	
☐ EX-Cam Bank1 Desired Position	0	DEG	
☐ EX-Cam Bank1 Actual Position	0	DEG	
☐ EX-Cam Bank2 Desired Position	0	DEG	
☐ EX-Cam Bank2 Actual Position	0	DEG	
☐ EX-Cam Phaser 1 Duty Cycle	0	%	
☐ EX-Cam Phaser 2 Duty Cycle	0	%	

Fig.3

SBHFL9610L

Sensor Name	Value	Unit	
☒ Camshaft Control	ON	-	
☒ Engine Speed	3840	RPM	
☒ EX-Cam Bank1 Actual Position	-15	DEG	
☒ EX-Cam Bank1 Desired Position	-14	DEG	
☒ EX-Cam Bank2 Desired Position	-14	DEG	
☒ EX-Cam Bank2 Actual Position	-15	DEG	
☒ EX-Cam Phaser 1 Duty Cycle	43	%	
☒ EX-Cam Phaser 2 Duty Cycle	44	%	

Fig.4

SBHFL9611L

Engine Control System

FL-247

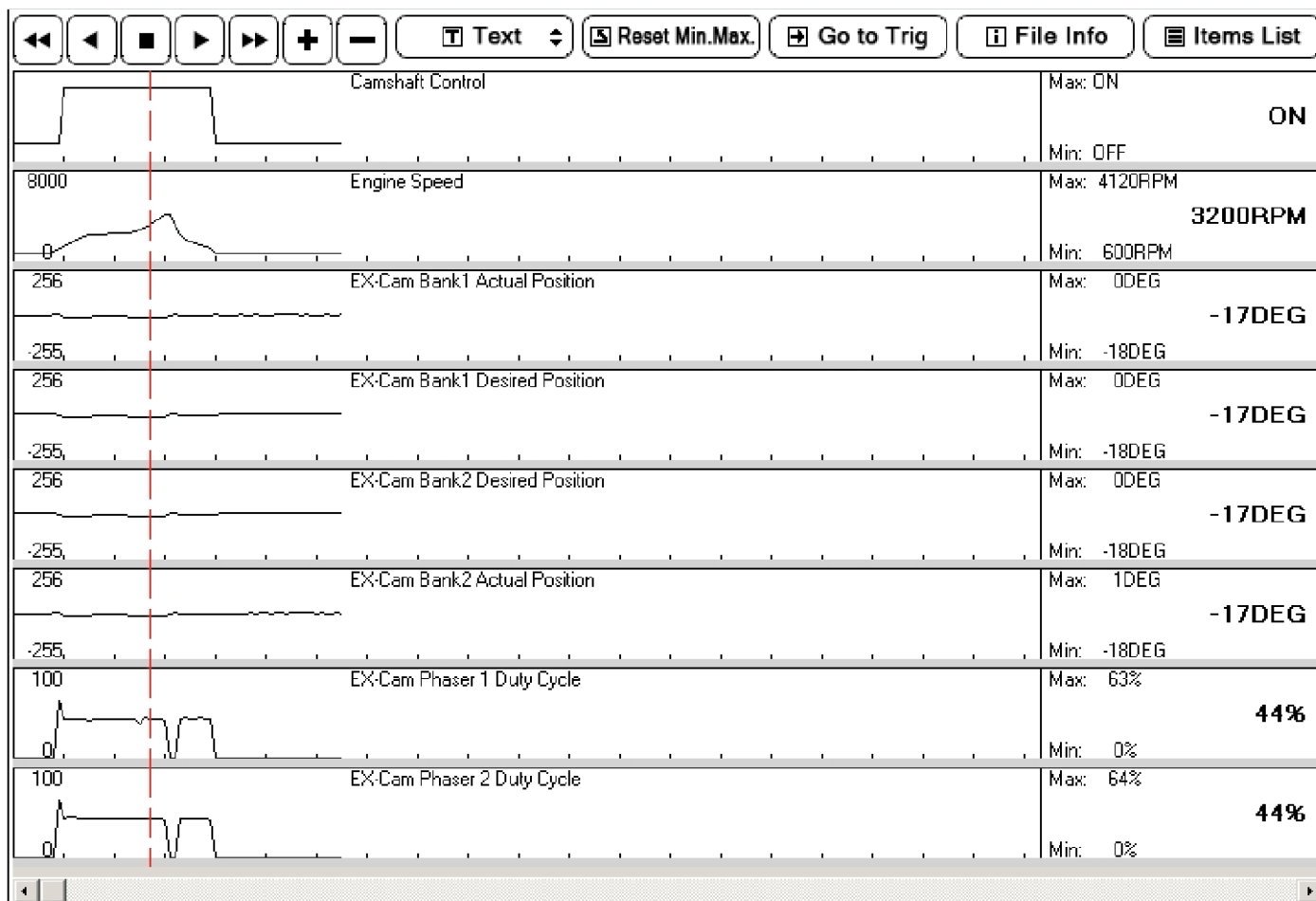


Fig.5

SBHFL9612L

Fig 1) Normal waveform of OCV at idle.

Fig 2) Normal waveform of OCV at acceleration. (3500rpm)

Fig 3) Normal data of EX-CVVT at idle.

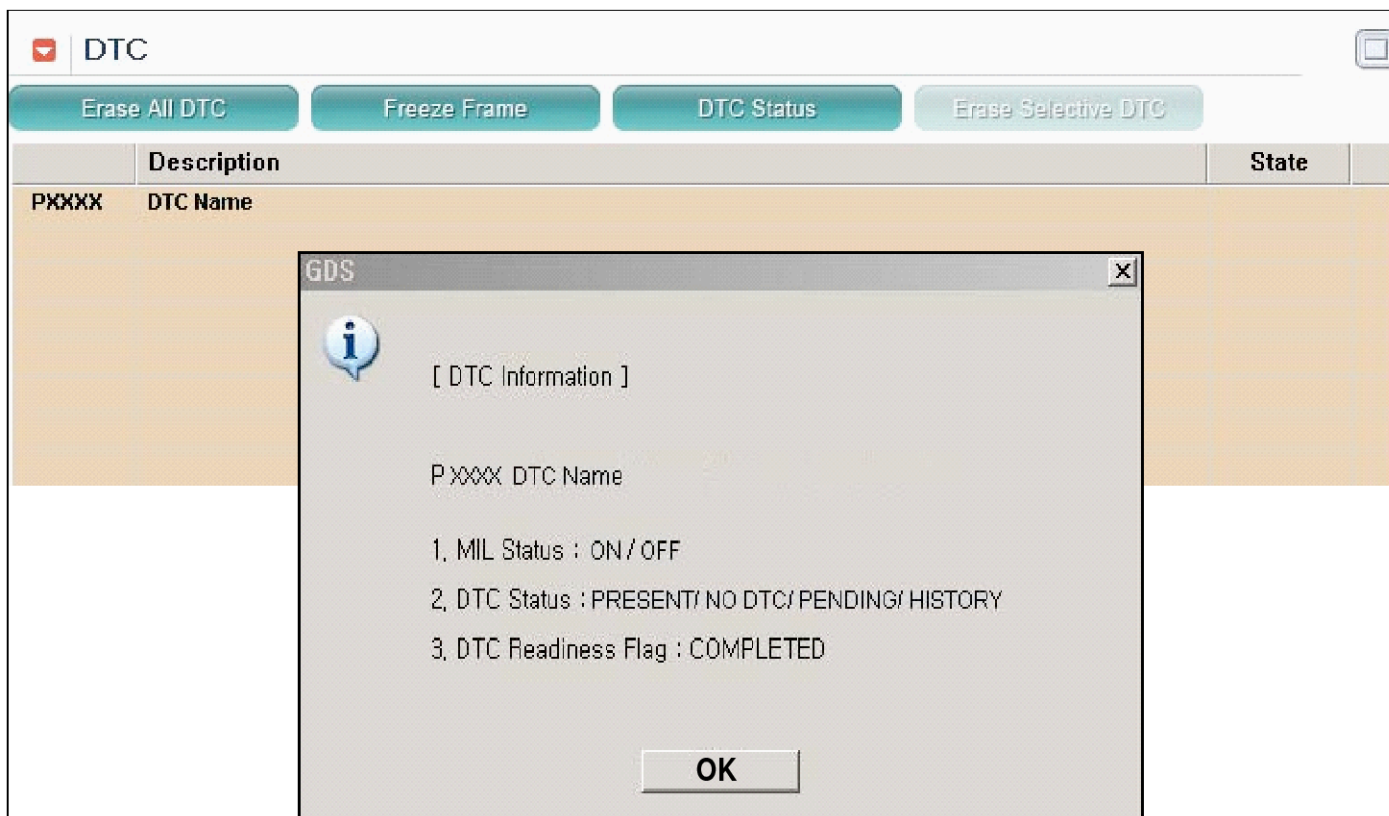
Fig 4) Normal data of EX-CVVT at acceleration.

Fig 5) Normal graph of EX-CVVT at acceleration.

The oil control valve is commanded by a pulse-with-modulated signal from the engine control unit. A duty cycle of zero commands the cam phaser to its default position. A duty cycle of 100% commands the cam phaser to its maximum phased position. When the phaser must be controlled to an intermediate position, the duty cycle is maintained in the region of the 'hold position'. This is a medium duty cycle, usually between 35% and 65%, depending on temperature and voltage conditions.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Power Circuit Inspection " as follow.

Power Circuit Inspection

■ Check voltage

1. IG "OFF" & Disconnect OCV connector.
2. IG "ON".
3. Measure voltage between power terminal of OCV harness connector and chassis ground.

Specification : B+

4. Is the measured voltage within specification ?

YES ► Go to " Control Circuit Inspection " procedure.

NO ► Check fuse between Main Relay and OCV is open or not installed.
 ► Check open in power circuit between Main Relay and OCV power circuit.
 ► Check short to ground in power circuit between Main Relay and OCV power circuit.
 ► Repair or replace as necessary go to "Verification of Vehicle Repair " procedure.

Engine Control System

FL-249

Control Circuit Inspection

■ Check resistance

1. IG "OFF" and disconnect OCV and ECM connector.
2. Measure resistance between control terminal of OCV harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification ?

YES ▶ Go to "Check open in harness" as follows .

NO ▶ Repair short to ground in OCV control circuit and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect OCV and ECM connector.
2. Measure resistance between control terminal of OCV harness connector and OCV control terminal of ECM harness connector.

Specification : Approx. below 1Ω

3. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in OCV control circuit and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check OCV resistance

1. IG "OFF" and disconnect OCV connector.
2. Measure resistance between power and signal terminals of OCV. (Component Side)

Specification : 6.7 ~ 7.7 Ω

3. Is the measured resistance within specification?

YES ▶ Go to "OCV Actuation Test" as follows.

NO ▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

■ OCV Actuation Test

1. Connect scantool and IG "ON"
2. Select "OIL CONTROL VALVE" on the Actuation Test
3. Activates "OIL CONTROL VALVE" by pressing "START" button
(Should hear a faint click from Oil Control solenoid Valve)
4. Repeat this procedure 4 or 5 times to ensure oil control solenoid valve reliability

Actuation Test

Test Items
A/C Compressor Relay
Fuel Pump Control
Immobilizer Lamp
Canister Shut Off Valve Clocked
Canister Purge Valve
Oil Control Valve
Ignition Coil-#1
Ignition Coil-#2
Ignition Coil-#3
Ignition Coil-#4

Duration

Until Stop Button

Conditions

IG, ON/ENG.OFF

Result

Start

Stop

SBHFL9606L

FL-250

Fuel System

5. Does OCV generate click sound during acutation test ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

NO ▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-251

P0086 Exhaust Valve Control Solenoid Circuit High (Bank 2)

Component Location

Refer to DTC P0085 : Exhaust Valve Control Solenoid Circuit Low (Bank 2)

General Description

Refer to DTC P0085 : Exhaust Valve Control Solenoid Circuit Low (Bank 2)

DTC Description

When the enable condition is satisfied The ECM checks that high and low outputs (Voltage level) are observed when OCVs are commanded. When a OCV output failure is detected, the appropriate fail counter is incremented.

If the failure threshold is exceeded 5 seconds during one diagnostic test(10 second),the test is failed and DTC is stored.

MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Detects a short to battery	• Poor Connection • Short to battery in Control Circuit • OCV • ECM
Enable Conditions	• No disabling Faults Present • Engine Running • $11V \leq \text{Battery Voltage} \leq 16V$	
Threshold value	• Short to battery	
Diagnosis Time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	• 2 Driving Cycles	

Specification

Refer to DTC P0085 : Exhaust Valve Control Solenoid Circuit Low (Bank 2)

Diagnostic Circuit Diagram

Refer to DTC P0085 : Exhaust Valve Control Solenoid Circuit Low (Bank 2)

Signal Waveform & Data

Refer to DTC P0085 : Exhaust Valve Control Solenoid Circuit Low (Bank 2)

Monitor Scantool Data

Refer to DTC P0085 : Exhaust Valve Control Solenoid Circuit Low (Bank 2)

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Control Circuit Inspection " procedure.

Control Circuit Inspection

■ Check short to battery in harness

1. IG "OFF" & Disconnect OCV connector.
2. Measure resistance between power and control terminals of OCV harness connector.

Specification : Infinite

3. Is the measured resistance within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Repair short to battery in OCV control circuit and go to "Verification of Vehicle Repair" procedure.

FL-252

Fuel System

Component Inspection

■ Check OCV resistance

1. IG "OFF" and disconnect OCV connector.
2. Measure resistance between power and signal terminals of OCV. (Component Side)

Specification : 6.7 ~ 7.7 Ω

3. Is the measured resistance within specification?

YES ▶ Go to "OCV Actuation Test" as follows.

NO ▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

■ OCV Actuation Test

1. Connect scantool and IG "ON"
2. Select "OIL CONTROL VALVE" on the Actuation Test
3. Activates "OIL CONTROL VALVE" by pressing "START" button
(Should hear a faint click from Oil Control solenoid Valve)
4. Repeat this procedure 4 or 5 times to ensure oil control solenoid valve reliability

☒ **Actuation Test**

Test Items
A/C Compressor Relay
Fuel Pump Control
Immobilizer Lamp
Canister Shut Off Valve Clocked
Canister Purge Valve
Oil Control Valve
Ignition Coil-#1
Ignition Coil-#2
Ignition Coil-#3
Ignition Coil-#4

● Duration

Until Stop Button

● Conditions

IG. ON/ENG.OFF

● Result

Start

Stop

SBHFL9606L

5. Does OCV generate click sound during acutation test ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

NO ▶ Substitute with a known - good OCV and check for proper operation. If the problem is corrected, replace OCV and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

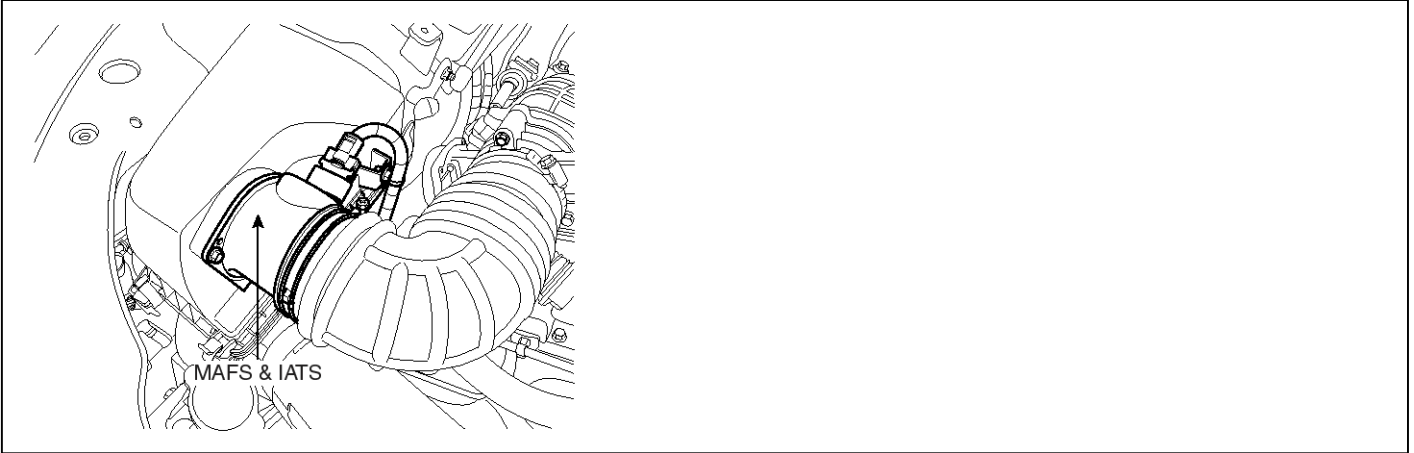
Refer to DTC P0085 : Exhaust Valve Control Solenoid Circuit Low (Bank 2)

Engine Control System

FL-253

P0101 Mass or Volume Air Flow "A" Circuit Range / Performance

Component Location



SBHFL9301L

General Description

The Mass Air Flow Sensor (MAFS) is located between the air cleaner assembly and the throttle body. The MAFS uses a hot film type sensing element to measure the mass of intake air entering the engine. This hot film type air flow sensor consists of a hot film sensor, housing and metering ducts. Mass air flow rate is measured by detection of heat transfer from a hot film probe. The change in air flow rate causes change in the amount of heat being transferred from the hot film probe surface to the air. A large amount of intake air represents acceleration or high load conditions while a small amount of intake air represents deceleration or idle. The mass of intake air should increase at acceleration and be stable during constant engine speed. The ECM uses this information to determine the injection duration and ignition timing for the desired air/fuel ratio.

DTC Description

The difference between values coming from the MAF Sensor and those are calculated is analyzed. This difference, or error, is then compared to high and low limit calibration values, which are functions of engine speed. ECM compares the difference between MAFS output and calculated flow rate value while enable condition is met.

If the actual air flow is higher or lower than calculated value(threshold) for more than 2min.

ECM determines that a fault exists and a DTC is stored.

MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	The MAF Rationality Diagnostic compares the difference between MAF Sensor output and calculated flow rate value to a calibration value	- Clogged air cleaner - MAFS
Enable Conditions	- Engine Coolant Temperature $\geq 60^{\circ}\text{C}$ (Fully Warmed up state) 600rpm < Engine Speed < 3000rpm	
Threshold value	Actual Air Mass Value is higher or lower than calculated value	
Diagnosis Time	Continuous (within 2min.)	
MIL On Condition	2 Driving Cycles	

FL-254

Fuel System

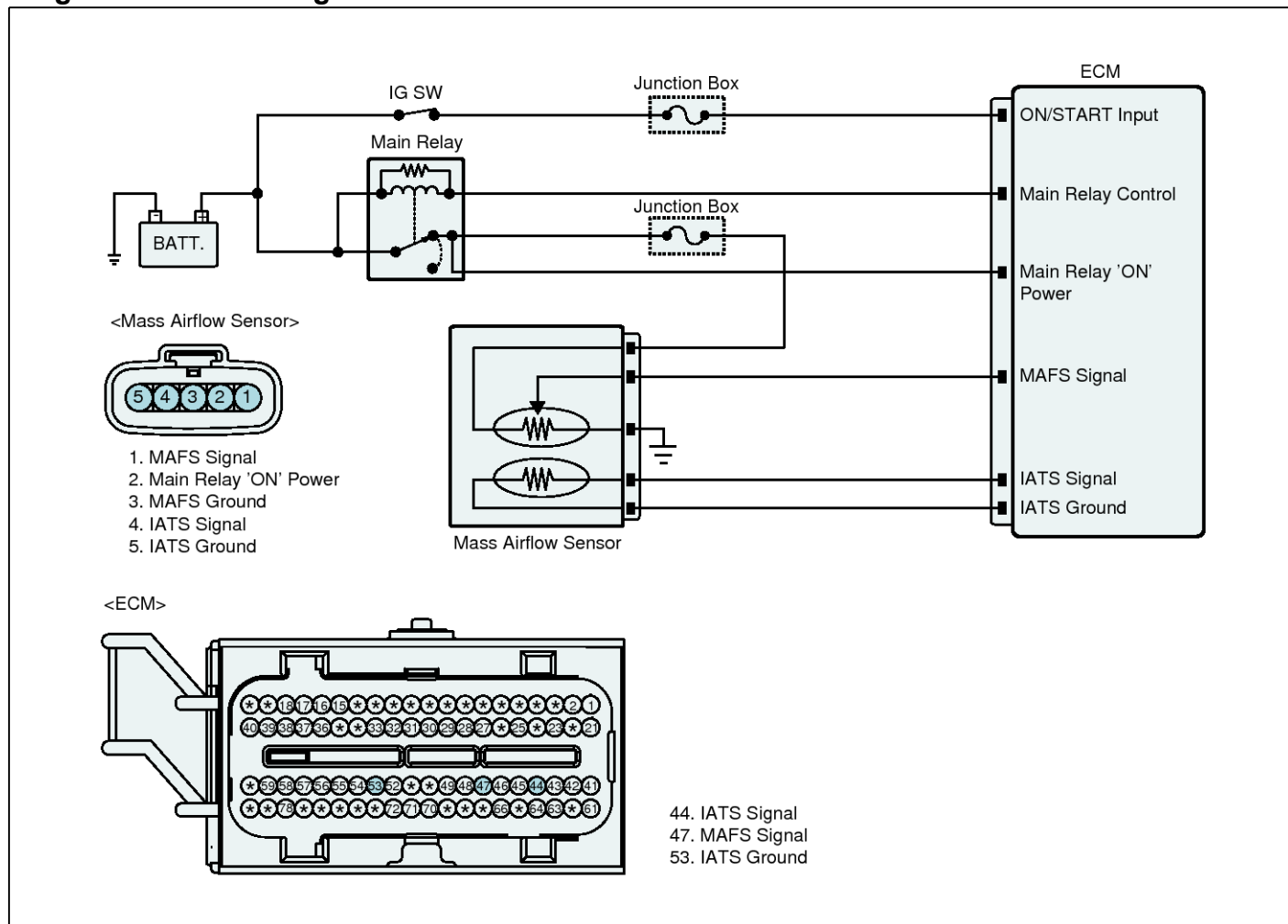
Specification

Air Flow(kg/h)	Frequency(Hz)
12.6	2617
18	2958
23.4	3241
32.4	3653
43.2	4024
57.6	4399
72	4704
108	5329
144	5897
198	6553
270	7240
360	7957
486	8738
666	9644
900	10590

Engine Control System

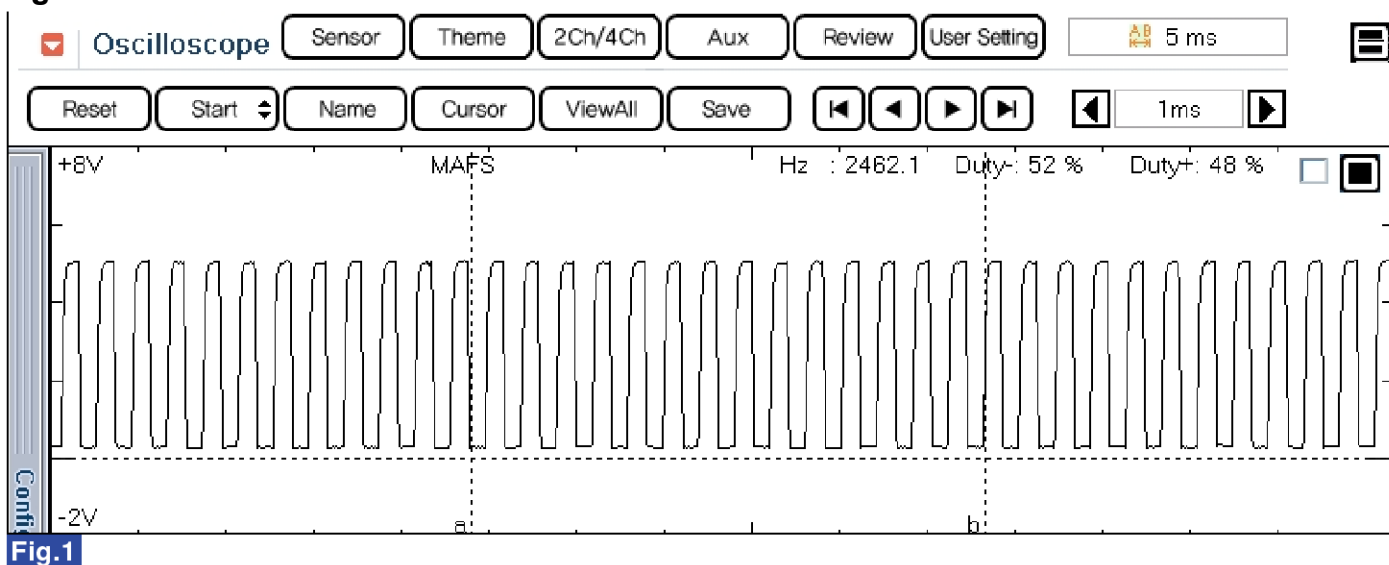
FL-255

Diagnostic Circuit Diagram



SBHFL9513L

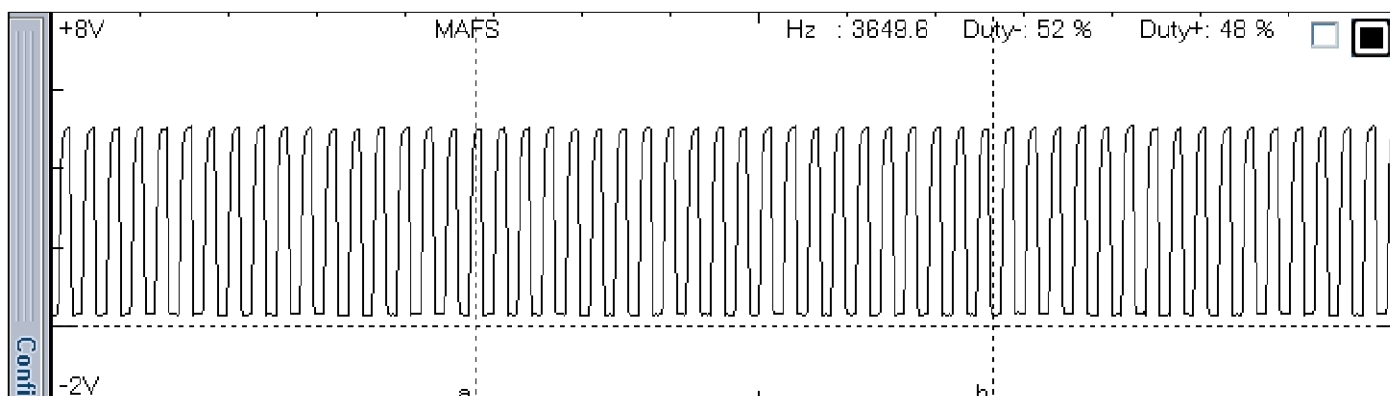
Signal Waveform & Data



SBHFL9621L

FL-256

Fuel System



SBHFL9622L

Current Data		
Standard Display	Full List	Graph
Items List	Reset Min.Max.	Record
Stop	VSS	
Sensor Name	Value	Unit
☒ Air Flow Rate from Mass Air Flow Sensor	11	kg/h
☒ Manifold Absolute Pressure Sensor	285	hPa
☒ Engine Speed	600	RPM

Fig.3

SBHFL9623L

Sensor Name	Value	Unit
☒ Air Flow Rate from Mass Air Flow Sensor	34	kg/h
☒ Manifold Absolute Pressure Sensor	250	hPa
☒ Engine Speed	2080	RPM

Fig.4

SBHFL9624L

Sensor Name	Value	Unit
☒ Air Flow Rate from Mass Air Flow Sensor	0	kg/h
☒ Manifold Absolute Pressure Sensor	374	hPa
☒ Engine Speed	640	RPM

Fig.5

SBHFL9625L

Fig 1) Normal waveform of MAFS at idle. (600rpm & 11kg/h)

Fig 2) Normal waveform of MAFS at acceleration. (2080rpm & 34kg/h)

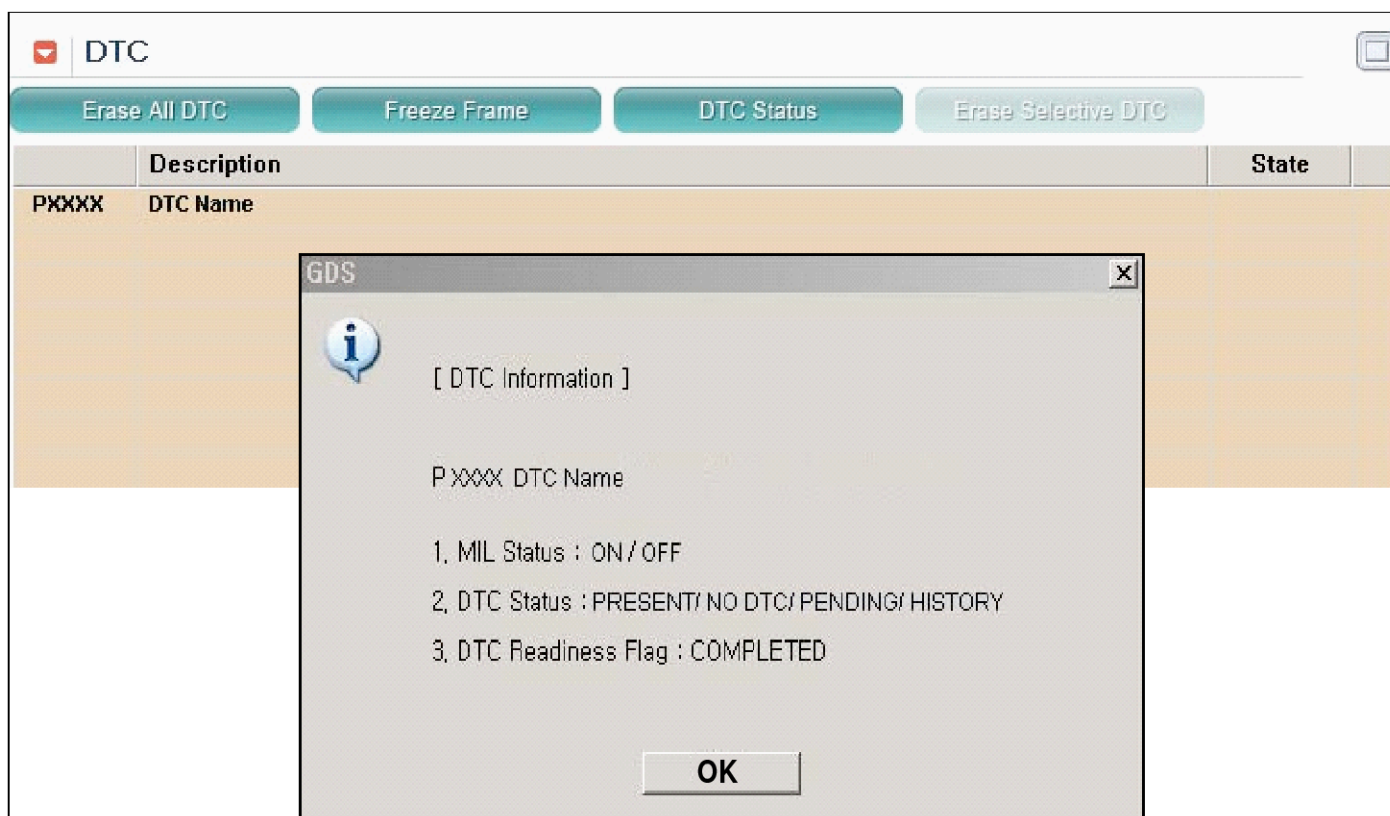
Fig 3) Normal data of MAFS at idle.

Fig 4) Normal data of MAFS at acceleration.

Fig 5) Abnormal data of MAFS at open or short condition.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Fault is intermittent caused by ECM memory was not cleared after repair. Erase DTC and drive the vehicle to satisfy the enable condition then, go to "Component Inspection" procedure.

Component Inspection

■ Visual Inspection

1. Check that MAFS is damaged, contaminated or deformed.
2. Check that air cleaner is clogged.
3. Has a problem been found ?

YES ▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check MAFS" as follows.

■ Check MAFS

1. IG "OFF" and install a scantool
2. ENG "ON" and monitor "MAFS" data on the service data.
3. Monitor signal waveform at signal terminal of MAFS with scantool.

Specification : Signal waveform will be displayed as follows. Frequency will be increased during acceleration. (Be aware that the signal of MAFS is not voltage display but frequency display.)

FL-258

Fuel System

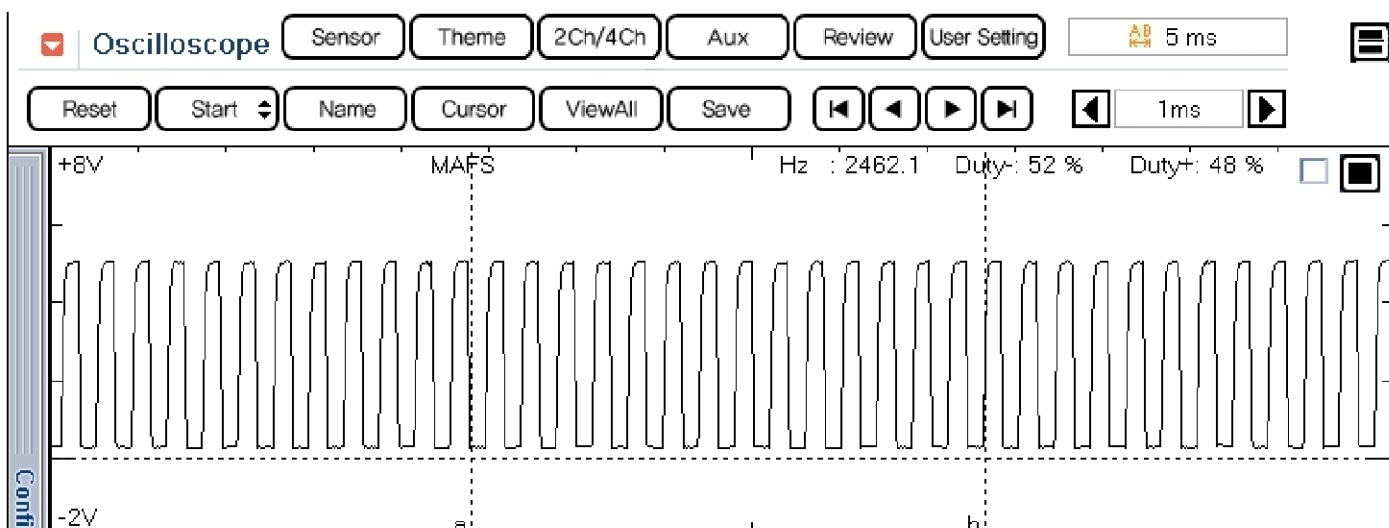


Fig.1

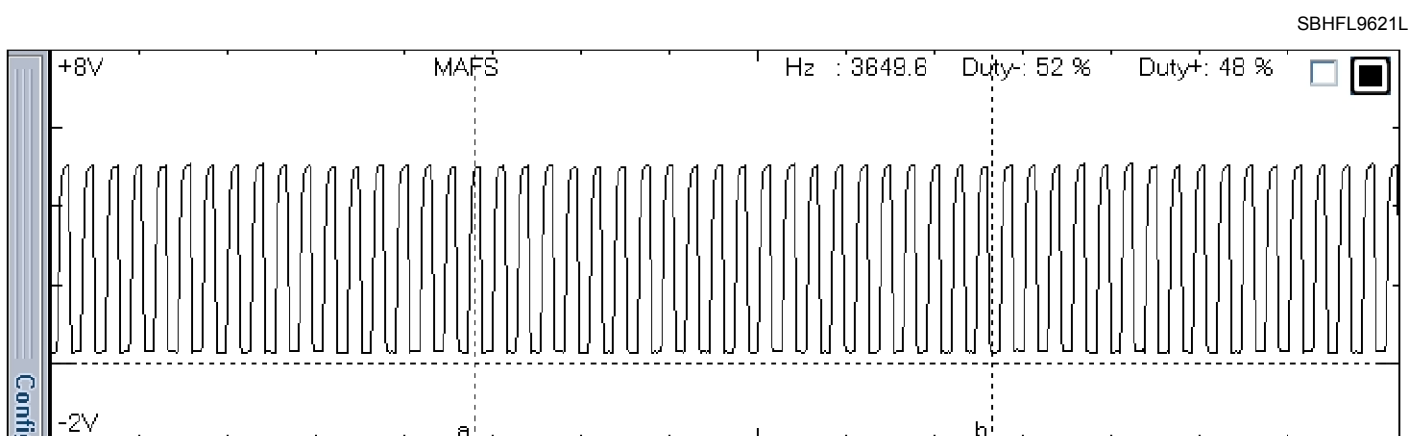


Fig.2

Fig 1) Normal waveform of MAFS at idle. (600rpm & 11kg/h)

Fig 2) Normal waveform of MAFS at acceleration. (2080rpm & 34kg/h)

4. Are both service data and signal waveform displayed correctly ?

YES ► Go to "Verification of Vehicle Repair" procedure.

NO ► Substitute with a known - good MAFS and check for proper operation. If the problem is corrected, replace MAFS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-259

P0102 Mass or Volume Air Flow "A" Circuit Low Input

Component Location

Refer to DTC P0101 : Mass or Volume Air Flow "A" Circuit Range/Performance

General Description

Refer to DTC P0101 : Mass or Volume Air Flow "A" Circuit Range/Performance

DTC Description

If ECM detects that frequency signal of MAFS is lower than 1000 Hz for more than 3.9 second during one diagnostic test (7.8 second) while enable condition is met, ECM determines that a fault exists and a DTC is stored.

MIL (Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Compares the airmeter input frequency to a high limit	• Poor Connection • Open or short in harness • MAFS • ECM
Enable Conditions	• Engine Speed ≥ 500 rpm • Engine Running Time ≥ 5 second • Ignition Voltage $\geq 11V$	
Threshold value	• MAF frequency signal $< 1000Hz$	
Diagnosis Time	• Continuous (More than 3.9 second failure for every 7.8 second tests)	
MIL On Condition	• 2 Driving Cycles	

Specification

Refer to DTC P0101 : Mass or Volume Air Flow "A" Circuit Range/Performance

Diagnostic Circuit Diagram

Refer to DTC P0101 : Mass or Volume Air Flow "A" Circuit Range/Performance

Signal Waveform & Data

Refer to DTC P0101 : Mass or Volume Air Flow "A" Circuit Range/Performance

Monitor Scantool Data

Refer to DTC P0101 : Mass or Volume Air Flow "A" Circuit Range/Performance

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Power Circuit Inspection" procedure.

Power Circuit Inspection

■ Check voltage

- IG "OFF" and Disconnect MAFS connector.
- IG "ON".
- Measure voltage between power terminal of MAFS harness connector and chassis ground.

Specification : B+

- Is the measured voltage within specification?

YES ▶ Go to "Signal Circuit Inspection" Procedure.

NO ▶ Check fuse between MAFS and main relay is open or not installed.

Signal Circuit Inspection

■ Check voltage

- IG "OFF" and Disconnect MAFS connector.
- IG "ON".
- Measure voltage between signal terminal of MAFS harness connector and chassis ground.

Specification : Approx. 5V

FL-260

Fuel System

4. Is the measured voltage within specification ?

YES ▶ Go to "Ground circuit inspection" procedure

NO ▶ If the measured voltage is "0", go to "Check open in harness" as follows. If the measured voltage is over "5V", go to "Check short to battery in harness" as follows.

■ Check short to battery in harness

1. IG "OFF" and disconnect MAFS and ECM connector.
2. Measure resistance between signal and power terminals of MAFS harness connector.
3. Measure resistance between signal terminal of MAFS harness connector and signal terminal of IATS harness connector.

Specification : Infinite

4. Is the measured resistance within specification ?

YES ▶ Go to "Check short to ground in harness" as follows.

NO ▶ Repair short to battery in harness and go to "Verification of Vehicle Repair" procedure.

■ Check short to ground in harness

1. IG "OFF" and disconnect MAFS and ECM connector.
2. Measure resistance between signal terminal of MAFS harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification ?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect MAFS and ECM connector.
2. Measure resistance between signal terminal of MAFS harness connector and MAFS signal terminal of ECM harness connector.

Specification : Approx. below 1Ω.

3. Is the measured resistance within specification ?

YES ▶ Go to "Ground circuit Inspection" procedure

NO ▶ Repair open in harness and go to "Verification of Vehicle Repair" procedure.

Ground Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect MAFS connector and then IG "ON".
2. Measure voltage between signal terminal of MAFS harness connector and chassis ground (Measurement "A")
3. Measure voltage between signal and ground terminals of MAFS harness connector (Measurement "B")

Specification : Voltage difference between Measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair contact resistance or open in harness and then go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Visual Inspection

1. Check that MAFS is damaged, contaminated or deformed.
2. Check that air cleaner is clogged.
3. Has a problem been found ?

YES ▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check MAFS" as follows.

■ Check MAFS

1. IG "OFF" and install a scantool
2. ENG "ON" and monitor "MAFS" data on the service data.
3. Monitor signal waveform at signal terminal of MAFS with scantool.

Specification : Signal waveform will be displayed as follows. Frequency will be increased during acceleration. (Be aware that the signal of MAFS is not voltage display but frequency display.)

Engine Control System

FL-261

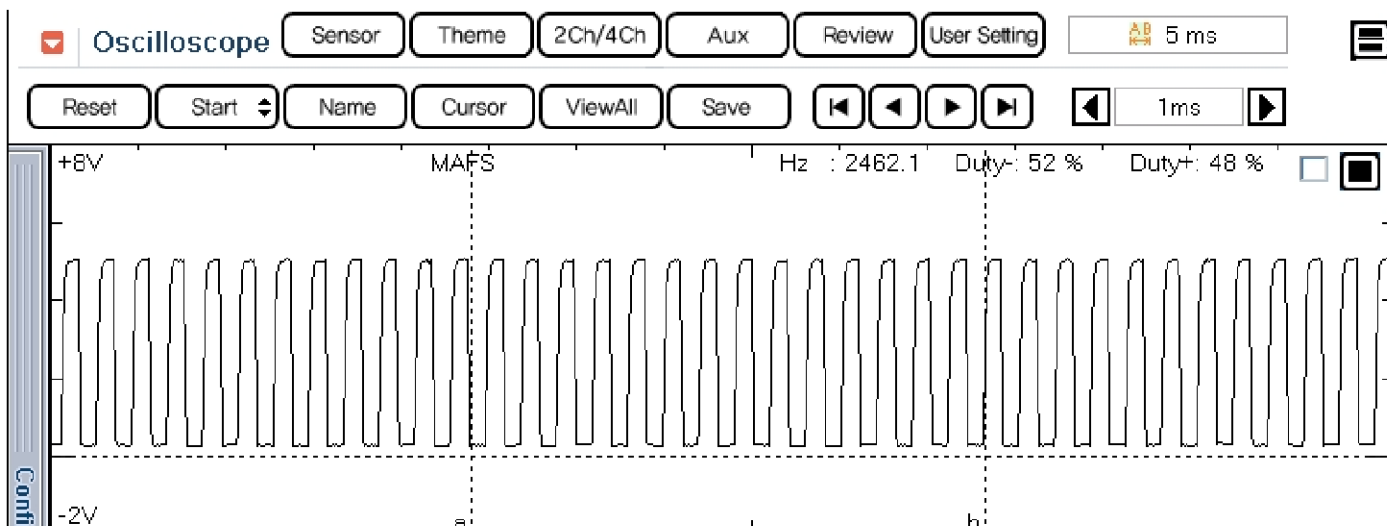


Fig.1

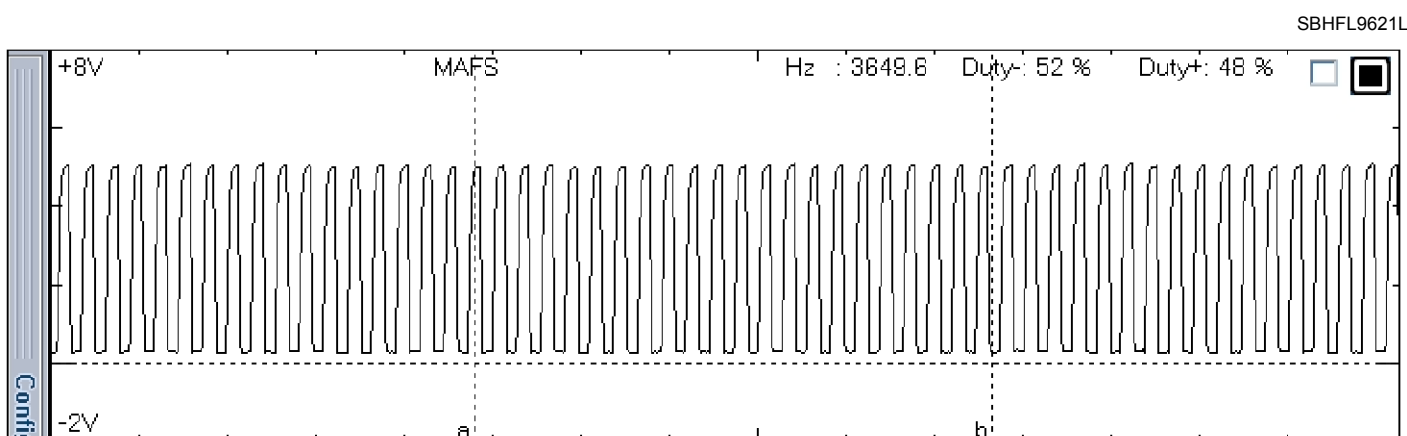


Fig.2

Fig 1) Normal waveform of MAFS at idle. (600rpm & 11kg/h)

Fig 2) Normal waveform of MAFS at acceleration. (2080rpm & 34kg/h)

4. Are both service data and signal waveform displayed correctly ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

NO ▶ Substitute with a known - good MAFS and check for proper operation. If the problem is corrected, replace MAFS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0101 : Mass or Volume Air Flow "A" Circuit Range/Performance

FL-262

Fuel System

P0103 Mass or Volume Air Flow "A" Circuit High Input

Component Location

Refer to DTC P0101 : Mass or Volume Air Flow "A"
Circuit Range/Performance

General Description

Refer to DTC P0101 : Mass or Volume Air Flow "A"
Circuit Range/Performance

DTC Description

If ECM detects that frequency signal of MAFS is higher than 11900 Hz for more than 3.9 second during 7.5 second diagnostic test while enable condition is met, ECM determines that a fault exists and a DTC is stored. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Compares the airmeter input frequency to a high limit	• Noise • MAFS • ECM
Enable Conditions	• Engine Speed ≥ 500 rpm • Engine Running Time ≥ 5 second • Ignition Voltage $\geq 11V$	
Threshold value	• MAF frequency signal $> 11900Hz$	
Diagnosis Time	• Continuous (More than 3.9 second failure for every 7.8 second tests)	
MIL On Condition	• 2 Driving Cycles	

Specification

Refer to DTC P0101 : Mass or Volume Air Flow "A"
Circuit Range/Performance

Diagnostic Circuit Diagram

Refer to DTC P0101 : Mass or Volume Air Flow "A"
Circuit Range/Performance

Signal Waveform & Data

Refer to DTC P0101 : Mass or Volume Air Flow "A"
Circuit Range/Performance

Monitor Scantool Data

Refer to DTC P0101 : Mass or Volume Air Flow "A"
Circuit Range/Performance

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Ground Circuit Inspection " procedure.

Ground Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect MAFS connector and then IG "ON".
2. IG "ON" & ENG "OFF"
3. Measure voltage between signal and ground terminals of MAFS harness connector (Measurement "B")

Specification : Voltage difference between Measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Repair contact resistance or open in harness and then go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Visual Inspection

1. Check that MAFS is damaged, contaminated or deformed.
2. Check that air cleaner is clogged.

Engine Control System

FL-263

3. Has a problem been found ?

YES ▶ Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check MAFS" as follows.

■ Check MAFS

1. IG "OFF" and install a scantool
2. ENG "ON" and monitor "MAFS" data on the service data.
3. Monitor signal waveform at signal terminal of MAFS with scantool.

Specification : Signal waveform will be displayed as follows. Frequency will be increased during acceleration. (Be aware that the signal of MAFS is not voltage display but frequency display.)

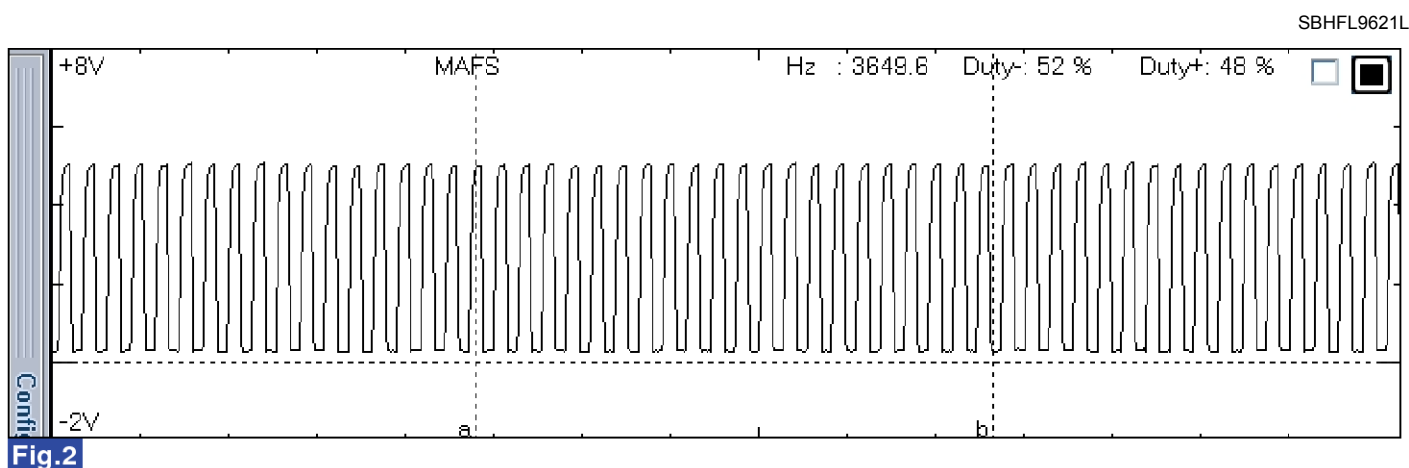
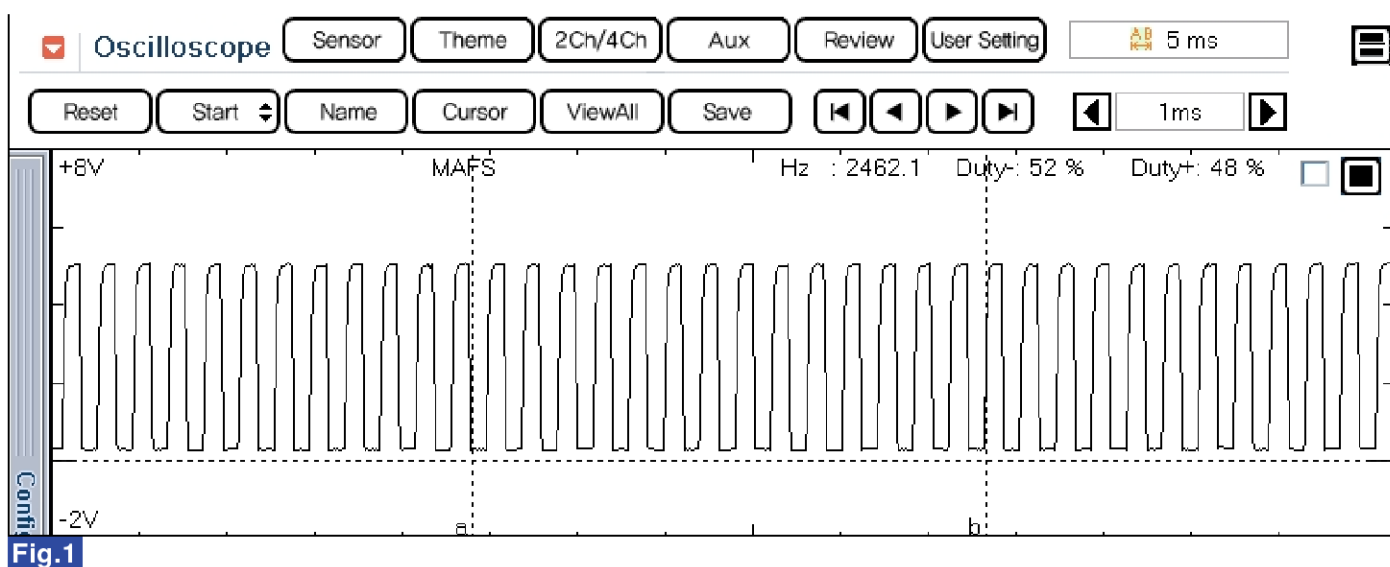


Fig 1) Normal waveform of MAFS at idle. (600rpm & 11kg/h)

Fig 2) Normal waveform of MAFS at acceleration. (2080rpm & 34kg/h)

SBHFL9622L

FL-264

Fuel System

4. Are both service data and signal waveform displayed correctly ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

 NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others.

NO ▶ Substitute with a known - good MAFS and check for proper operation. If the problem is corrected, replace MAFS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0101 : Mass or Volume Air Flow "A"
Circuit Range/Performance

Engine Control System

FL-265

P0105 Manifold Absolute Pressure/Barometric Pressure Circuit

Component Location



SBHFL9302L

General Description

The amount of intake air flow must be inputted to ECM in order to determine the fuel injection quantity. To measure the pressure inside of intake manifold, MAFS is used at idle and MAPS is required at accelerating. MAPS(Manifold Absolute Pressure) calculates the amount of air indirectly as measuring the pressure inside of intake manifold. This mechanism is also called Speed-Density Type.

MAPS transfers analog output signal which is proportional to the change of intake manifold pressure, then, with this signal and RPM, ECM calculates the amount of intake air flow.

MAPS is mounted on surge tank to measure the pressure inside of intake manifold, and it consists of a piezo electric element and hybrid IC which amplifies output signal from the element. A piezo electric element is a sort of a diaphragm using piezo electric effect. One side of the diaphragm is surrounded with vacuum chamber while intake pressure is applied to the other side. Thus, signals are output by the transformation of diaphragm according to the change of pressure inside of intake manifold.

DTC Description

If the signal output of MAP sensor is stuck under enable conditions, ECM determines that a fault exists and a DTC is stored. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitor the MAP sensor's signal	Faulty MAPS
Enable Conditions	- No Disabling Fault Present - Shutdown time > 20 minutes - Engine running	
Threshold value	The difference between the signal at key-on and the signal at engine start < 0.5 kPa	
Diagnosis Time	For 3 seconds out of 5 seconds	
MIL On Condition	NO MIL ON(DTC only)	

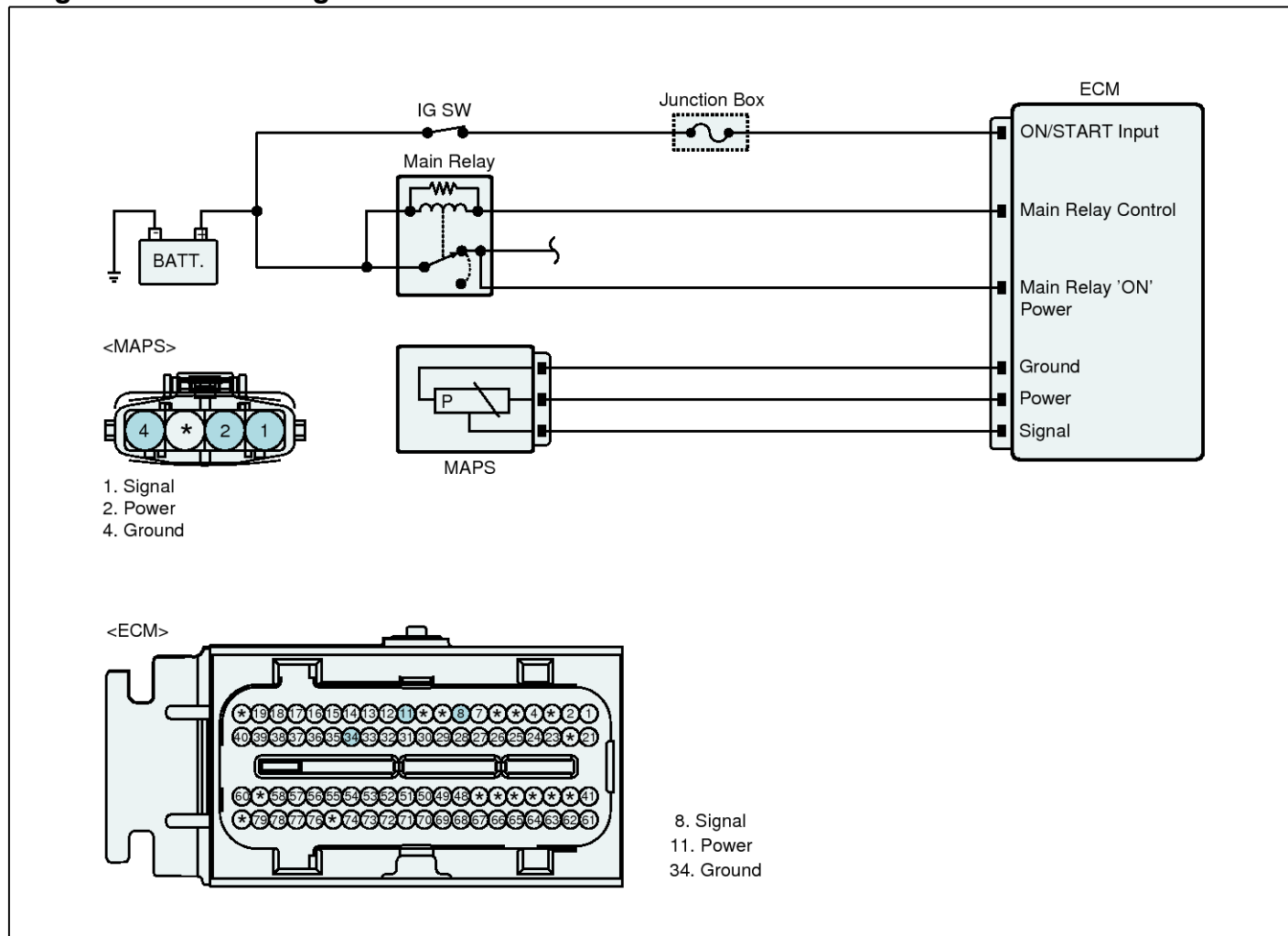
FL-266

Fuel System

Specification

Pressure(kPa)	Voltage(V)
20	0.79
46.66	1.84
101.32	4.0

Diagnostic Circuit Diagram



SBHFL9514L

Signal Waveform & Data

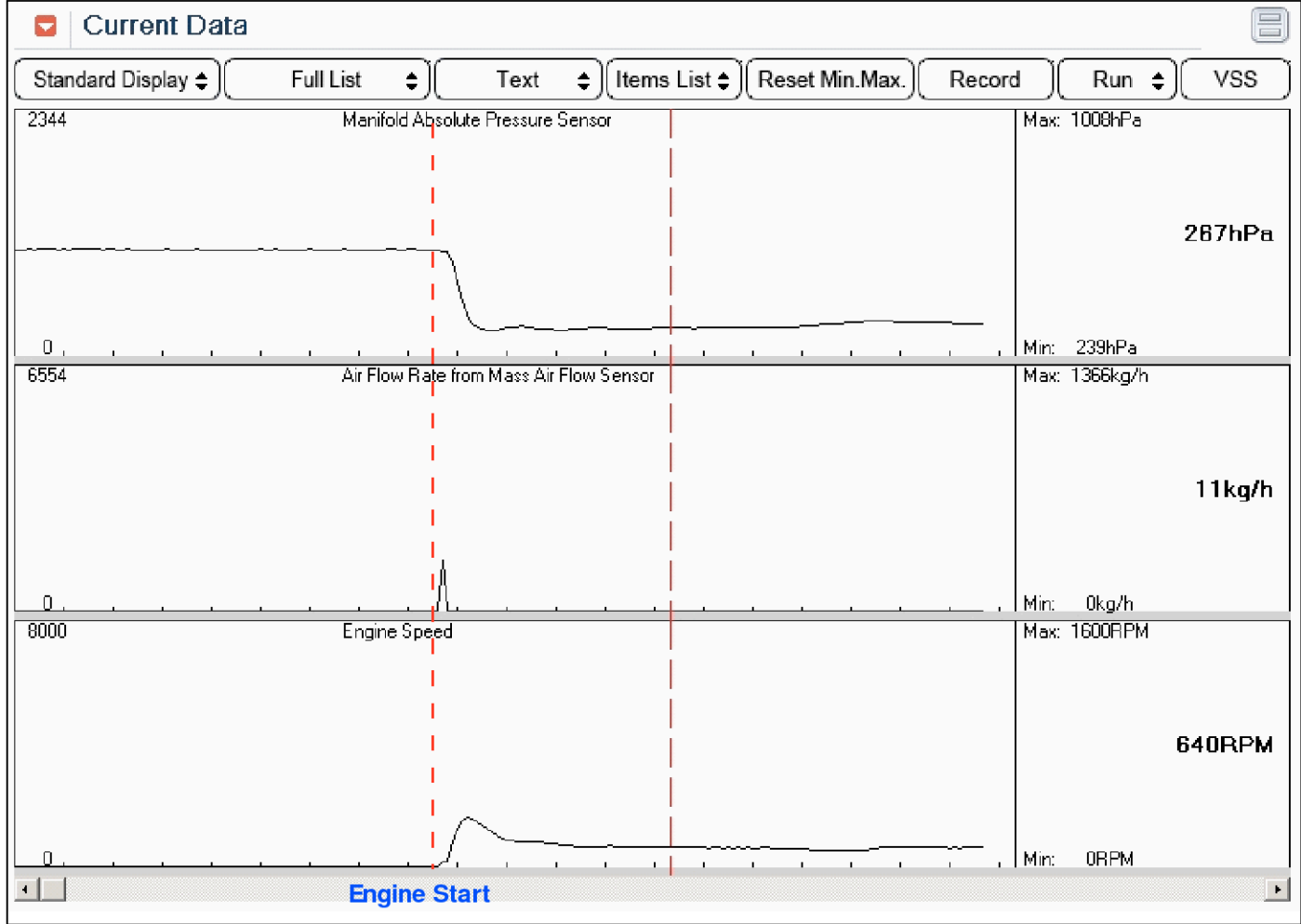


Fig.1

SBHFL9626L

Fig 1) Normal graph of the MAP at the time when engine starts.

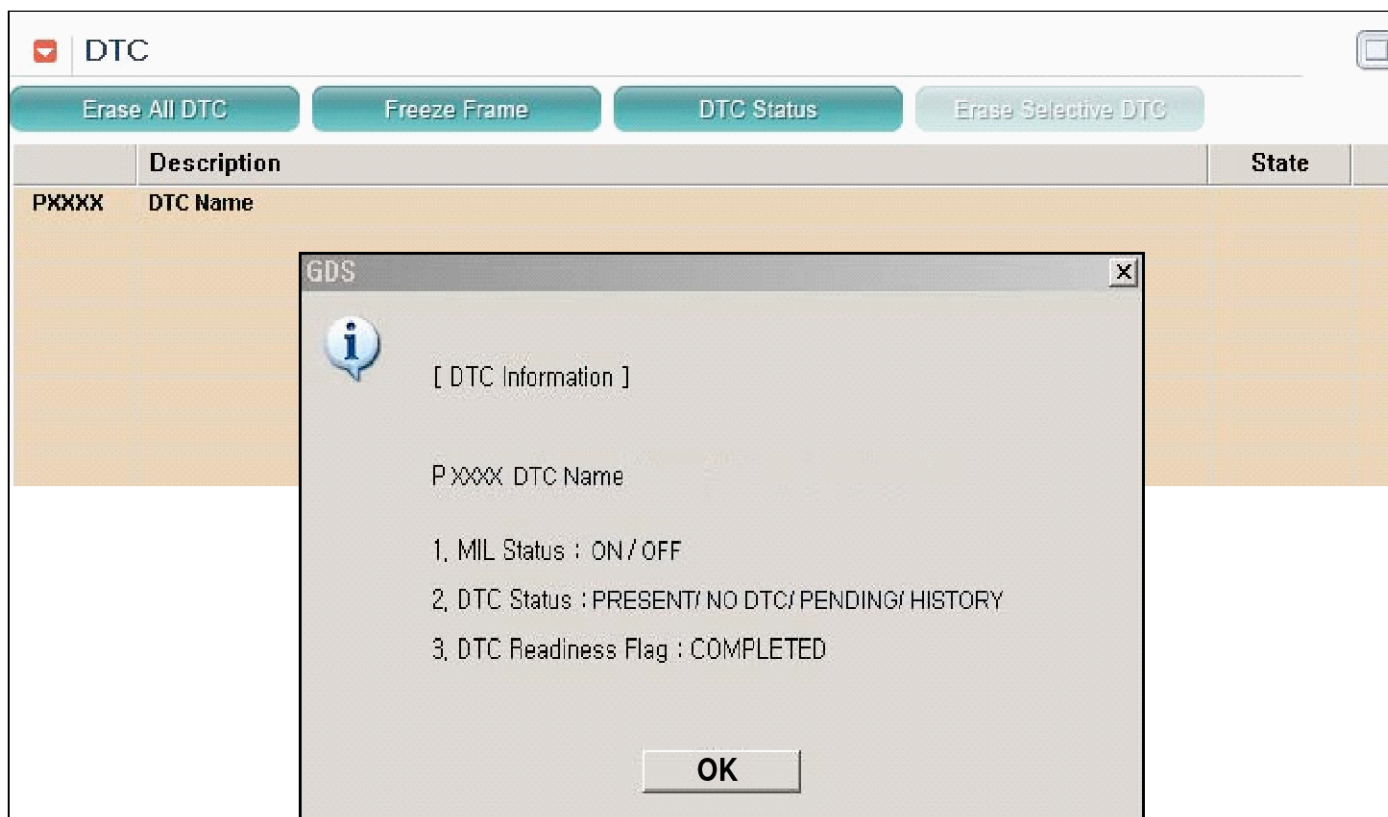
FL-268

Fuel System

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Component Inspection" procedure.

NO ► Fault is intermittent caused by ECM memory was not cleared after repair. Erase DTC and drive the vehicle to satisfy the enable condition then, go to "Component Inspection" procedure.

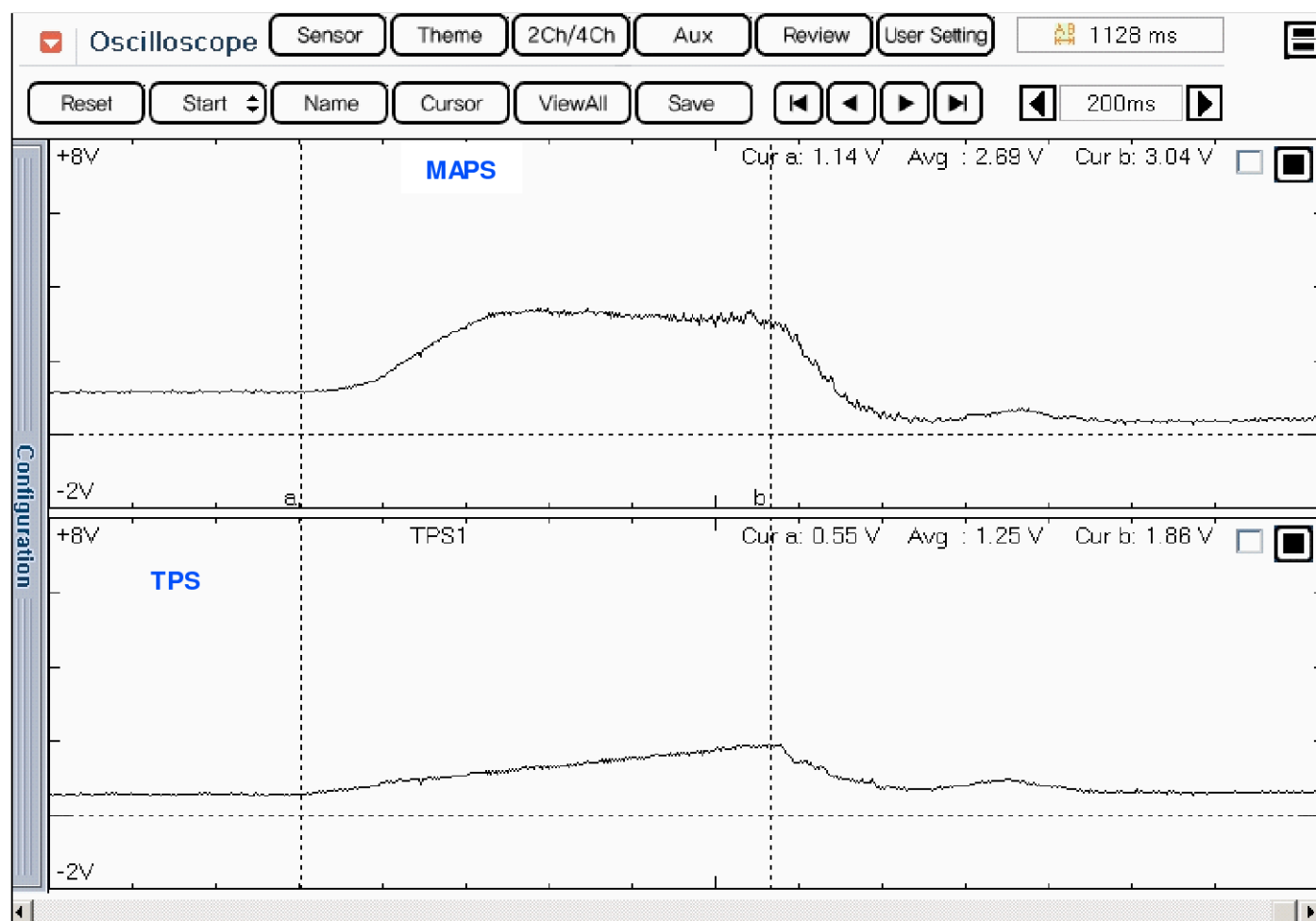
Component Inspection

■ Check MAPS Performance

1. IG "OFF" and install a scantool.
2. Connect probe to MAPS and TPS to check signal waveform by using oscilloscope function.
3. ENG "ON" and monitor signal waveform during acceleration and deceleration.

Specification : Signal waveform will be displayed as follows.

Pressure(kPa)	Voltage(V)
20	0.79
46.66	1.84
101.32	4.0



SBHFL9627L

4. Is the measured signal waveform(MAP/TPS Rationality) O.K ?

YES ► Go to "Verification of Vehicle Repair" procedure.

NO ► Substitute with a known - good MAPS and check for proper operation. If the problem is corrected, replace MAPS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

FL-270

Fuel System

P0106	Manifold	Absolute	Pressure/Barometric	Pressure	Circuit
Range/Performance					

Component Location

Refer to DTC P0105 : Manifold Absolute Pressure/Barometric Pressure Circuit

General Description

Refer to DTC P0105 : Manifold Absolute Pressure/Barometric Pressure Circuit

DTC Description

ECM compares the difference between MAPS output and calculated MAPS value while enable condition is met.

If the actual MAP value or lower than calculated (threshold) value for 2 min failure during tip in-out driving, ECM determines that a fault exists and a DTC is stored.

MIL(Malfunction Indicatin Lamp) turns on when the malfunction lasts till cosecutive 2 driving cycle.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		The MAP reading is compared to expected MAP high and low limits based on engine speed & Throttle Position	- Faulty TPS - Faulty MAPS
Enable Conditions		- Engine Coolant Temperature $\geq 60^{\circ}\text{C}$ (Fully Warmed up state) 600rpm < Engine Speed < 3000rpm	
Threshold value	Case 1	- Power Test - Altitude compensated MAP < Calculated min. MAP data - Altitude compensated MAP > Calculated max. MAP data	
	Case 2	- Decelleration Test - Altitude compensated MAP < Calculated MAP data	
Diagnosis Time		Continuous (within 5min.)	
MIL On Condition		NO MIL ON(DTC only)	

Specification

Refer to DTC P0105 : Manifold Absolute Pressure/Barometric Pressure Circuit

Diagnostic Circuit Diagram

Refer to DTC P0105 : Manifold Absolute Pressure/Barometric Pressure Circuit

Engine Control System

FL-271

Signal Waveform & Data

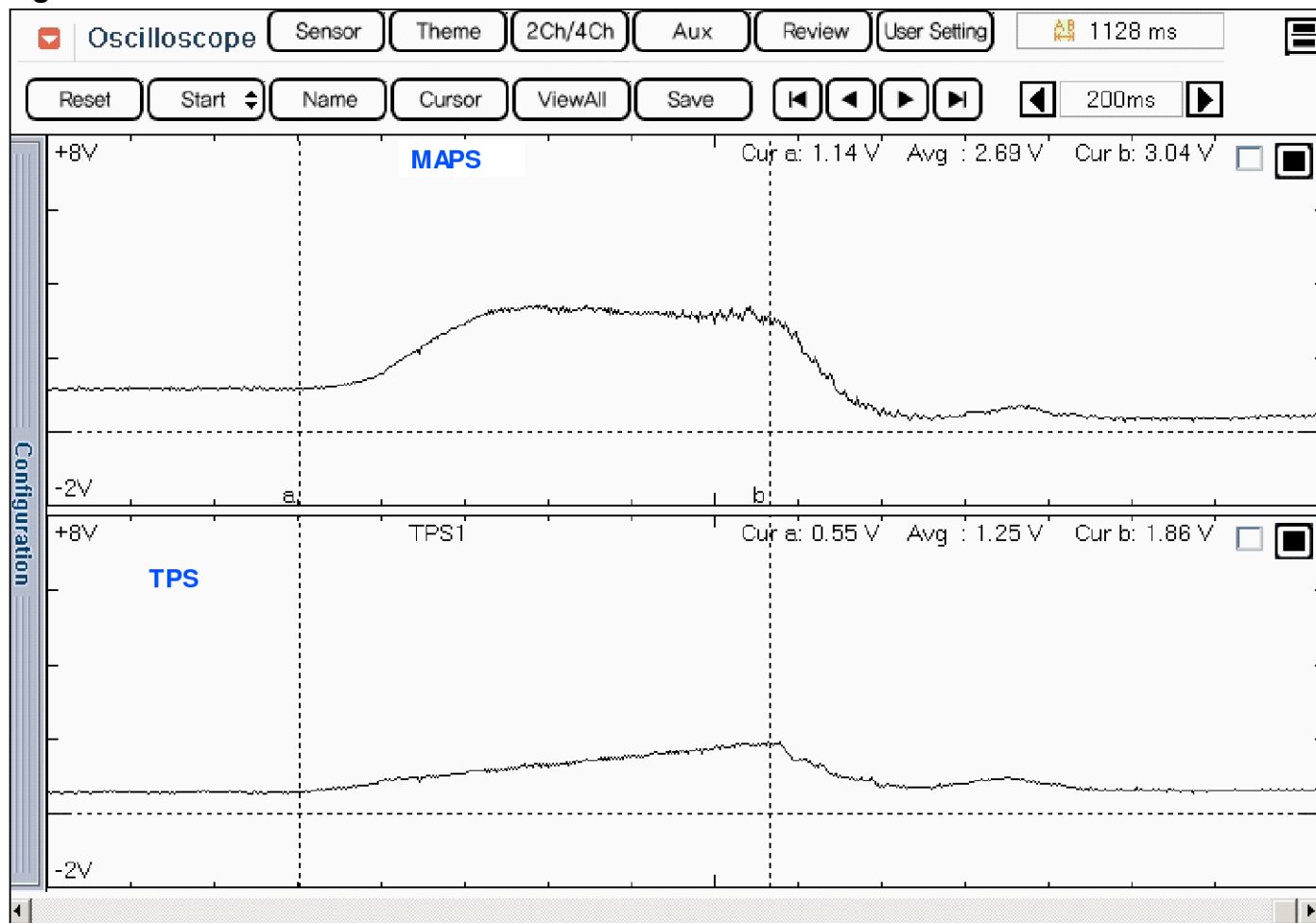


Fig.1

Current Data		
Standard Display	Full List	Graph
Items List	Reset Min.Max.	Record
Stop	VSS	
Sensor Name	Value	Unit
☒ Air Flow Rate from Mass Air Flow Sensor	11	kg/h
☒ Manifold Absolute Pressure Sensor	285	hPa
☒ Engine Speed	600	RPM

Fig.2

Fig 1) Normal waveform of MAPS & TPS with acceleration.

Fig 2) Normal data of MAPS at idle.

It is necessary that MAPS should be checked along with TPS. Because the MAP/TPS rationality diagnostic is comprised of two tests. A deceleration test is performed to provide a robust method for detection of an altitude compensated MAP value that is too high for the

deceleration condition. The second test compares the altitude compensated MAP value to both high and low limits, dependent upon throttle position and engine speed. When the MAP value is out of the threshold range, the MAP/TPS system is determined to be failed.

FL-272

Fuel System

Monitor Scantool Data

Refer to DTC P0105 : Manifold Absolute Pressure/ Barometric Pressure Circuit

Component Inspection

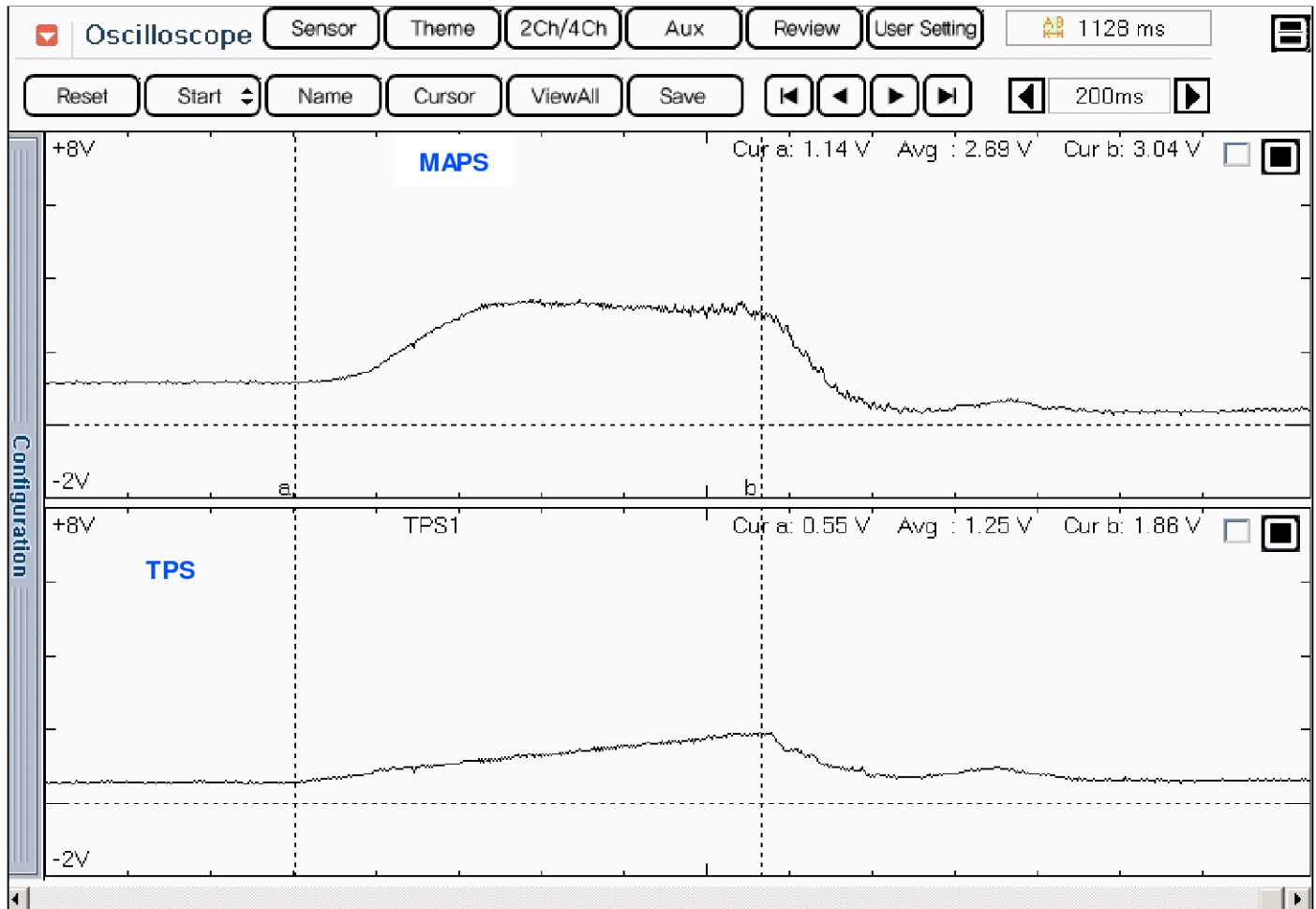
■ Check MAPS Performance

1. IG "OFF" and install a scantool.
2. Connect probe to MAPS and TPS to check signal waveform by using oscilloscope function.

3. ENG "ON" and monitor signal waveform during acceleration and deceleration.

Specification : Signal waveform will be displayed as follows.

Pressure(kPa)	Voltage(V)
20	0.79
46.66	1.84
101.32	4.0



SBHFL9627L

4. Is the measured signal waveform(MAP/TPS Rationality) O.K ?

YES ► Go to "Verification of Vehicle Repair" procedure.

NO ► Substitute with a known - good MAPS and check for proper operation. If the problem is corrected, replace MAPS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0105 : Manifold Absolute Pressure/ Barometric Pressure Circuit

Engine Control System

FL-273

P0107 Manifold Absolute Pressure/Barometric Pressure Circuit Low Input

Component Location

Refer to DTC P0105 : Manifold Absolute Pressure/Barometric Pressure Circuit

General Description

Refer to DTC P0105 : Manifold Absolute Pressure/Barometric Pressure Circuit

DTC Description

Checking output signals of MAPS every 5 sec. under detecting condition, if an output signal is below 0.25V for more than 2.5 sec., ECM sets P0107. Warning lamp turns on when the malfunction lasts till continuous 2 driving cycle.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		This code detects a continuous short to low or open in either the signal circuit or the MAP	- Connecting Condition - Open or short to ground in power circuit - Open or short to ground in signal circuit - MAPS - ECM
Enable Conditions	Case 1	- No TPS Active Fault Present - Ignition Voltage $\geq 11V$ - Engine Speed $\leq 1000rpm$ - Throttle Position $\geq 0\%$	
	Case 2	- No TPS Active Fault Present - Ignition Voltage $\geq 11V$ - Engine Speed $> 1000rpm$ - Throttle Position $\geq 30\%$	
Threshold value		MAP Signal $< 0.25V$	
Diagnosis Time		Continuous (More than 2.5 seconds failure for every 5 seconds test)	
MIL On Condition		2 Driving Cycles	

Specification

Refer to DTC P0105 : Manifold Absolute Pressure/Barometric Pressure Circuit

Diagnostic Circuit Diagram

Refer to DTC P0105 : Manifold Absolute Pressure/Barometric Pressure Circuit

Signal Waveform & Data

Refer to DTC P0106 : Manifold Absolute Pressure/Barometric Pressure Circuit Range/ Performance

Monitor Scantool Data

Refer to DTC P0105 : Manifold Absolute Pressure/Barometric Pressure Circuit

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Power Circuit Inspection " procedure .

Power Circuit Inspection

■ Check voltage

- IG "OFF" and Disconnect MAPS connector.
- IG "ON".
- Measure voltage between power terminal of MAPS harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ► Go to "Signal Circuit Inspection" Procedure.

NO ► Repair open or short in harness and go to " Verification of Vehicle Repair" procedure.

FL-274

Fuel System

Signal Circuit Inspection

■ Check short to ground in harness

1. IG "OFF".
2. Disconnect MAPS and ECM connector.
3. Measure the resistance between signal terminal of MAPS harness connector and ground.

Specification : Infinite

4. Is the measured resistance within specification ?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect MAPS and ECM connector.
2. Measure resistance between signal terminal of MAPS harness connector and MAPS signal terminal of ECM harness connector.

Specification : Approx. below 1Ω.

3. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check MAPS Performance

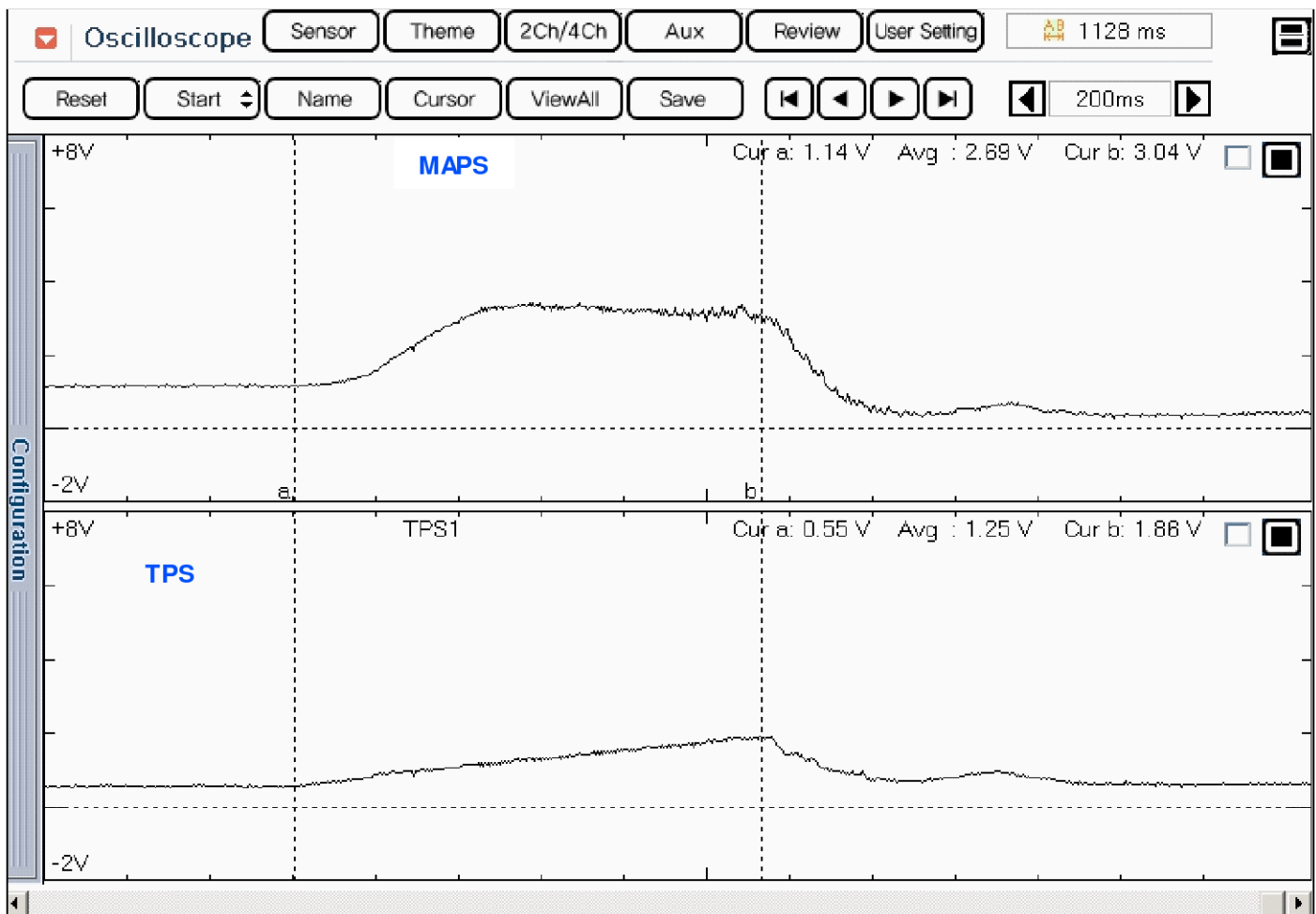
1. IG "OFF" and install a scantool.
2. Connect probe to MAPS and TPS to check signal waveform by using oscilloscope function.
3. ENG "ON" and monitor signal waveform during acceleration and deceleration.

Specification : Signal waveform will be displayed as follows.

Pressure(kPa)	Voltage(V)
20	0.79
46.66	1.84
101.32	4.0

Engine Control System

FL-275



SBHFL9627L

4. Is the measured signal waveform(MAP/TPS Rationality) O.K ?

YES ► Go to "Verification of Vehicle Repair" procedure.

NO ► Substitute with a known - good MAPS and check for proper operation. If the problem is corrected, replace MAPS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0105 : Manifold Absolute Pressure/Barometric Pressure Circuit

FL-276

Fuel System

P0108 Manifold Absolute Pressure/Barometric Pressure Circuit High Input

Component Location

Refer to DTC P0105 : Manifold Absolute Pressure/Barometric Pressure Circuit

General Description

Refer to DTC P0105 : Manifold Absolute Pressure/Barometric Pressure Circuit

DTC Description

Checking output signals of MAPS every 5 sec. under detecting condition, if an output signal is above 4.5V for more than 2.5 sec., ECM sets P0108. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		This code detects a continuous short to high in either the signal circuit or the MAP sensor	- Connecting Condition - Short in Signal Circuit - Open in Ground Circuit - Faulty MAPS - Faulty ECM
Enable Conditions	Case 1	- No TPS Active Fault Present - Engine Running Time > 10sec - Engine Speed ≤ 2500rpm - Throttle Position ≤ 30%	
	Case 2	- No TPS Active Fault Present - Engine Running Time > 10sec - Engine Speed > 2500rpm - Throttle Position ≤ 40%	
Threshold value		MAP Signal > 4.5V	
Diagnosis Time		Continuous (More than 2.5 seconds failure for every 5 seconds test)	
MIL On Condition		2 Driving Cycles	

Specification

Refer to DTC P0105 : Manifold Absolute Pressure/Barometric Pressure Circuit

Diagnostic Circuit Diagram

Refer to DTC P0105 : Manifold Absolute Pressure/Barometric Pressure Circuit

Signal Waveform & Data

Refer to DTC P0106 : Manifold Absolute Pressure/Barometric Pressure Circuit Range/ Performance

Monitor Scantool Data

Refer to DTC P0105 : Manifold Absolute Pressure/Barometric Pressure Circuit

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Power Circuit Inspection " procedure .

Power Circuit Inspection

■ Check voltage

- IG "OFF" and Disconnect MAPS connector.
- IG "ON".
- Measure voltage between power terminal of MAPS harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ► Go to "Ground Circuit Inspection" Procedure .

NO ► Repair open or short in harness and go to " Verification of Vehicle Repair" procedure.

Engine Control System

FL-277

Ground Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect MAPS connector and then IG "ON".
2. Measure voltage between signal terminal of MAPS harness connector and chassis ground (Measurement "A")
3. Measure voltage between signal and ground terminals of MAPS harness connector (Measurement "B")

Specification : Voltage difference between Measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

YES ▶ Go to "Signal Circuit Inspection" procedure.

NO ▶ Repair contact resistance or open in harness and then go to "Verification of Vehicle Repair" procedure.

Signal Circuit Inspection

■ Check short to battery in harness

1. IG "OFF".
2. Disconnect MAPS and ECM connector.
3. Measure the resistance between signal terminal of MAPS harness connector and ground.

Specification : Infinite

4. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" as follows.

NO ▶ Repair short in harness and then go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check MAPS Performance

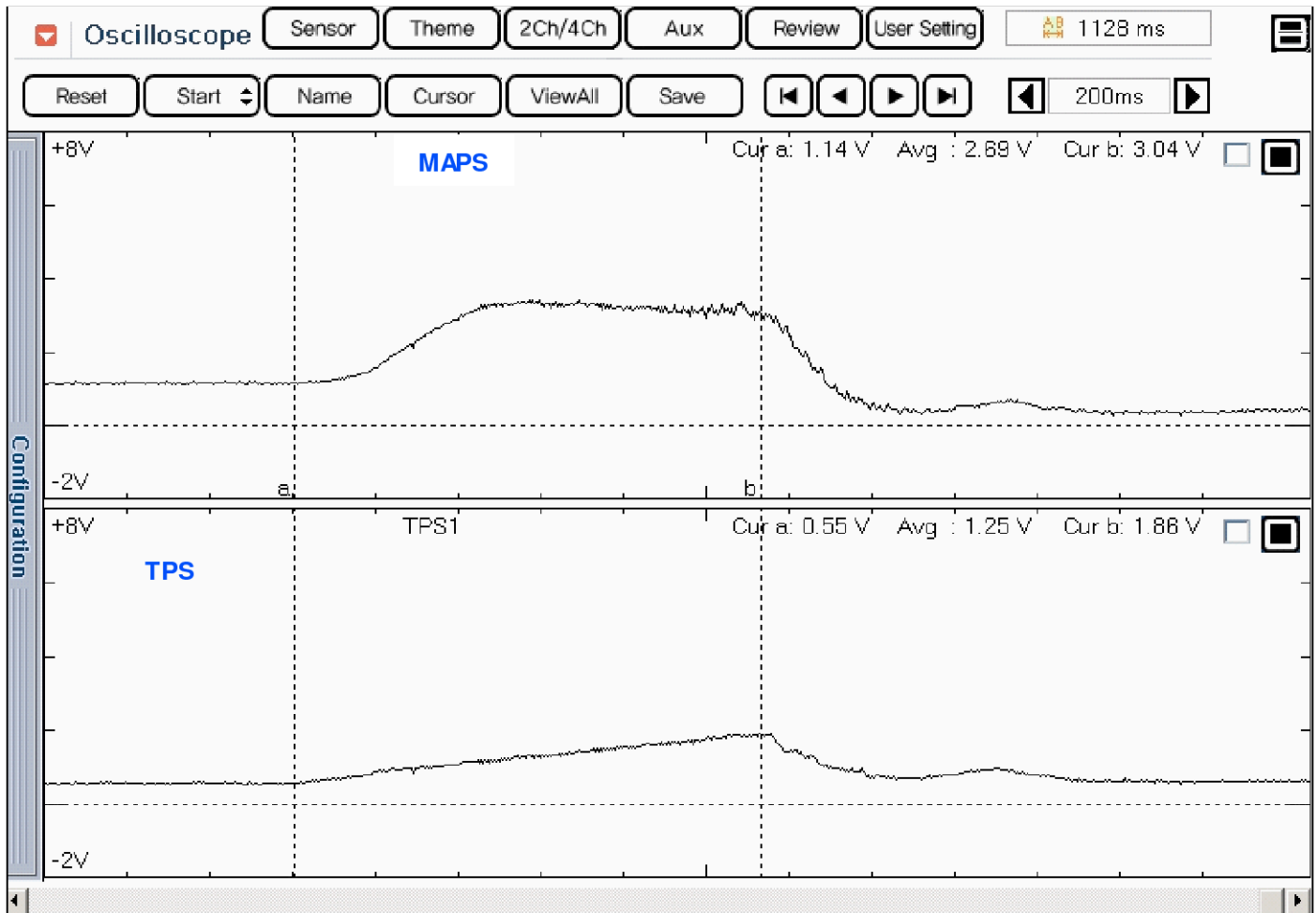
1. IG "OFF" and install a scantool.
2. Connect probe to MAPS and TPS to check signal waveform by using oscilloscope function.
3. ENG "ON" and monitor signal waveform during acceleration and deceleration.

Specification : Signal waveform will be displayed as follows.

Pressure(kPa)	Voltage(V)
20	0.79
46.66	1.84
101.32	4.0

FL-278

Fuel System



SBHFL9627L

4. Is the measured signal waveform(MAP/TPS Rationality) O.K ?

YES ► Go to "Verification of Vehicle Repair" procedure.

NO ► Substitute with a known - good MAPS and check for proper operation. If the problem is corrected, replace MAPS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0105 : Manifold Absolute Pressure/ Barometric Pressure Circuit

Engine Control System

FL-279

P0109 Manifold Absolute Pressure/Barometric Pressure Circuit Intermittent

Component Location

Refer to DTC P0105 : Manifold Absolute Pressure/Barometric Pressure Circuit

General Description

Refer to DTC P0105 : Manifold Absolute Pressure/Barometric Pressure Circuit

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	This code detects a continuous short to low or open in either the signal circuit or the MAP	- Connecting condition - Open or short to ground in power circuit - Open or short to ground in signal circuit - MAPS - ECM
Enable Conditions	- Engine running $\Delta APS < 5\%$ - Engine Speed $> 800\text{rpm}$	
Threshold value	$\text{MAP\_stable} - \text{MAP\_current} > 10\%$	
Diagnosis Time	-	
MIL On Condition	NO MIL ON(DTC only)	

Specification

Refer to DTC P0105 : Manifold Absolute Pressure/Barometric Pressure Circuit

Diagnostic Circuit Diagram

Refer to DTC P0105 : Manifold Absolute Pressure/Barometric Pressure Circuit

Signal Waveform & Data

Refer to DTC P0106 : Manifold Absolute Pressure/Barometric Pressure Circuit Range/ Performance

Monitor Scantool Data

Refer to DTC P0105 : Manifold Absolute Pressure/Barometric Pressure Circuit

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Power Circuit Inspection " procedure .

DTC Description

ECM monitors MAP output signal continuously. If there is the signal change over 10% momentarily without the operation of accel pedal, ECM determines that a fault exists and a DTC is stored.

Power Circuit Inspection

■ Check voltage

- IG "OFF" and Disconnect MAPS connector.
- IG "ON".
- Measure voltage between power terminal of MAPS harness connector and chassis ground.

Specification : Approx. 5V

- Is the measured voltage within specification ?

YES ▶ Go to "Signal Circuit Inspection" Procedure.

NO ▶ Repair open or short in harness and go to "Verification of Vehicle Repair" procedure.

■ Check short to ground in harness

- IG "OFF".
- Disconnect MAPS and ECM connector.
- Measure the resistance between signal terminal of MAPS harness connector and ground.

Specification : Infinite

- Is the measured resistance within specification ?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness and go to "Verification of Vehicle Repair" procedure.

FL-280

Fuel System

■ Check open in harness

1. IG "OFF" and disconnect MAPS and ECM connector.
2. Measure resistance between signal terminal of MAPS harness connector and MAPS signal terminal of ECM harness connector.

Specification : Approx. below 1Ω.

3. Is the measured resistance within specification ?

YES ► Go to "Ground Inspection" procedure.

NO ► Repair open in harness and go to "Verification of Vehicle Repair" procedure.

Ground Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect MAPS connector and then IG "ON".
2. Measure voltage between signal terminal of MAPS harness connector and chassis ground (Measurement "A")
3. Measure voltage between signal and ground terminals of MAPS harness connector (Measurement "B")

Specification : Voltage difference between Measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

YES ► Go to "Component Circuit Inspection" procedure.

NO ► Repair contact resistance or open in harness and then go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check MAPS Performance

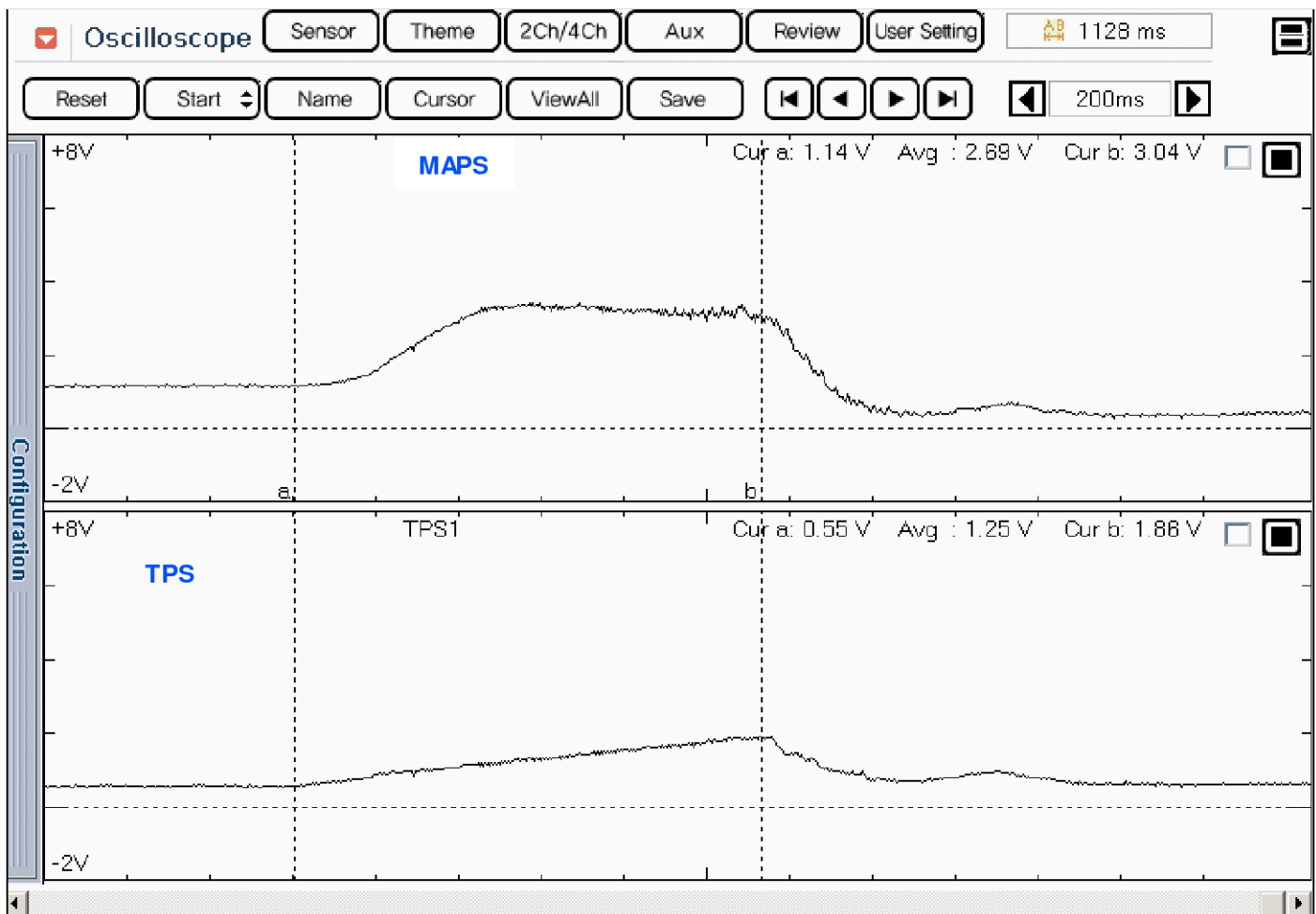
1. IG "OFF" and install a scantool.
2. Connect probe to MAPS and TPS to check signal waveform by using oscilloscope function.
3. ENG "ON" and monitor signal waveform during acceleration and deceleration.

Specification : Signal waveform will be displayed as follows.

Pressure(kPa)	Voltage(V)
20	0.79
46.66	1.84
101.32	4.0

Engine Control System

FL-281



SBHFL9627L

4. Is the measured signal waveform(MAP/TPS Rationality) O.K ?

YES ► Go to "Verification of Vehicle Repair" procedure.

NO ► Substitute with a known - good MAPS and check for proper operation. If the problem is corrected, replace MAPS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0105 : Manifold Absolute Pressure/ Barometric Pressure Circuit

P0110 Intake Air Temperature Sensor 1 Circuit

Component Location



SBHFL9301L

General Description

The Intake Air Temperature Sensor (IATS) is installed into the Mass Air Flow Sensor (MAFS). The IATS uses a thermistor whose resistance changes with the temperature. The electrical resistance of the IATS decreases as the temperature increases, and increases as the temperature decreases. The 5 V power source in the ECM is supplied to the IATS via a resistor in the ECM. That is, the resistor in the ECM and the thermistor in the IATS are connected in series. When the resistance value of the thermistor in IATS changes according to the intake air temperature, the signal voltage also changes. Using this signal, the information of the intake air temperature, the ECM corrects basic fuel injection duration and ignition timing.

DTC Description

ECM monitors temperature difference between MAX. and MIN IATS in order to detect movement in IATS not only Start Test but Drive Test while enable condition is met. If ECM detects intake air temperature changes less than 5.4 °FECM determines that a fault exists and a DTC is stored.

MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

Engine Control System

FL-283

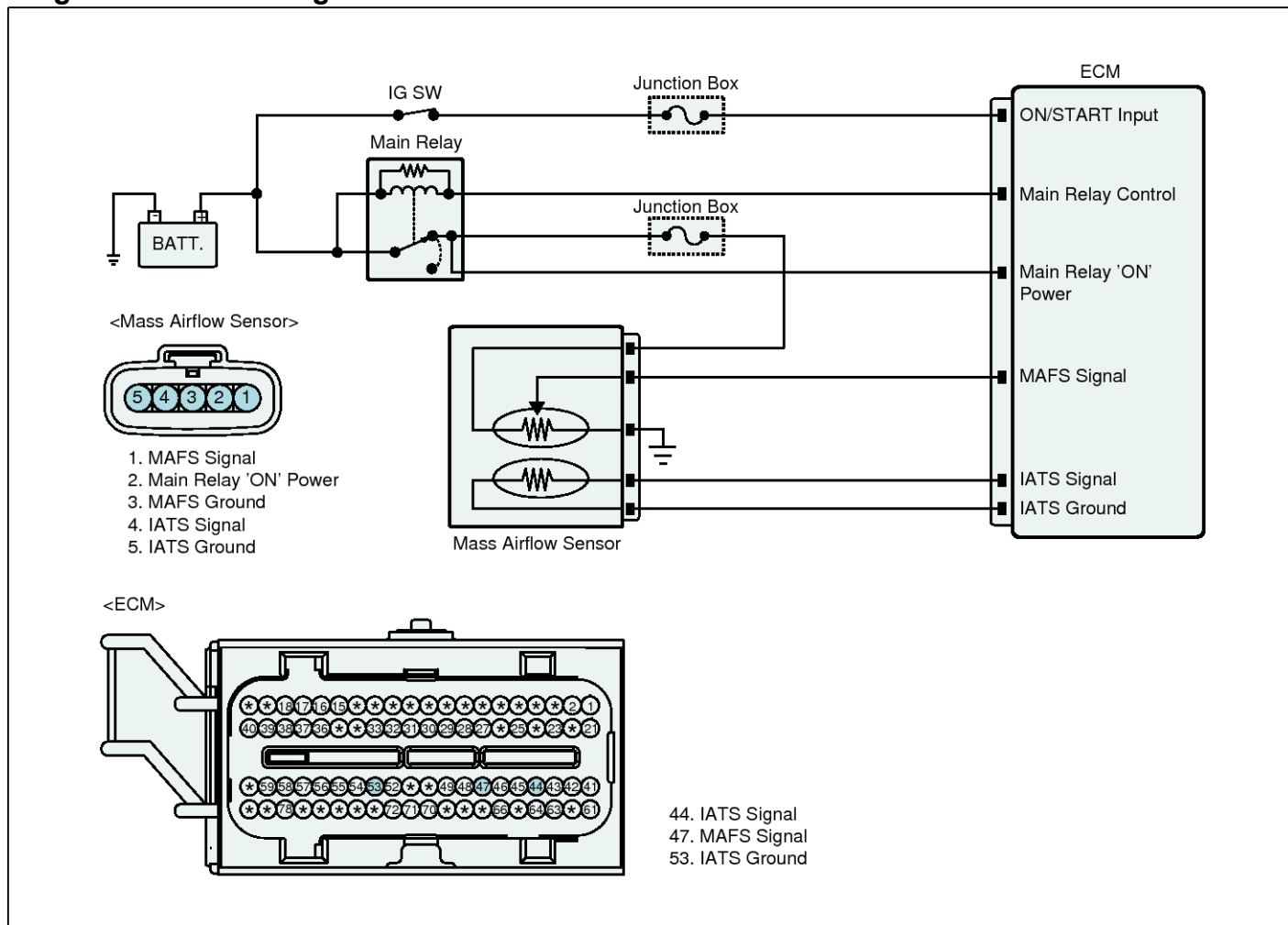
DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy	Case 1	Start Test : Monitors the difference between max and min IAT in order to detect movement in IAT for a certain time.	Faulty IATS
	Case 2	Drive test : Performs the max and min delta check while driving under load for a length of time followed by an idle for a certain time.	
Enable Conditions		- Engine soaked time > 360min - Engine Running State - No fault present - IAT stored previous trip - No IAT Tests pending	
Threshold value		Max IAT - Min IAT $\leq 3^{\circ}\text{C}$ (5.4 $^{\circ}\text{F}$)	
Diagnosis Time		Continuous (10 min.)	
MIL On Condition		NO MIL ON(DTC only)	

Specification

Temp. ($^{\circ}\text{C}$)	Resistance ($\text{k}\Omega$)	Temp. ($^{\circ}\text{C}$)	Resistance ($\text{k}\Omega$)
-40	95.95 ~ 105.78	20	3.42 ~ 3.61
-20	27.4 ~ 29.77	40	1.43 ~ 1.5
0	9.08 ~ 9.72	60	0.66 ~ 0.69
10	5.49 ~ 5.83	80	0.33 ~ 0.34

Diagnostic Circuit Diagram



SBHFL9513L

Engine Control System

FL-285

Signal Waveform & Data

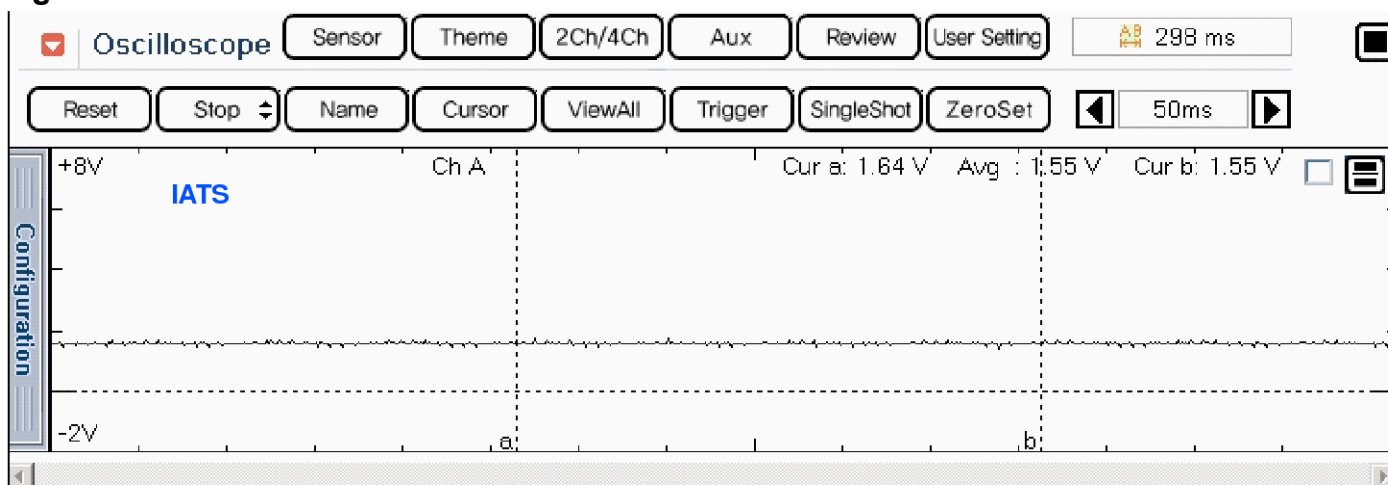


Fig.1

SBHFL9630L

Current Data		
Standard Display	Full List	Graph
Items List	Reset Min.Max.	Record
Stop	VSS	
Sensor Name	Value	Unit
☐ Engine Coolant Temperature Sensor	10.5	'C
☐ Intake Air Temperature Sensor	12.0	'C
☐ Oil Temperature Sensor	10.5	'C

Fig.2

SBHFL9631L

Sensor Name	Value	Unit
☒ Engine Speed	640	RPM
☒ Engine Coolant Temperature Sensor	90.8	'C
☒ Intake Air Temperature Sensor	27.8	'C
☒ Oil Temperature Sensor	88.5	'C

Fig.3

SBHFL9632L

Fig 1) Normal waveform of IATS at 43°C (109°F)

Fig 2) Normal data of IATS(53°F) & ECTS & EOTS at ig on

Fig 3) Normal data of IATS(82°F) & ECTS & EOTS after warming up.

The output signals of IATS & ECTS change smoothly without any rapid changes. Those have almost same characteristic signal during the early period after start. It means that the temperatures of intake air and engine coolant are depended on the temperature of atmosphere. Meanwhile, during the warming up, the output signal of ECTS is going up increasingly. but, the output signal of

IATS changes a little bit. even it may not change almost. It means that the heat of engine does not affect on the temperature of intake air. Meanwhile, during the warming up, the output signal of ECTS is going up increasingly. but, the output signal of IATS changes a little bit. even it may not change almost. It means that the heat of engine does not affect on the temperature of intake air.

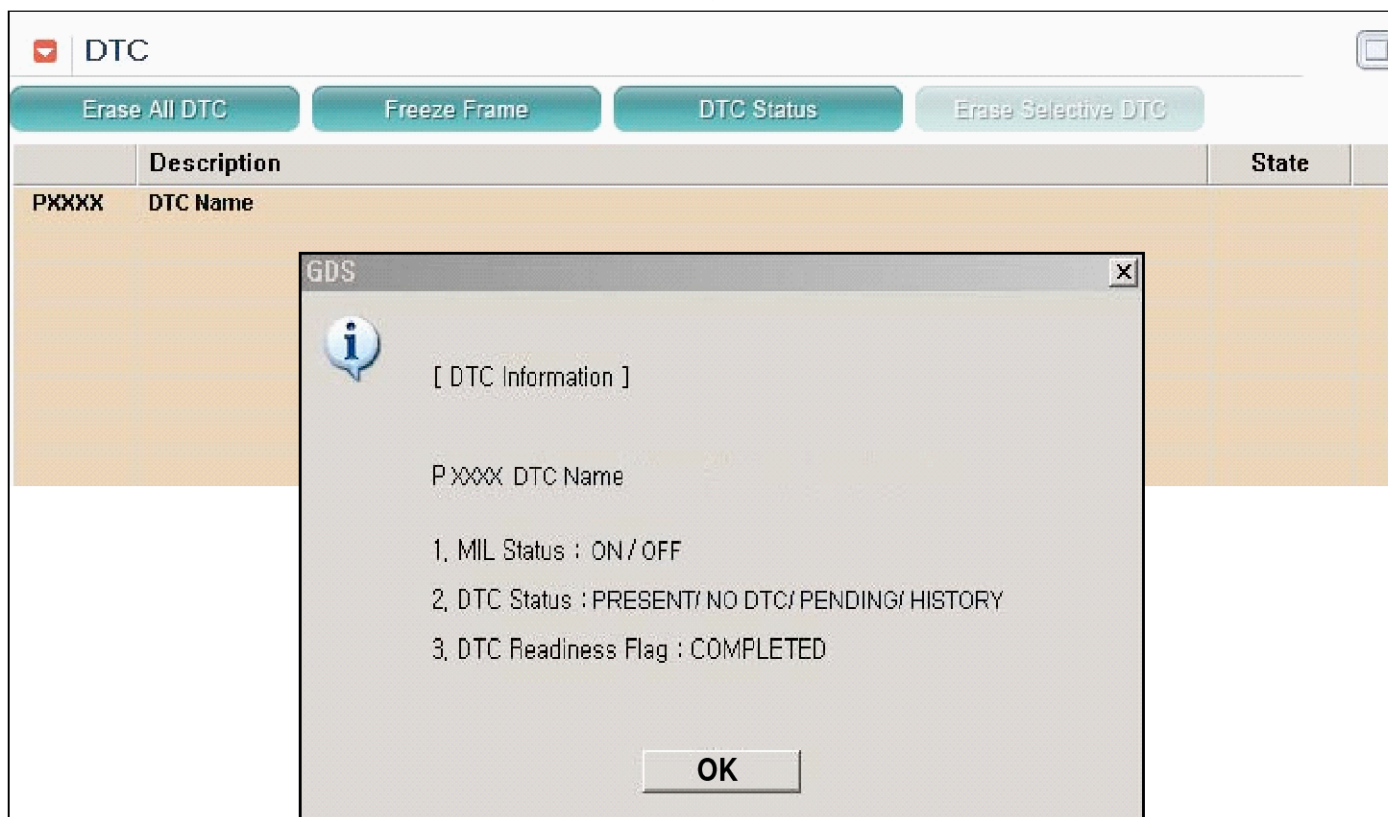
FL-286

Fuel System

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Component Inspection" procedure.

NO ► Fault is intermittent caused by ECM memory was not cleared after repair. Erase DTC and drive the vehicle to satisfy the enable condition then, go to "Component Inspection" procedure.

Component Inspection

■ Check IATS resistance

1. IG "OFF" and disconnect IATS connector.
2. Measure resistance between signal and ground terminals of IATS connector after checking out the temperature of IATS with scantool (Component Side)

Specification :

Temp. (°C)	Resistance (kΩ)
-40	95.95 ~ 105.78
-20	27.4 ~ 29.77
0	9.08 ~ 9.72
10	5.49 ~ 5.83
20	3.42 ~ 3.61
40	1.43 ~ 1.5
60	0.66 ~ 0.69
80	0.33 ~ 0.34

3. Is the measured resistance within specification ?

YES ► Go to "Verification of Vehicle Repair" procedure.

NO ► Substitute with a known - good IATS and check for proper operation. If the problem is corrected, replace IATS and go to "Verification of Vehicle Repair" procedure.

Engine Control System

FL-287

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

FL-288

Fuel System

P0111 Intake Air Temperature Sensor 1 Circuit Range / Performance

Component Location

Refer to DTC P0110 : Intake Air Temperature Sensor 1 Circuit

General Description

Refer to DTC P0110 : Intake Air Temperature Sensor 1 Circuit

DTC Description

ECM monitors temperature changes resulting from soaking the vehicle. Therefore, Coolant temperature and Intake temperature should be changed. If ECM detects intake air temperature correlated to coolant temperature does not change ECM determines that a fault exists and a DTC is stored. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy	Case 1	• Monitors the difference between the startup coolant and IAT values	• IATS
	Case 2	• Monitors the difference between the startup IAT and coolant values	
Enable Conditions	Case 1	• Engine soaked time ≥ 360 min • Engine running state • No faults present • IAT stored previous trip • Startup Coolant Temperature $> -20^{\circ}\text{C}$ • Airflow > 15 g/s • Vehicle speed > 40 kph	
	Case 2	• Engine soaked time ≥ 360 min • Engine running state • No faults present • IAT stored previous trip • Airflow > 15 g/s • Vehicle speed > 40 kph	
Threshold value	Case 1	• Startup Coolant - Startup IAT $\geq 22^{\circ}\text{C}$	
	Case 2	• Startup IAT - Startup Coolant $\geq 17^{\circ}\text{C}$	
Diagnosis Time		• Continuous (More than 1.25 second failure)	
MIL On Condition		• NO MIL ON(DTC only)	

Specification

Refer to DTC P0110 : Intake Air Temperature Sensor 1 Circuit

Diagnostic Circuit Diagram

Refer to DTC P0110 : Intake Air Temperature Sensor 1 Circuit

Signal Waveform & Data

Refer to DTC P0110 : Intake Air Temperature Sensor 1 Circuit

Monitor Scantool Data

Refer to DTC P0110 : Intake Air Temperature Sensor 1 Circuit

Component Inspection

■ Check IATS resistance

1. IG "OFF" and disconnect IATS connector.
2. Measure resistance between signal and ground terminals of IATS connector after checking out the temperature of IATS with scantool (Component Side)

Engine Control System

FL-289

Specification :

Temp. (°C)	Resistance (kΩ)
-40	95.95 ~ 105.78
-20	27.4 ~ 29.77
0	9.08 ~ 9.72
10	5.49 ~ 5.83
20	3.42 ~ 3.61
40	1.43 ~ 1.5
60	0.66 ~ 0.69
80	0.33 ~ 0.34

3. Is the measured resistance within specification ?

YES ► Go to "Verification of Vehicle Repair" procedure.

NO ► Substitute with a known - good IATS and check for proper operation. If the problem is corrected, replace IATS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0110 : Intake Air Temperature Sensor 1 Circuit

FL-290

Fuel System

P0112 Intake Air Temperature Sensor 1 Circuit Low Input

Component Location

Refer to DTC P0110 : Intake Air Temperature Sensor 1 Circuit

General Description

Refer to DTC P0110 : Intake Air Temperature Sensor 1 Circuit

DTC Description

Checking output signals of IATS every 20 sec. under detecting condition, if an output signal is below 0.1V for more than 10 sec., ECM sets P0112. MIL (Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		This code detects a continuous short to ground in either the signal circuit or the sensor	- Poor connection - Short to ground in harness - IATS - ECM
Enable Conditions	Case 1	- Engine running state - No Vehicle speed sensor fault - Vehicle speed > 50kph(30mph)	
	Case 2	- Engine running time > 120 sec - Time from IG "OFF" to IG "ON" > 360 min	
Threshold value		Intake air temperature sensor's voltage < 0.1V	
Diagnosis Time		Continuous (More than 10 seconds failure for every 20 seconds test)	
MIL On Condition		2 Driving Cycles	

Specification

Refer to DTC P0110 : Intake Air Temperature Sensor 1 Circuit

Diagnostic Circuit Diagram

Refer to DTC P0110 : Intake Air Temperature Sensor 1 Circuit

Signal Waveform & Data

Refer to DTC P0110 : Intake Air Temperature Sensor 1 Circuit

Monitor Scantool Data

Refer to DTC P0110 : Intake Air Temperature Sensor 1 Circuit

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Signal Circuit Inspection " procedure .

Signal Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect IATS connector.
- IG "ON"
- Measure voltage between signal terminal of IATS harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Go to "Check short to ground in harness" procedure.

Engine Control System

FL-291

■ Check short to ground in harness

1. IG "OFF" and disconnect IATS connector and ECM connector.
2. Measure resistance between signal terminal of IATS harness connector and chassis ground.(Measurement "A")
3. Measure resistance between signal and ground terminals of IATS harness connector.(Measurement "B")
4. Measure resistance between signal terminal of IATS harness connector and ground terminal of MAFS harness connector.(Measurement "B")

Specification : Infinite

5. Is the measured resistance within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Repair short to ground in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check IATS resistance

1. IG "OFF" and disconnect IATS connector.
2. Measure resistance between signal and ground terminals of IATS connector after checking out the temperature of IATS with scantool (Component Side)

Specification :

Temp. (°C)	Resistance (kΩ)
-40	95.95 ~ 105.78
-20	27.4 ~ 29.77
0	9.08 ~ 9.72
10	5.49 ~ 5.83
20	3.42 ~ 3.61
40	1.43 ~ 1.5
60	0.66 ~ 0.69
80	0.33 ~ 0.34

3. Is the measured resistance within specification ?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Substitute with a known - good IATS and check for proper operation. If the problem is corrected, replace IATS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0110 : Intake Air Temperature Sensor 1 Circuit

FL-292

Fuel System

P0113 Intake Air Temperature Sensor 1 Circuit High Input

Component Location

Refer to DTC P0110 : Intake Air Temperature Sensor 1 Circuit

General Description

Refer to DTC P0110 : Intake Air Temperature Sensor 1 Circuit

DTC Description

Checking output signals of IATS every 20 sec. under detecting condition, if an output signal is over 4.9V for more than 10 sec., ECM sets P0113. MIL (Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	This code detects a continuous short to high in either the signal circuit or the sensor	- Connecting condition - Open or short to battery in harness - Open in ground harness - IATS - ECM
Enable Conditions	- Engine running state - No Vehicle speed sensor fault - No ECTS fault - No MAFS fault - Intake airflow < 15 g/s - Vehicle speed < 25kph(9.3mph) - Engine coolant temperature > 50°C(122°F)	
Threshold value	Intake air temperature sensor's voltage > 4.9V	
Diagnosis Time	Continuous (More than 10 seconds failure for every 20 seconds test)	
MIL On Condition	2 Driving Cycles	

Specification

Refer to DTC P0110 : Intake Air Temperature Sensor 1 Circuit

Diagnostic Circuit Diagram

Refer to DTC P0110 : Intake Air Temperature Sensor 1 Circuit

Signal Waveform & Data

Refer to DTC P0110 : Intake Air Temperature Sensor 1 Circuit

Monitor Scantool Data

Refer to DTC P0110 : Intake Air Temperature Sensor 1 Circuit

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Signal Circuit Inspection " procedure .

Signal Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect IATS connector.
- IG "ON"
- Measure voltage between signal terminal of IATS harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ If the voltage is 0V, go to "Check open in harness" as follows. If the voltage is more than 5.1V, go to "Check short to battery in harness" as follows.

Engine Control System

FL-293

■ Check short to battery in harness

1. IG "OFF" and disconnect IATS connector and ECM connector.
2. Measure resistance between signal terminal of IATS harness connector and power terminal of MAFS harness connector.
3. Measure resistance between signal terminal of IATS harness connector and signal terminal of MAFS harness connector.

Specification : Infinite

4. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short to battery in harness and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect IATS connector and ECM connector.
2. Measure resistance between signal terminal of IATS harness connector and IATS signal terminal of ECM harness connector.

Specification : below 1Ω

3. Is the measured resistance within specification ?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Repair open in harness and go to "Verification of Vehicle Repair" procedure.

Ground Circuit Inspection

■ Check open in harness

1. IG "OFF" and disconnect IATS connector and then IG "ON".
2. Measure voltage between signal terminal of IATS harness connector and chassis ground.(Measurement "A")
3. Measure voltage between signal and ground terminals of IATS harness connector.(Measurement "B")

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair contact resistance or open in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check IATS resistance

1. IG "OFF" and disconnect IATS connector.
2. Measure resistance between signal and ground terminals of IATS connector after checking out the temperature of IATS with scantool (Component Side)

Specification :

Temp. (°C)	Resistance (k Ω)
-40	95.95 ~ 105.78
-20	27.4 ~ 29.77
0	9.08 ~ 9.72
10	5.49 ~ 5.83
20	3.42 ~ 3.61
40	1.43 ~ 1.5
60	0.66 ~ 0.69
80	0.33 ~ 0.34

3. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good IATS and check for proper operation. If the problem is corrected, replace IATS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

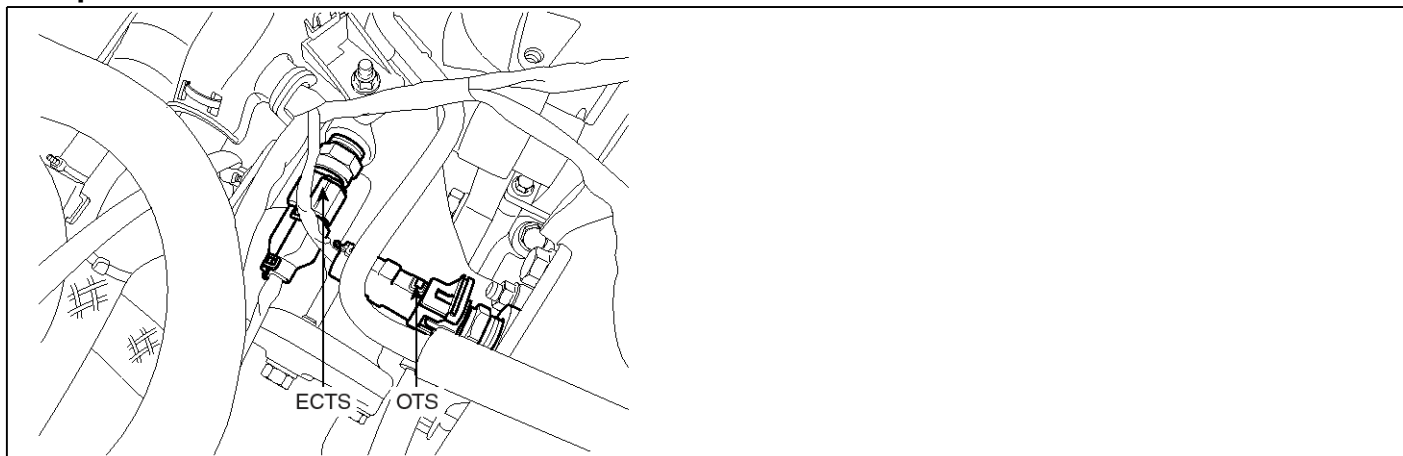
Refer to DTC P0110 : Intake Air Temperature Sensor 1 Circuit

FL-294

Fuel System

P0115 Engine Coolant Temperature Circuit

Component Location



SBHFL9303L

General Description

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

DTC Description

Checking the engine coolant temperature under detecting condition, if the difference between its current temperature and startup temperature is less than threshold value over predetermined period, ECM sets P0115. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitor the engine coolant temperature	ECTS
Enable Conditions	- Engine running state - Before startup, leave it under IG-OFF over 6 hours - No disabling faults(DTCs related to HO2S, MAFS/MAP-S, catalyst, fuel system, ECTS, or misfire)	
Threshold value	The difference between the current its temperature and the startup temperature $< 3^{\circ}\text{C}$ (5.4°F)	
Diagnosis Time	Once per driving cycle (More than 120 seconds failure)	
MIL On Condition	NO MIL ON(DTC only)	

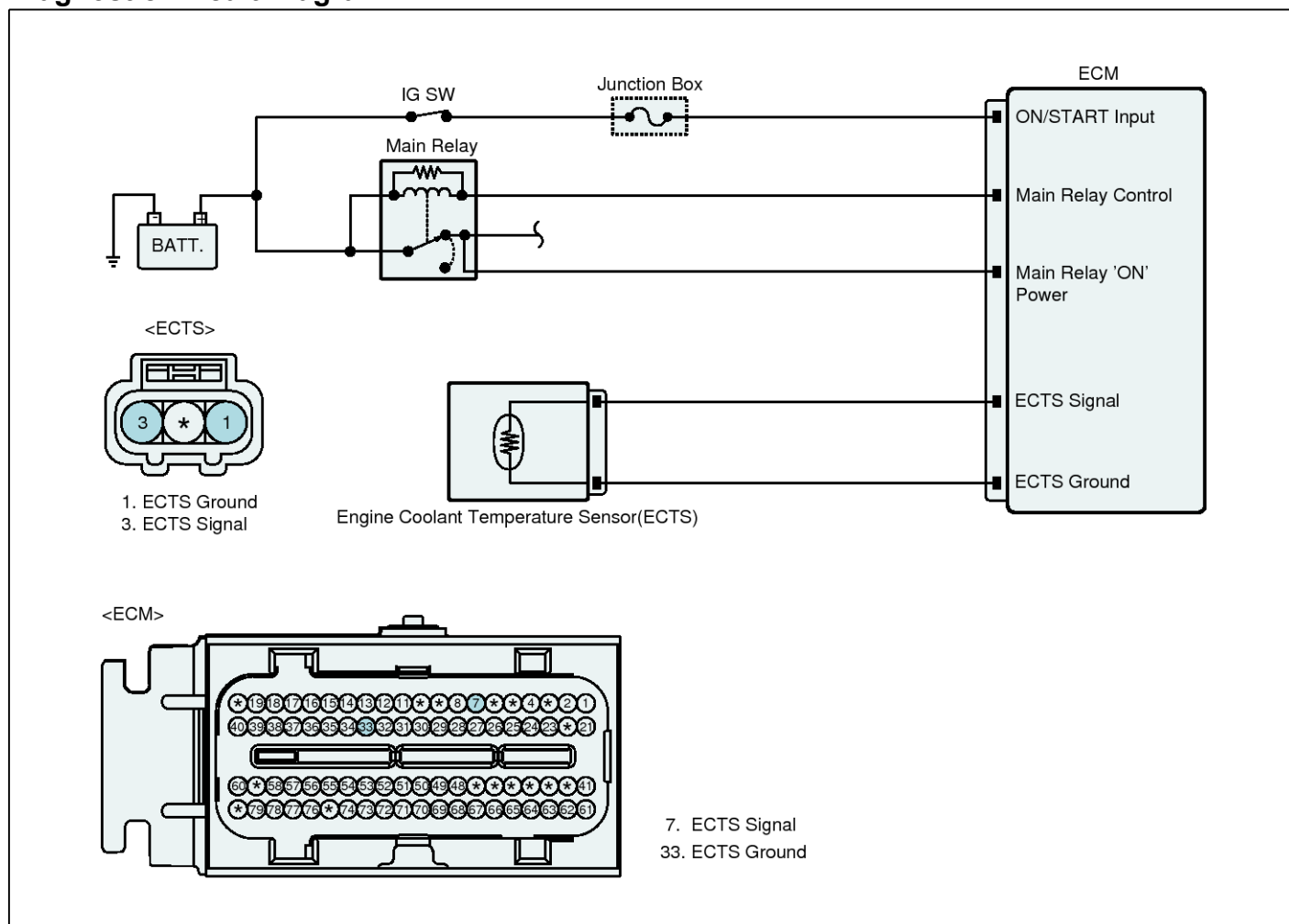
Engine Control System

FL-295

Specification

Temp. (°C)	Resistance (kΩ)	Temp. (°C)	Resistance (kΩ)
-40	48.14	40	1.15
-20	14.13 ~ 16.83	60	0.59
0	5.79	80	0.32
20	2.31 ~ 2.59		

Diagnostic Circuit Diagram



SBHFL9515L

Signal Waveform & Data

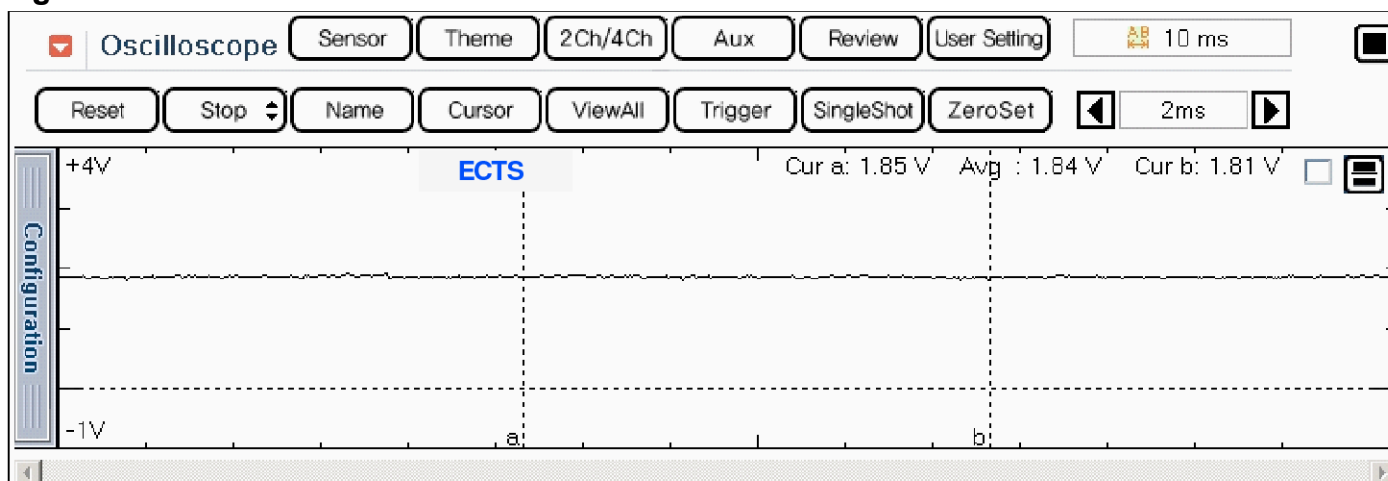


Fig.1

SBHFL9633L

Current Data		
Sensor Name	Value	Unit
☐ Engine Coolant Temperature Sensor	10.5	'C
☐ Intake Air Temperature Sensor	12.0	'C
☐ Oil Temperature Sensor	10.5	'C

Fig.2

SBHFL9631L

Sensor Name	Value	Unit
☒ Engine Speed	640	RPM
☒ Engine Coolant Temperature Sensor	90.8	'C
☒ Intake Air Temperature Sensor	27.8	'C
☒ Oil Temperature Sensor	88.5	'C

Fig.3

Fig 1) Normal waveform of ECTS at 90°C (194°F)

Fig 2) Normal data of IATS & ECTS(51°F) & EOTS at ig on

Fig 3) Normal data of IATS & ECTS(195°F) & EOTS after warming up.

The output signals of IATS & ECTS change smoothly without any rapid changes. Those have almost same characteristic signal during the early period after start. It means that the temperatures of intake air and engine coolant are depended on the temperature of atmosphere.

Meanwhile, during the warming up, the output signal of ECTS is going up increasingly. but, the output signal of IATS changes a little bit. even it may not change almost. It means that the heat of engine does not affect on the temperature of intake air.

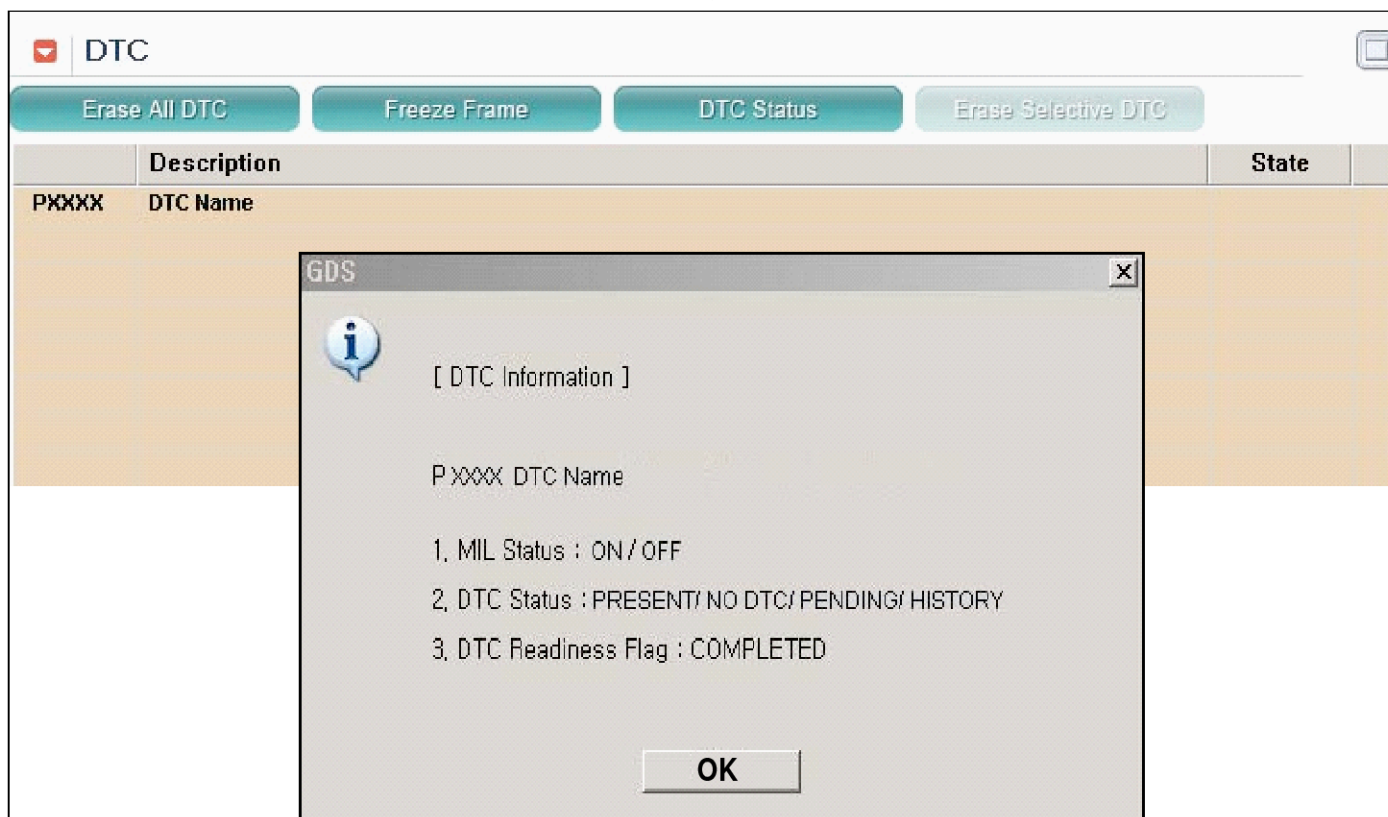
Engine Control System

FL-297

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Component Inspection" procedure.

NO ► Fault is intermittent, go to "Verification of vehicle Repair" procedure.

Component Inspection

■ Check ECTS resistance

1. IG "OFF" and disconnect ECTS connector.
2. Measure resistance between signal and ground terminals of ECTS connector after checking out the temperature of ECTS with scantool (Component Side)

Specification :

Temp. (°C)	Resistance (kΩ)
-40	48.14
-20	14.13 ~ 16.83
0	5.79
20	2.31 ~ 2.59
40	1.15
60	0.59
80	0.32

3. Is the measured resistance within specification ?

YES ► Clear DTC and Test-drive under enable conditions above-mentioned. After the test, If this DTC is set, recheck it thoroughly. If not, it is intermittent fault, go to "Verification of vehicle Repair" procedure.

NO ► Substitute with a known - good ECTS and check for proper operation. If the problem is corrected, Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-299

P0116 Engine Coolant Temperature Circuit Range / Performance

Component Location

Refer to DTC P0115 : Engine Coolant Temperature Circuit

General Description

Refer to DTC P0115 : Engine Coolant Temperature Circuit

DTC Description

Checking the engine coolant temperature under detecting condition, if the engine coolant temperature's signal is temporarily stuck above the lowest enable temperature to enable other diagnostic, ECM sets P0116. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitor the engine coolant temperature	ECTS
Enable Conditions	- Shutdown time > 180 minutes - Intake air-temperature at start-up < 40 °C(104 °F) - No disabling faults(ECTS) - Engine running > 60 seconds - Minimum airflow is satisfied for a certain time.	
Threshold value	When the start-up engine coolant temperature does not rise by 3 °C(5.4 °F).	
Diagnosis Time	Immediately	
MIL On Condition	NO MIL ON(DTC only)	

Specification

Refer to DTC P0115 : Engine Coolant Temperature Circuit

Diagnostic Circuit Diagram

Refer to DTC P0115 : Engine Coolant Temperature Circuit

Signal Waveform & Data

Refer to DTC P0115 : Engine Coolant Temperature Circuit

Monitor Scantool Data

Refer to DTC P0115 : Engine Coolant Temperature Circuit

Component Inspection

■ Check ECTS resistance

1. IG "OFF" and disconnect ECTS connector.
2. Measure resistance between signal and ground terminals of ECTS connector after checking out the temperature of ECTS with scantool (Component Side)

Specification :

Temp. (°C)	Resistance (kΩ)
-40	48.14
-20	14.13 ~ 16.83
0	5.79
20	2.31 ~ 2.59
40	1.15
60	0.59
80	0.32

3. Is the measured resistance within specification ?

YES ► Clear DTC and Test-drive under enable conditions above-mentioned. After the test, If this DTC is set, recheck it thoroughly. If not, it is intermittent fault, go to "Verification of vehicle Repair" procedure.

NO ► Substitute with a known - good ECTS and check for proper operation. If the problem is corrected, Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0115 : Engine Coolant Temperature Circuit

FL-300

Fuel System

P0117 Engine Coolant Temperature Circuit Low Input

Component Location

Refer to DTC P0115 : Engine Coolant Temperature Circuit

General Description

Refer to DTC P0115 : Engine Coolant Temperature Circuit

DTC Description

Checking output signals from ECTS every 80 sec. under detecting condition, if an output signal is below 0.1V for more than 40 sec., ECM sets P0117. MIL (Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		• Signal low	• Poor connection • Short to ground in harness • ECTS • ECM
Enable Conditions	Case 1	• Time after start-up > 120 sec.	
	Case 2	• Time from IG "OFF" to IG "ON" > 360 min • Engine running state	
Threshold value		• Engine coolant temperature sensor's voltage < 0.1V	
Diagnosis Time		• Continuous (More than 40 seconds failure for every 80 second test)	
MIL On Condition		• 2 Driving Cycles	

Specification

Refer to DTC P0115 : Engine Coolant Temperature Circuit

Diagnostic Circuit Diagram

Refer to DTC P0115 : Engine Coolant Temperature Circuit

Signal Waveform & Data

Refer to DTC P0115 : Engine Coolant Temperature Circuit

Monitor Scantool Data

Refer to DTC P0115 : Engine Coolant Temperature Circuit

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Signal Circuit Inspection " procedure

Signal Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect ECTS connector.
- IG "ON"
- Measure voltage between signal terminal of ECTS harness connector and chassis ground.

Specification : Approx. 5V

- Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Go to "Check short to ground in harness" as follows.

■ Check short to ground in harness

- IG "OFF" and disconnect ECTS connector and ECM connector.
- Measure resistance between signal terminal of ECTS harness connector and chassis ground. (Measurement "A")
- Measure resistance between signal and ground terminals of ECTS harness connector. (Measurement "B")

Specification : Infinite

Engine Control System

FL-301

4. Is the measured resistance within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Repair short to ground in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check ECTS resistance

1. IG "OFF" and disconnect ECTS connector.
2. Measure resistance between signal and ground terminals of ECTS connector after checking out the temperature of ECTS with scantool (Component Side)

Specification :

Temp. (°C)	Resistance (kΩ)
-40	48.14
-20	14.13 ~ 16.83
0	5.79
20	2.31 ~ 2.59
40	1.15
60	0.59
80	0.32

3. Is the measured resistance within specification ?

YES ► Clear DTC and Test-drive under enable conditions above-mentioned. After the test, If this DTC is set, recheck it thoroughly. If not, it is intermittent fault, go to "Verification of vehicle Repair" procedure.

NO ► Substitute with a known - good ECTS and check for proper operation. If the problem is corrected, Go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0115 : Engine Coolant Temperature Circuit

FL-302

Fuel System

P0118 Engine Coolant Temperature Circuit High Input

Component Location

Refer to DTC P0115 : Engine Coolant Temperature Circuit

General Description

Refer to DTC P0115 : Engine Coolant Temperature Circuit

DTC Description

Checking output signals from ECTS every 80 sec. under detecting condition, if an output signal is above 4.9V for more than 40 sec., ECM sets P0118. MIL (Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		• Open, Signal high	• Poor connection • Open or short to battery in signal harness • Open in ground harness • ECTS • ECM
Enable Conditions	Case 1	• Time after start-up > 120 sec.	
	Case 2	• Time from IG "OFF" to IG "ON" > 360 min • Intake air temperature $\geq -10^{\circ}\text{C}$ (14°F) • Engine running state	
Threshold value		• Engine coolant temperature sensor's voltage > 4.9V	
Diagnosis Time		• Continuous (More than 10 sec. failure for every 20 sec. test)	
MIL On Condition		• 2 Driving Cycles	

Specification

Refer to DTC P0115 : Engine Coolant Temperature Circuit

Diagnostic Circuit Diagram

Refer to DTC P0115 : Engine Coolant Temperature Circuit

Signal Waveform & Data

Refer to DTC P0115 : Engine Coolant Temperature Circuit

Monitor Scantool Data

Refer to DTC P0115 : Engine Coolant Temperature Circuit

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Signal Circuit Inspection " procedure .

Signal Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect ECTS connector.
2. IG "ON"
3. Measure voltage between signal terminal of ECTS harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ If the voltage is 0V, go to "Check open in harness" as follows. If the voltage is more than 5.1V, go to "Check short to battery in harness" as follows.

Engine Control System

FL-303

■ Check open in harness

1. IG "OFF" and disconnect ECTS connector and ECM connector.
2. Measure resistance between signal terminal of ECTS harness connector and ECTS signal terminal of ECM harness connector.

Specification : below 1Ω

3. Is the measured resistance within specification ?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Repair open in harness and go to "Verification of Vehicle Repair" procedure.

Ground Circuit Inspection

■ Check open in harness

1. IG "OFF" and disconnect ECTS connector and then IG "ON".
2. Measure voltage between signal terminal of ECTS harness connector and chassis ground. (Measurement "A")
3. Measure voltage between signal and ground terminals of ECTS harness connector. (Measurement "B")

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair contact resistance or open in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check ECTS resistance

1. IG "OFF" and disconnect ECTS connector.
2. Measure resistance between signal and ground terminals of ECTS connector after checking out the temperature of ECTS with scantool (Component Side)

Specification :

Temp. (°C)	Resistance (kΩ)
-40	48.14
-20	14.13 ~ 16.83
0	5.79
20	2.31 ~ 2.59
40	1.15
60	0.59
80	0.32

3. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good ECTS and check for proper operation. If the problem is corrected, replace ECTS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0115 : Engine Coolant Temperature Circuit

FL-304

Fuel System

P0122 Throttle/Pedal Position Sensor/Switch "A" Circuit Low Input

Component Location



SBHFL9302L

General Description

The Electronic Throttle Control(ETC) system is made of the components throttle body, Throttle Position Sensor(TPS)1&2 and Accelerator Position Sensor(APS) 1&2. TPS1&2 are sharing the same source voltage and ground. The throttle valve opening is control by throttle motor which is controlled by Engine Control Module(ECM). The opposite position indicator shows inverted signal characteristics. TPS1 output voltage increases smoothly in proportion with the throttle valve opening angle after starting. TPS2 output voltage decreases in inverse proportion with the throttle valve opening angle after starting. TPS provides feedback to the ECM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC Description

Checking output signals from TPS1 every 8.5 sec. under detecting condition, if an output signal is below 0.25V for more than 0.1 sec., ECM sets P0122. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Signal low	• Poor connection • Open or short to ground in power harness • Short to ground in signal harness • TPS • ECM
Enable Conditions	• IG "ON"	
Threshold value	• The voltage of TPS < 0.25V	
Diagnosis Time	• Continuous (more than 0.1 sec. failure for every 8.5 sec .test)	
MIL On Condition	• 1 driving cycles	

Engine Control System

FL-305

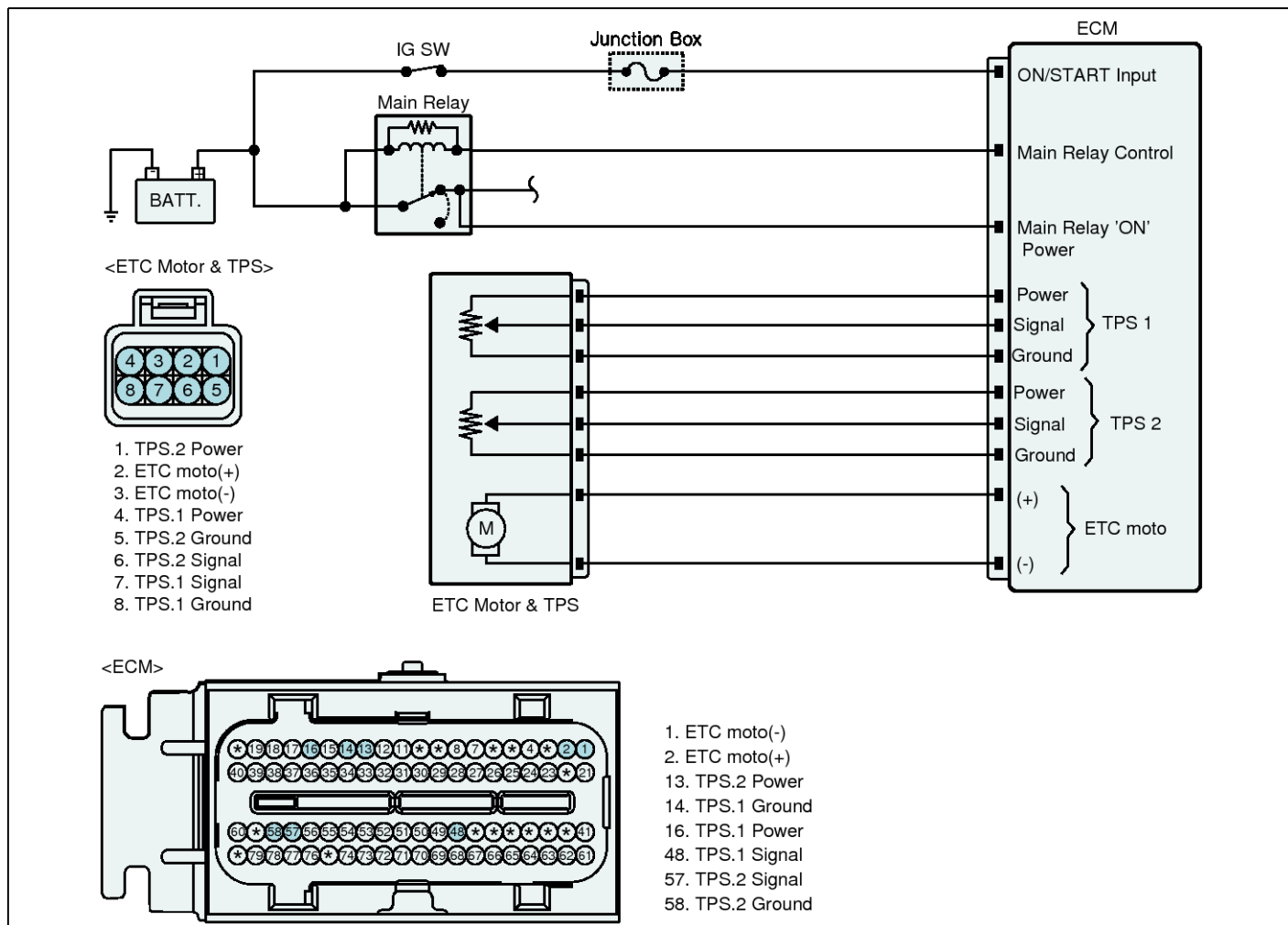
Specification

Throttle Opening (°)	Output Voltage (V) [Vref=5.0]	
	TPS1	TPS2
0°	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	0.0V

Diagnostic Circuit Diagram

FL-306

Fuel System



SBHFL9516L

Signal Waveform & Data

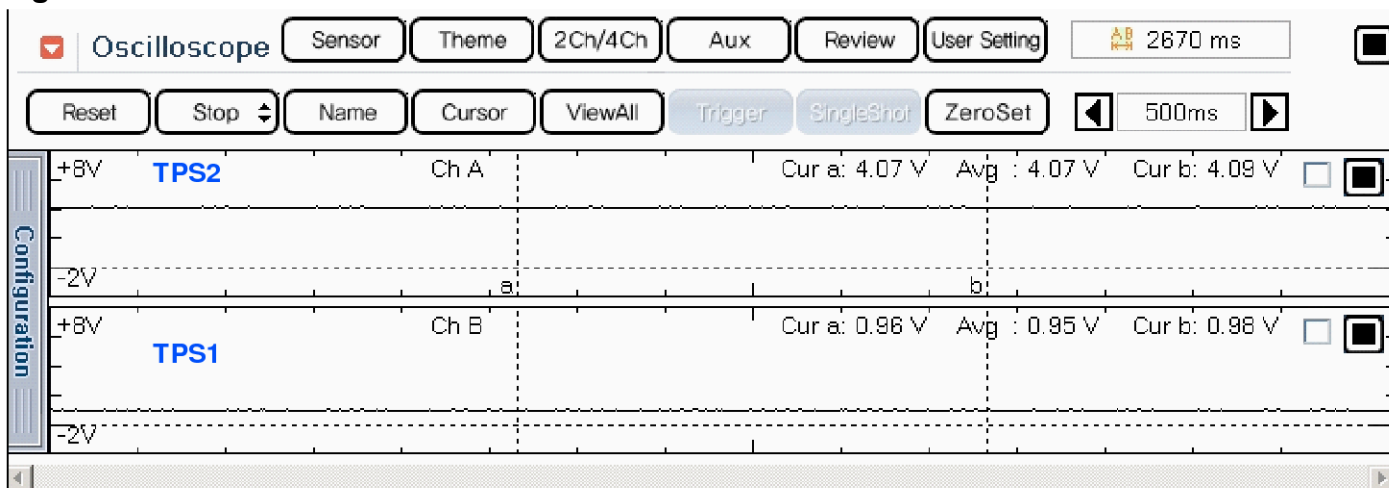


Fig.1

SBHFL9634L

Engine Control System

FL-307

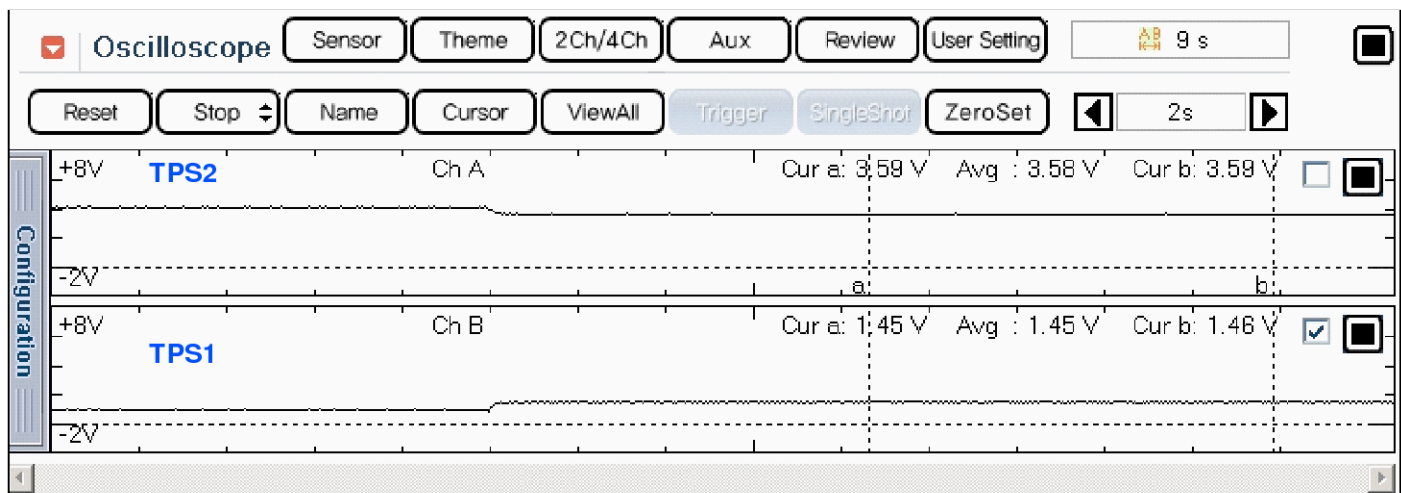


Fig.2

SBHFL9635L

Sensor Name	Value	Unit
☒ ETC Throttle Position	4.1	DEG
☒ Throttle Position1 Duty	5.1	DEG
☒ Throttle Position2 Duty	5.2	DEG
☒ Throttle Position1 Voltage	0.7	V
☒ Throttle Position2 Voltage	4.3	V
☒ ETC Motor Duty	-12	%

Fig.3

SBHFL9636L

Sensor Name	Value	Unit
☒ Engine Speed	0	RPM
☒ ETC Throttle Position	9.9	DEG
☒ Throttle Position1 Duty	130.1	DEG
☒ Throttle Position2 Duty	132.0	DEG
☒ Throttle Position1 Voltage	4.9	V
☒ Throttle Position2 Voltage	0.1	V

Fig.4

SBHFL9637L

Sensor Name	Value	Unit
☒ Throttle Position1 Duty	0.0	DEG
☒ Throttle Position2 Duty	5.3	DEG
☒ Throttle Position1 Voltage	0.0	V
☒ Throttle Position2 Voltage	4.3	V
☒ Engine Speed	640	RPM

Fig.5

SBHFL9638L

Fig 1) Normal waveform of TPS1 & TPS2 with no accel pedal depressed under IG ON condition

Fig 2) Normal waveform of TPS1 & TPS2 with accel pedal depressed under IG ON condition

FL-308

Fuel System

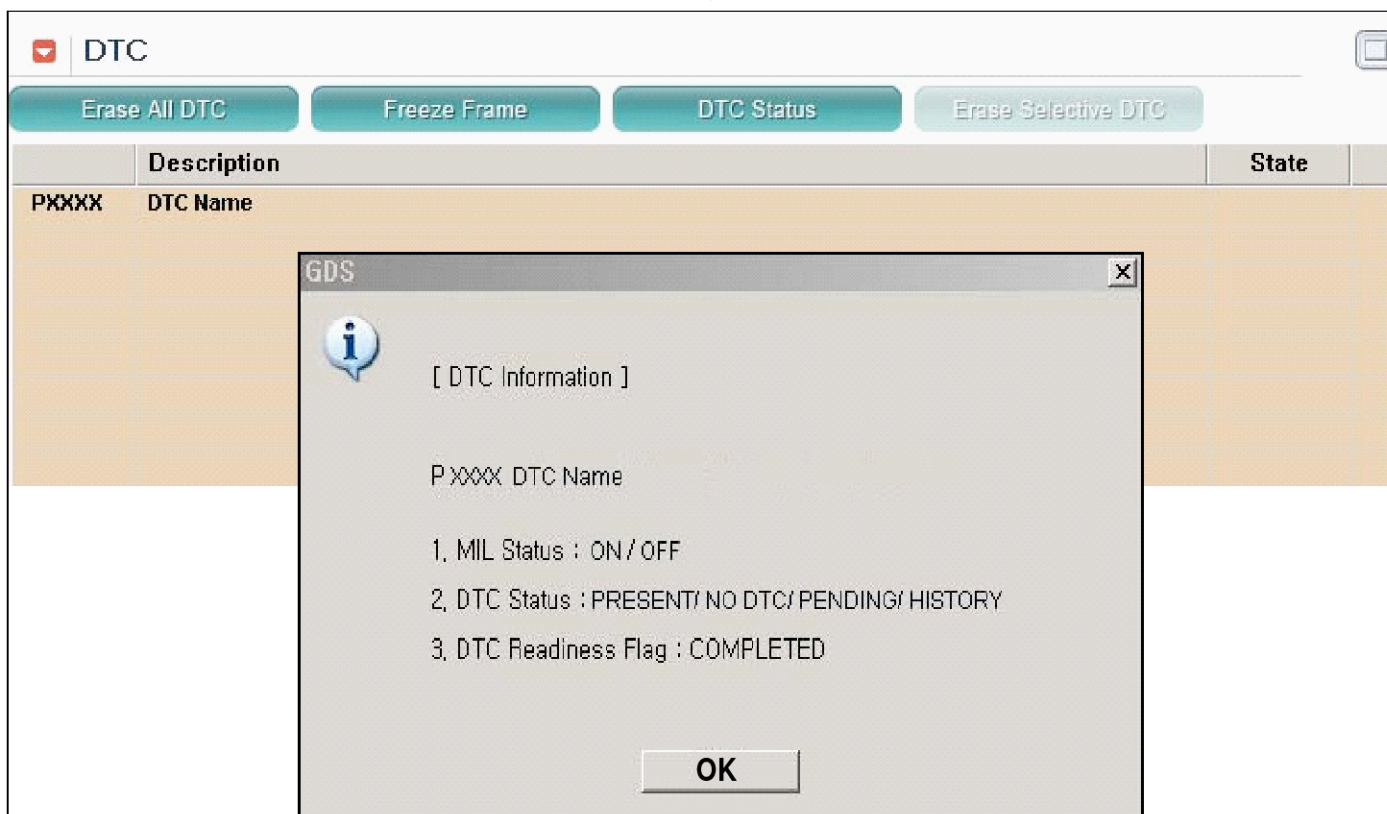
Fig 3) Normal data of TPS1 & TPS2 under IG ON condition

Fig 4) Abnormal data of TPS1 & TPS2 under open condition

Fig 5) Abnormal data of TPS1 & TPS2 under short to ground in TSP1 circuit

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination,

deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Power Circuit Inspection" procedure.

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect ETC Motor & TPS connector.
2. IG "ON".
3. Measure voltage between TPS1 power terminal of ETC Motor & TPS harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

Engine Control System

FL-309

YES ▶ Go to "Signal circuit inspection" procedure.

NO ▶ Repair open or short to ground in power harness, and go to "Verification of Vehicle Repair" procedure.

Signal Circuit Inspection

■ Check short to ground in harness

1. IG "OFF" and disconnect ETC Motor & TPS connector and ECM connector.
2. Measure resistance between TPS1 signal terminal of ETC Motor & TPS harness connector and chassis ground.(Measurement "A")

FL-310

Fuel System

3. Measure resistance between TPS1 signal and TPS1(2) ground terminals of ETC Motor & TPS harness connector.(Measurement "B")

Specification : Infinite

4. Is the measured resistance within specification ?

YES ▶ Go to "Component inspection" procedure.

NO ▶ Repair short to ground in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check TPS resistance

1. IG "OFF" and disconnect ETC Motor & TPS connector.
2. Measure resistance between TPS1 power and TPS1 ground terminals of ETC Motor & TPS connector.(component side)

Specification : 4 ~ 6kΩ

3. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good ECT motor & TPS and check for proper operation. If the problem is corrected, replace ECT motor & TPS and go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will take 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-311

P0123 Throttle/Pedal Position Sensor/Switch "A" Circuit High Input

Component Location

Refer to DTC P0122 : Throttle/Pedal Position Sensor/Switch "A" Circuit Low Input

General Description

Refer to DTC P0122 : Throttle/Pedal Position Sensor/Switch "A" Circuit Low Input

DTC Description

Checking output signals from TPS1 every 8.5 sec. under detecting condition, if an output signal is above 4.75V for more than 0.1 sec., ECM sets P0123. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Signal high	• Poor connection • Open or short to battery in signal harness • Open in ground harness • TPS • ECM
Enable Conditions	• IG "ON"	
Threshold value	• The voltage of TPS > 4.75V	
Diagnosis Time	• Continuous (more than 0.1 sec. failure for every 8.5 sec .test)	
MIL On Condition	• 1 driving cycles	

Specification

Refer to DTC P0122 : Throttle/Pedal Position Sensor/Switch "A" Circuit Low Input

Diagnostic Circuit Diagram

Refer to DTC P0122 : Throttle/Pedal Position Sensor/Switch "A" Circuit Low Input

Signal Waveform & Data

Refer to DTC P0122 : Throttle/Pedal Position Sensor/Switch "A" Circuit Low Input

Monitor Scantool Data

Refer to DTC P0122 : Throttle/Pedal Position Sensor/Switch "A" Circuit Low Input

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Signal Circuit Inspection " procedure

Signal Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect ETC Motor & TPS connector.
2. IG "ON".
3. Measure voltage between TPS1 signal terminal of ETC Motor & TPS harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ► Go to "Check open in harness" as follows.

NO ► Go to "Check short to battery in harness" as follows.

■ Check open in harness

1. IG "OFF" and disconnect ETC Motor & TPS connector and ECM connector.
2. Measure resistance between TPS1 signal terminal of ETC Motor & TPS harness connector and TPS1 signal terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification ?

YES ► Go to "Ground Circuit Inspection" procedure.

NO ► Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

FL-312

Fuel System

■ Check short to battery in harness

1. IG "OFF" and disconnect ETC Motor & TPS connector and ECM connector.
2. Measure resistance between TPS1 signal and TPS1 power terminals of ETC Motor & TPS harness connector.(Measurement "A")
3. Measure resistance between TPS1 signal and TPS2 power terminals of ETC Motor & TPS harness connector.(Measurement "A")
4. Measure resistance between TPS1 signal and ETC motor(+) terminals of ETC Motor & TPS harness connector.(Measurement "B")
5. Measure resistance between TPS1 signal and ETC motor(-) terminals of ETC Motor & TPS harness connector.(Measurement "B")

Specification : Infinite

6. Is the measured resistance within specification ?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

Ground Circuit Inspection

■ Check open in harness

1. IG "OFF" and disconnect ECTS connector and then IG "ON".
2. Measure voltage between TPS1 power terminal of ETC Motor & TPS harness connector and chassis ground.(Measurement "A")
3. Measure voltage between TPS1 power and TPS1 ground terminals of ETC Motor & TPS harness connector.(Measurement "B")

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair contact resistance or open in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check TPS resistance

1. IG "OFF" and disconnect ETC Motor & TPS connector.
2. Measure resistance between TPS1 power and TPS1 ground terminals of ETC Motor & TPS connector.(component side)

Specification : 4 ~ 6kΩ

3. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good ECT motor & TPS and check for proper operation. If the problem is corrected, replace ECT motor & TPS and go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will take 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

Verification of Vehicle Repair

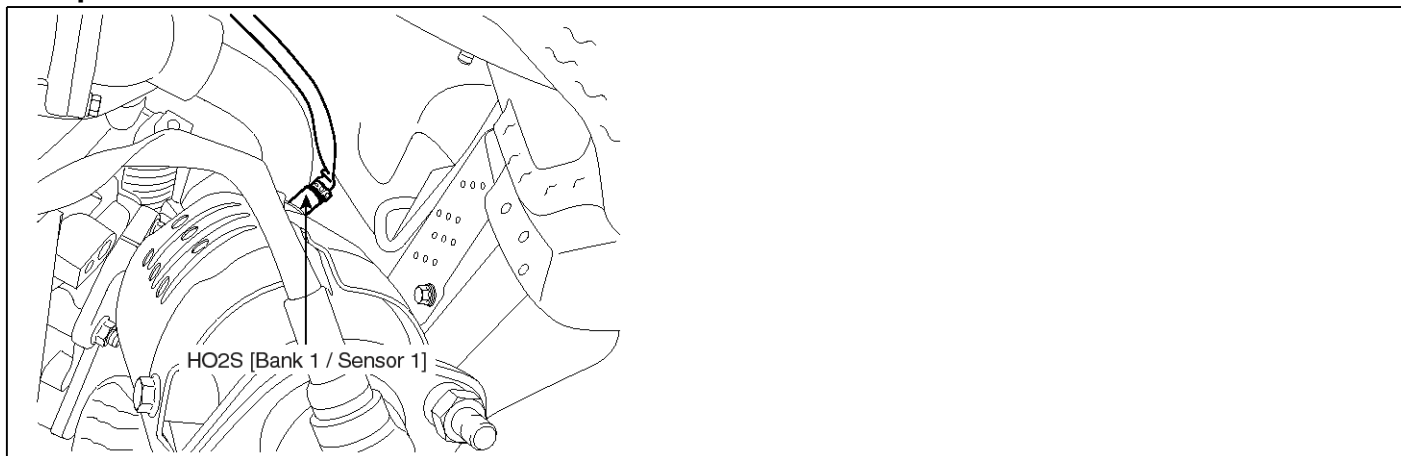
Refer to DTC P0122 : Throttle/Pedal Position Sensor/Switch "A" Circuit Low Input

Engine Control System

FL-313

P0131 O2 Sensor Circuit Low Voltage(Bank 1 / Sensor 1)

Component Location



SBHFL9311L

General Description

In order to control emissions of the CO, HC and NOx components of the exhaust gas, heated oxygen sensor (HO2S), mounted on the front side and rear side of catalytic converter, detects the oxygen content in the exhaust gas. The front HO2S signal is used to control air/fuel ratio (closed loop fuel control) and the rear HO2S signal is used to monitor front HO2S and catalyst for proper operation. The HO2S requires a minimum temperature to operate properly and provide a closed loop fuel control system. The HO2S contains the heater element to reduce its warming-up time and ensure its performance during all driving conditions. The oxygen sensor generates a voltage that indicates the difference between the oxygen content of the exhaust stream and the oxygen content of ambient air. When the exhaust stream is "rich," there is more oxygen in the ambient air than in the exhaust stream, so the voltage will be higher.

DTC Description

Checking output signals from HO2S under detecting condition, if an output signal is below 0.04V for more than predetermine time, ECM sets P0131. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitor signal voltage	- Poor connection - Short to ground in harness - HO2S(B1/S1) - ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running ≥ 60 sec - Engine warm-up state	
Threshold value	The voltage of HO2S(B1/S1) $< 0.04V$	
Diagnosis Time	Continuous (more than 12.5 sec. failure for every 15 s-ec.test)	
MIL On Condition	2 Driving Cycles	

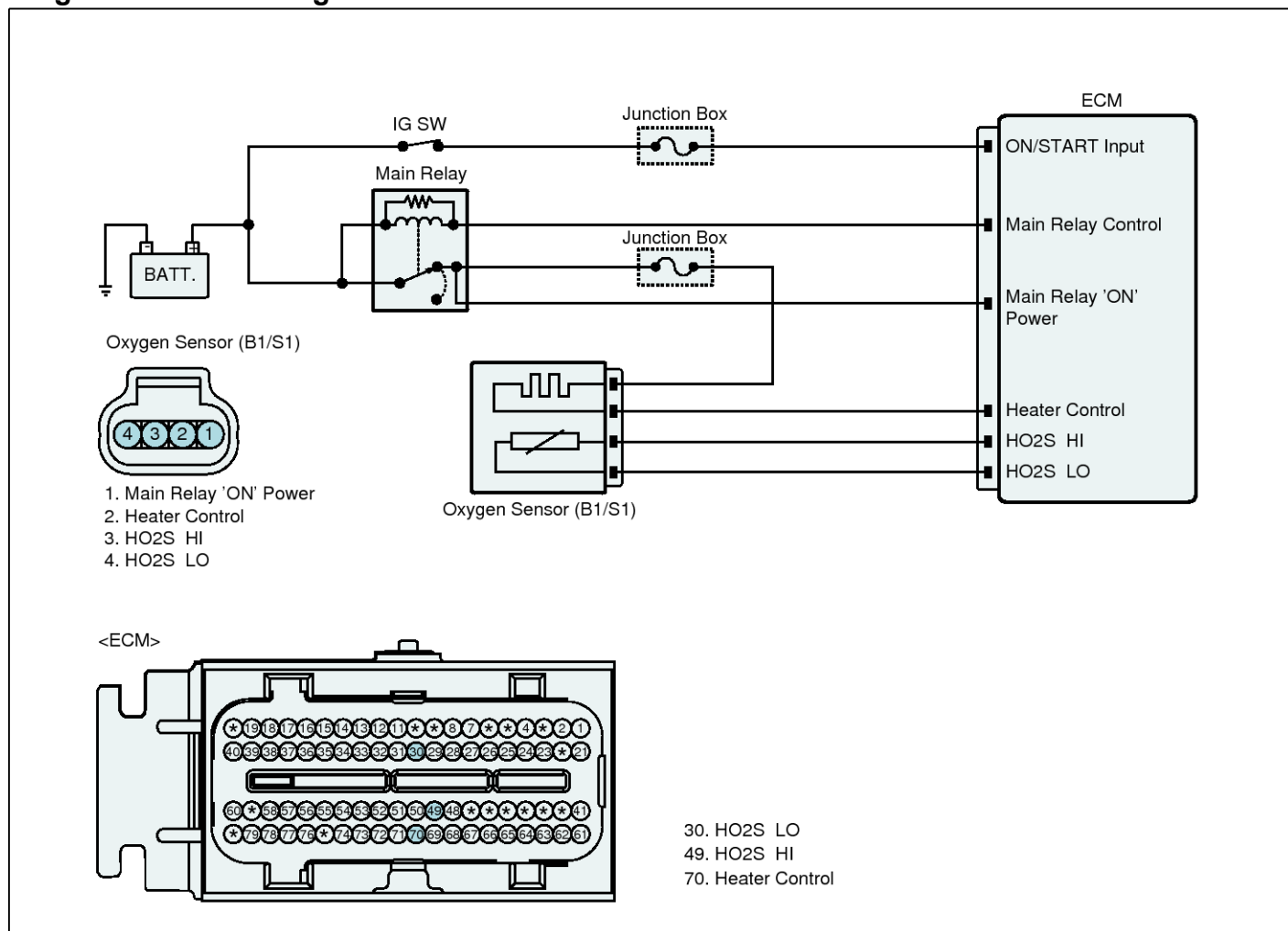
FL-314

Fuel System

Specification (Reference only)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is commonly switching from rich to lean more than 3 times in 10 sec.	Signal is commonly above 0.6V.
HO2S signal at open circuit(Pumping current OFF)	Approx. 0.45V	
HO2S signal at open circuit(Pumping current ON)	Approx. 3.5V	

Diagnostic Circuit Diagram



SBHFL9508L

Signal Waveform & Data

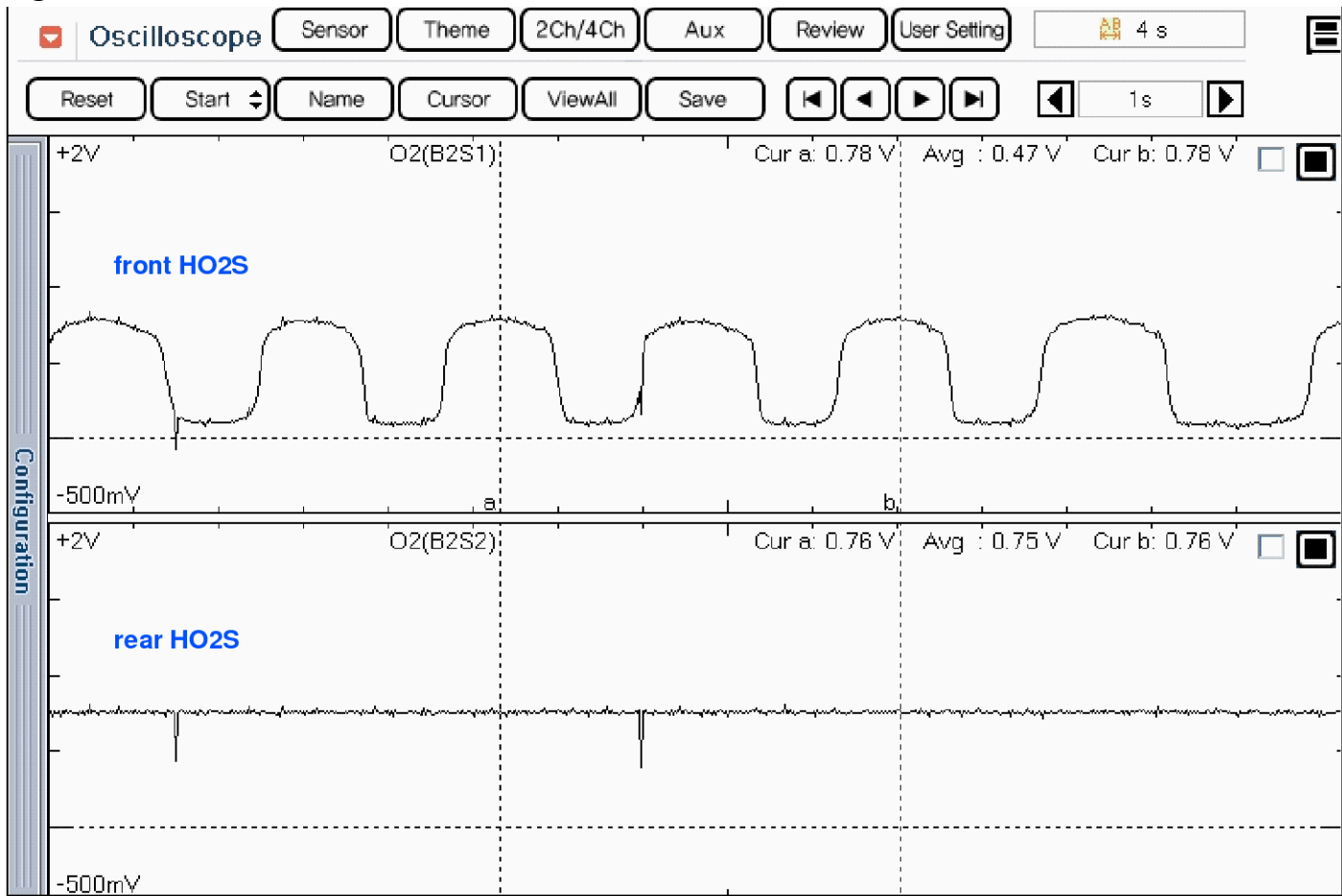


Fig.1

SBHFL9698L

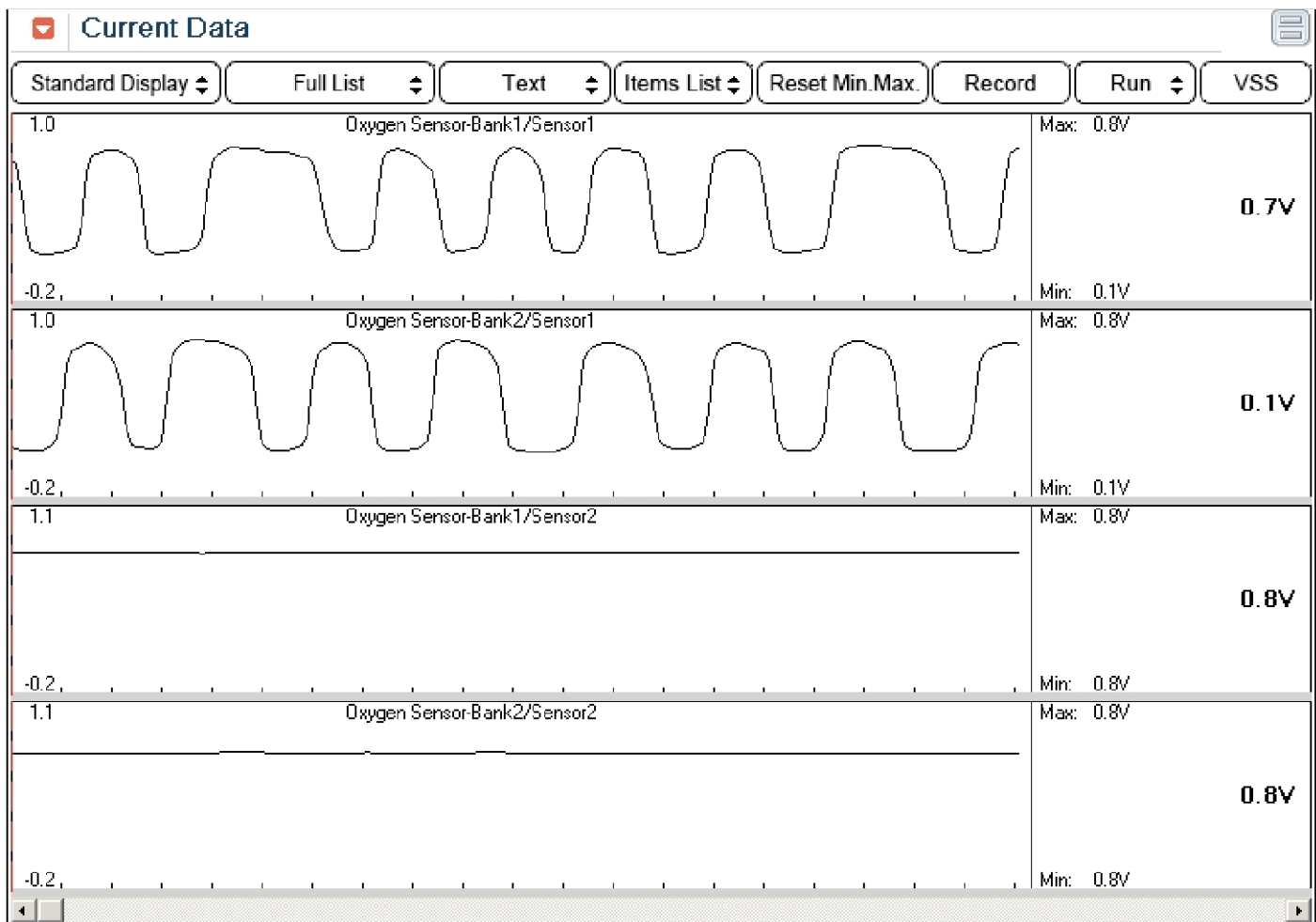


Fig.2

SBHFL9639L

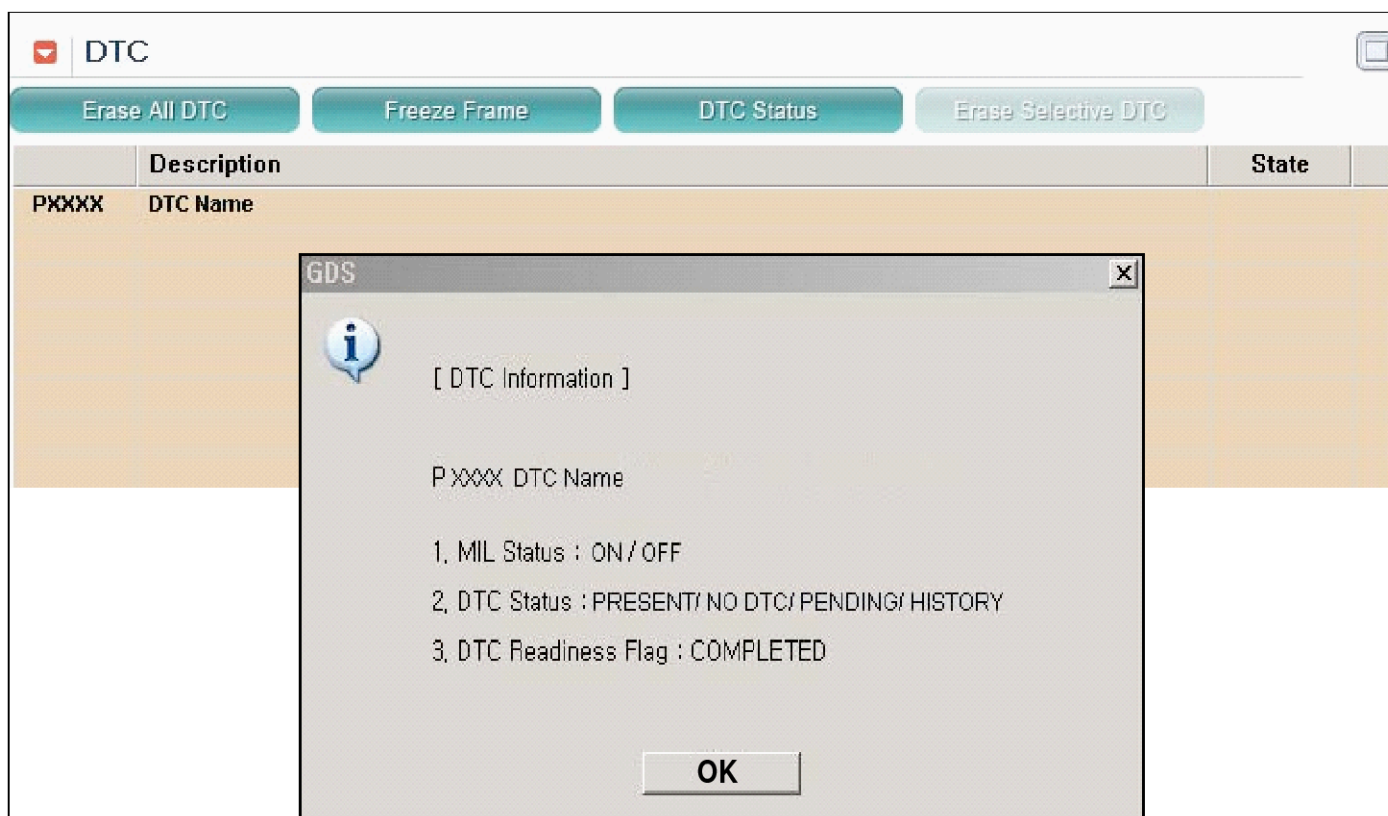
Fig 1) Normal waveforms of front HO2S(the upper) and rear HO2S(the lower)

Fig 2) Normal graph of front HO2S and rear HO2S at idle.

After warming-up, if accelerator pedal is released suddenly around 4000rpm, the HO2S signal reading will be lower than 200mV resulting from Fuel cut-off for the moment. Conversely, if suddenly accelerator pedal is depressed, HO2S signal reading will be around 0.6V ~1.0V. At idle, Normally HO2S signal will switch from lean to rich with 3 Hz. And as racing, Its frequency rises.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ▶ Go to "Terminal and Connector inspection" procedure.

NO ▶ Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Signal Circuit Inspection " procedure .

Signal Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect HO2S(B1/S1) connector.
2. IG "ON".
3. Measure voltage between signal terminal of HO2S(B1/S1) harness connector and chassis ground.

Specification : Approx. 3.5V - when pumping current is ON

Approx. 0.45V - when pumping current is

OFF

4. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

FL-318

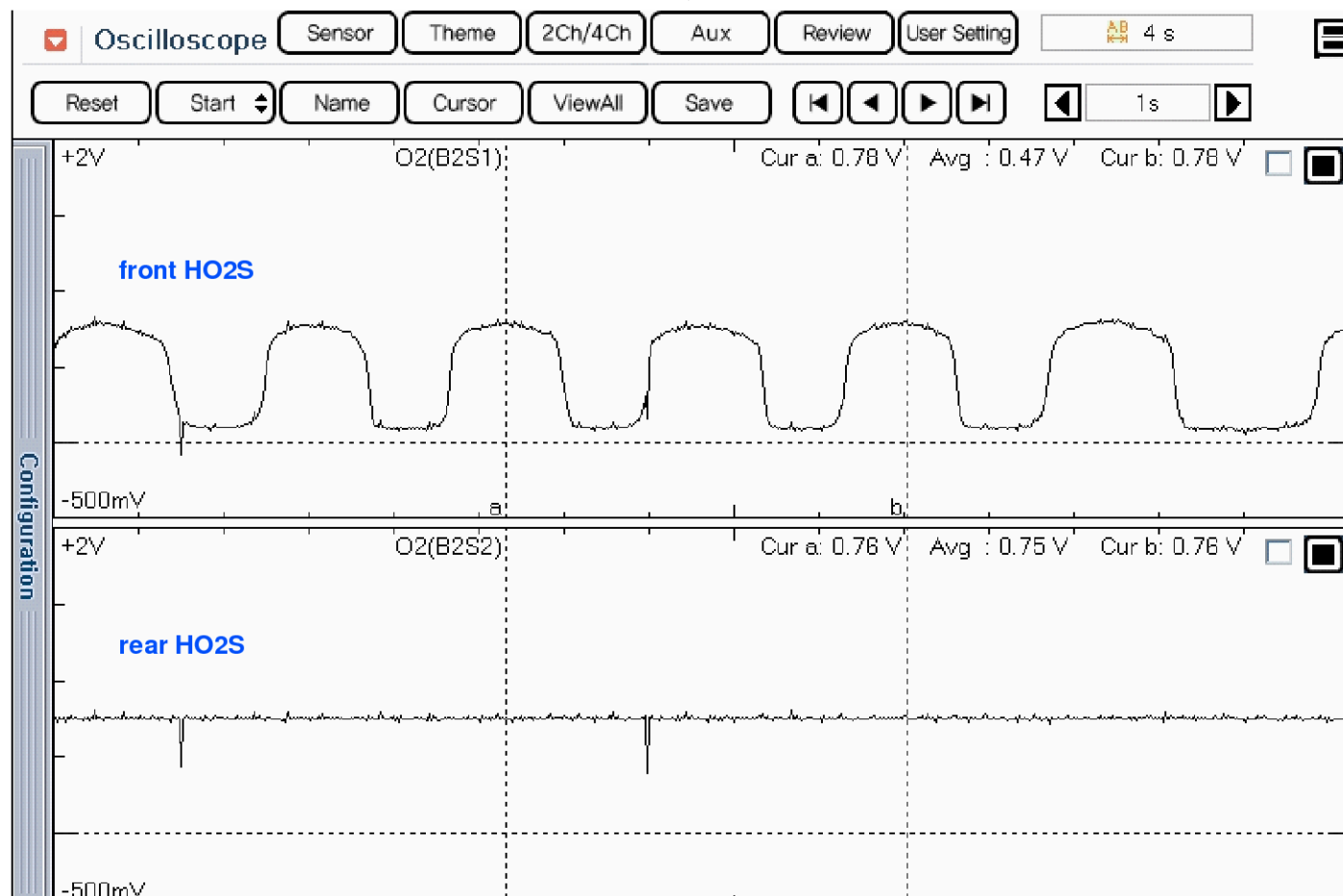
Fuel System

Component Inspection

■ Check the Signal waveform of HO2S

1. IG "OFF" and connect HO2S connector.
2. Engine start.

3. After warming-up, monitor signal waveform of HO2S with scantool.



SBHFL9640L

4. Is the sensor switching properly?

YES ► Go to "Check HO2S" as below.

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

■ Check HO2S

1. IG "OFF" and disconnect HO2S connector.
2. Check that the HO2S is securely installed.
3. Check the HO2S for contamination or damage
4. Is the sensor normal?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

⚠ NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Engine Control System

FL-319

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

FL-320

Fuel System

P0132 O2 Sensor Circuit High Voltage(Bank 1 / Sensor 1)

Component Location

Refer to DTC P0131 : O2 Sensor Circuit Low Voltage(Bank 1/Sensor 1)

General Description

Refer to DTC P0131 : O2 Sensor Circuit Low Voltage(Bank 1/Sensor 1)

DTC Description

Checking output signals from HO2S under detecting condition, if an output signal is above 1.3V for more than predeterminate time, ECM sets P0132. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitor signal voltage	- Poor connection - Short to battery in harness - HO2S(B1/S1) - ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running ≥ 60 sec - Engine warm-up state	
Threshold value	The voltage of HO2S(B1/S1) $> 1.3V$	
Diagnosis Time	Continuous (more than 12.5 sec.failure for every 15 sec. test)	
MIL On Condition	2 Driving Cycles	

Specification

Refer to DTC P0131 : O2 Sensor Circuit Low Voltage(Bank 1/Sensor 1)

Diagnostic Circuit Diagram

Refer to DTC P0131 : O2 Sensor Circuit Low Voltage(Bank 1/Sensor 1)

Signal Waveform & Data

Refer to DTC P0131 : O2 Sensor Circuit Low Voltage(Bank 1/Sensor 1)

Monitor Scantool Data

Refer to DTC P0131 : O2 Sensor Circuit Low Voltage(Bank 1/Sensor 1)

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Signal Circuit Inspection " procedure .

Signal Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect HO2S(B1/S1) connector.
- IG "ON".
- Measure voltage between signal terminal of HO2S(B1/S1) harness connector and chassis ground.

Specification : Approx. 3.5V - when pumping current is ON

Approx. 0.45V - when pumping current is OFF

- Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

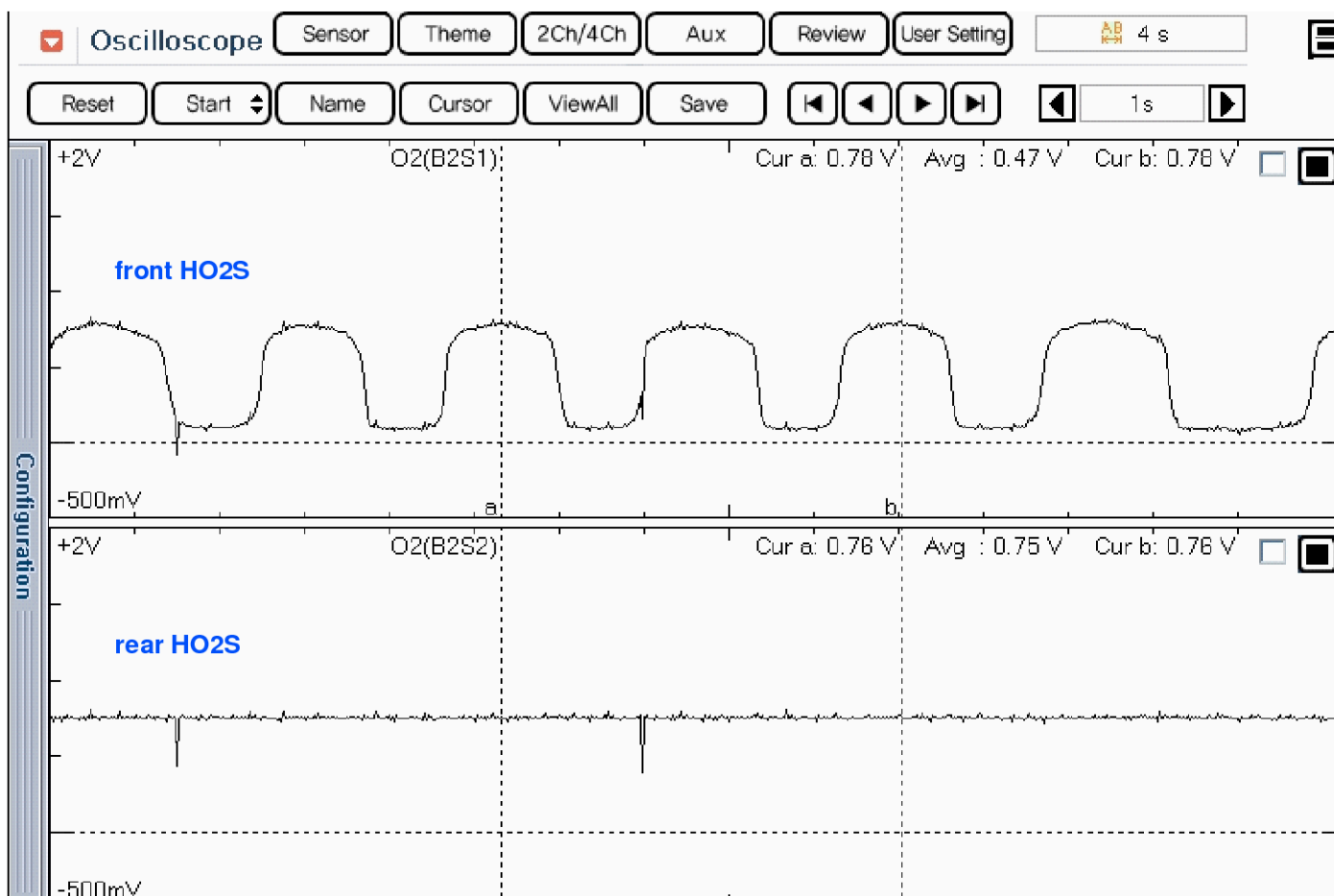
Component Inspection

■ Check the Signal waveform of HO2S

- IG "OFF" and connect HO2S connector.
- Engine start.
- After warming-up, monitor signal waveform of HO2S with scantool.

Engine Control System

FL-321



SBHFL9640L

4. Is the sensor switching properly?

YES ► Go to "Check HO2S" as below.

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Check HO2S

1. IG "OFF" and disconnect HO2S connector.
2. Check that the HO2S is securely installed.
3. Check the HO2S for contamination or damage
4. Is the sensor normal?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0131 : O2 Sensor Circuit Low Voltage(Bank 1/Sensor 1)

FL-322

Fuel System

P0133 O2 Sensor Circuit Slow Response (Bank 1 / Sensor 1)

Component Location

Refer to DTC P0131 : O2 Sensor Circuit Low Voltage (Bank 1 / Sensor 1)

General Description

Refer to DTC P0131 : O2 Sensor Circuit Low Voltage (Bank 1 / Sensor 1)

DTC Description

Checking output signals from HO2S under detecting condition, if ECM judges it's signals too slow, ECM sets P0133. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitor HO2S's response rate	- Poor connection - Faulty HO2S - Faulty ECM
Enable Conditions	- Engine warm-up sufficiently - Engine run time > 60sec - Drive at a steady speed between 45-55 mph(72-88 km/h) - Engine Coolant > 70 °C(158 °F) - No disabling faults	
Threshold value	The calculated response rate is too slow (out of threshold in ECM)	
Diagnosis Time	Continuous	
MIL On Condition	2 Driving Cycles	

Specification

Refer to DTC P0131 : O2 Sensor Circuit Low Voltage (Bank 1 / Sensor 1)

Diagnostic Circuit Diagram

Refer to DTC P0131 : O2 Sensor Circuit Low Voltage (Bank 1 / Sensor 1)

Signal Waveform & Data

Refer to DTC P0131 : O2 Sensor Circuit Low Voltage (Bank 1 / Sensor 1)

Monitor Scantool Data

Refer to DTC P0131 : O2 Sensor Circuit Low Voltage (Bank 1 / Sensor 1)

Component Inspection

1. Replace the HO2S.
2. Clear DTC with scantool.
3. Start the engine and warm it up until the radiator fan comes on (more than at least 10 minutes).
4. Drive at a steady speed between 45-55 mph(72-88 km/h) for 120 sec.
5. Stop and then maintain idle state.
6. Check if O2 sensor monitoring readiness is complete.

7. Does the scan tool show DTC P0133?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Troubleshooting is finished

Verification of Vehicle Repair

Refer to DTC P0131 : O2 Sensor Circuit Low Voltage(Bank 1/Sensor 1)

Engine Control System

FL-323

P0134 O2 Sensor Circuit No Activity Detected (Bank 1 Sensor 1)

Component Location

Refer to DTC P0131 : O2 Sensor Circuit Low Voltage (Bank 1 / Sensor 1)

General Description

Refer to DTC P0131 : O2 Sensor Circuit Low Voltage (Bank 1 / Sensor 1)

DTC Description

Checking output signals from HO2S under detecting condition, if an output voltage is approx.0.45V or 3.5V for more than predetermine time, ECM sets P0134. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		• Monitor signal voltage	• Poor connection • Open in harness • HO2S(B1/S1) • ECM
Enable Conditions		• Battery voltage $\geq 10V$ • Engine running ≥ 60 sec • Engine warm-up state • No disable faults	
Threshold value	Case 1	• $1.2V \leq \text{Voltage of HO2S} \leq 3.9V$ (at pumping current ON)	
	Case 2	• $0.415V \leq \text{Voltage of HO2S} \leq 0.515V$ (at pumping current OFF)	
Diagnosis Time		• Continuous (more than 76.5 sec.failure for every 90 sec .test)	
MIL On Condition		• 2 Driving Cycles	

Specification

Refer to DTC P0131 : O2 Sensor Circuit Low Voltage (Bank 1 / Sensor 1)

Diagnostic Circuit Diagram

Refer to DTC P0131 : O2 Sensor Circuit Low Voltage (Bank 1 / Sensor 1)

Signal Waveform & Data

Refer to DTC P0131 : O2 Sensor Circuit Low Voltage (Bank 1 / Sensor 1)

Monitor Scantool Data

Refer to DTC P0131 : O2 Sensor Circuit Low Voltage (Bank 1 / Sensor 1)

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Signal Circuit Inspection " procedure .

Signal Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect HO2S(B1/S1) connector.
- IG "ON".
- Measure voltage between signal terminal of HO2S(B1/S1) harness connector and chassis ground.

Specification : Approx. 3.5V - when pumping current is ON

Approx. 0.45V - when pumping current is OFF

4. Is the measured voltage within specification ?

YES ▶ Go to "Ground circuit inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

FL-324

Fuel System

Ground Circuit Inspection

■ Check open in harness

1. IG "ON" and disconnect HO2S(B1/S1) connector.
2. Measure voltage between signal terminal of HO2S(B1/S1) harness connector and chassis ground. (Measurement "A")
3. Measure voltage between signal and ground terminals of HO2S(B1/S1) harness connector. (Measurement "B")

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

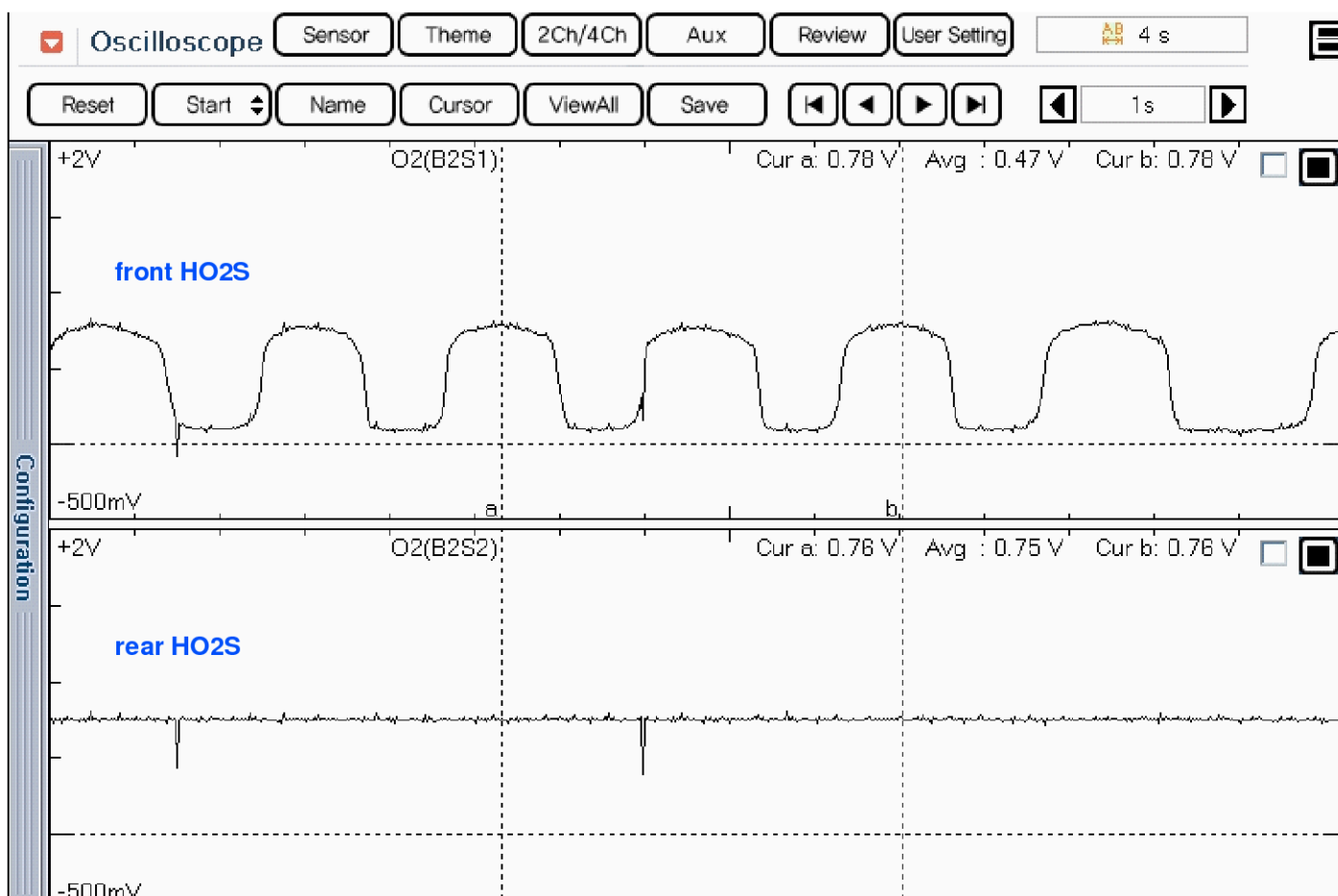
YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair contact resistance or open in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check the Signal waveform of HO2S

1. IG "OFF" and connect HO2S connector.
2. Engine start.
3. After warming-up, monitor signal waveform of HO2S with scantool.



SBHFL9640L

Engine Control System

FL-325

4. Is the sensor switching properly?

YES ► Go to "Check HO2S" as below.

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

■ Check HO2S

1. IG "OFF" and disconnect HO2S connector.
2. Check that the HO2S is securely installed.
3. Check the HO2S for contamination or damage
4. Is the sensor normal?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0131 : O2 Sensor Circuit Low Voltage(Bank 1/Sensor 1)

FL-326

Fuel System

P0137 O2 Sensor Circuit Low Voltage (Bank 1 / Sensor 2)

Component Location



SBHFL9312L

General Description

The rear heated oxygen sensor is mounted on the rear side of the Catalytic Converter (warm-up catalytic converter) or in the rear exhaust pipe, which is able to detect catalyst efficiency. The rear heated oxygen sensor (HO2S) produces a voltage between 0V and 1V. This rear heated oxygen sensor is used to estimate the oxygen storage capability. If a catalyst has good conversion properties, the oxygen fluctuations are smoothed by the oxygen storage capacity of the catalyst. If the conversion provided by the catalyst is low due to aging, poisoning or misfiring, then the oxygen fluctuations are similar to signals from the front oxygen sensor.

DTC Description

Checking output signals from HO2S under detecting condition, if an output signal is below 0.04V for more than predetermine time, ECM sets P0137. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitor signal voltage	- Poor connection - Short to ground in harness - HO2S(B1/S2) - ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running ≥ 60 sec - Engine warm-up state	
Threshold value	The voltage of HO2S(B1/S2) $< 0.04V$	
Diagnosis Time	Continuous (more than 12.5 sec. failure for every 15 s-ec.test)	
MIL On Condition	2 Driving Cycles	

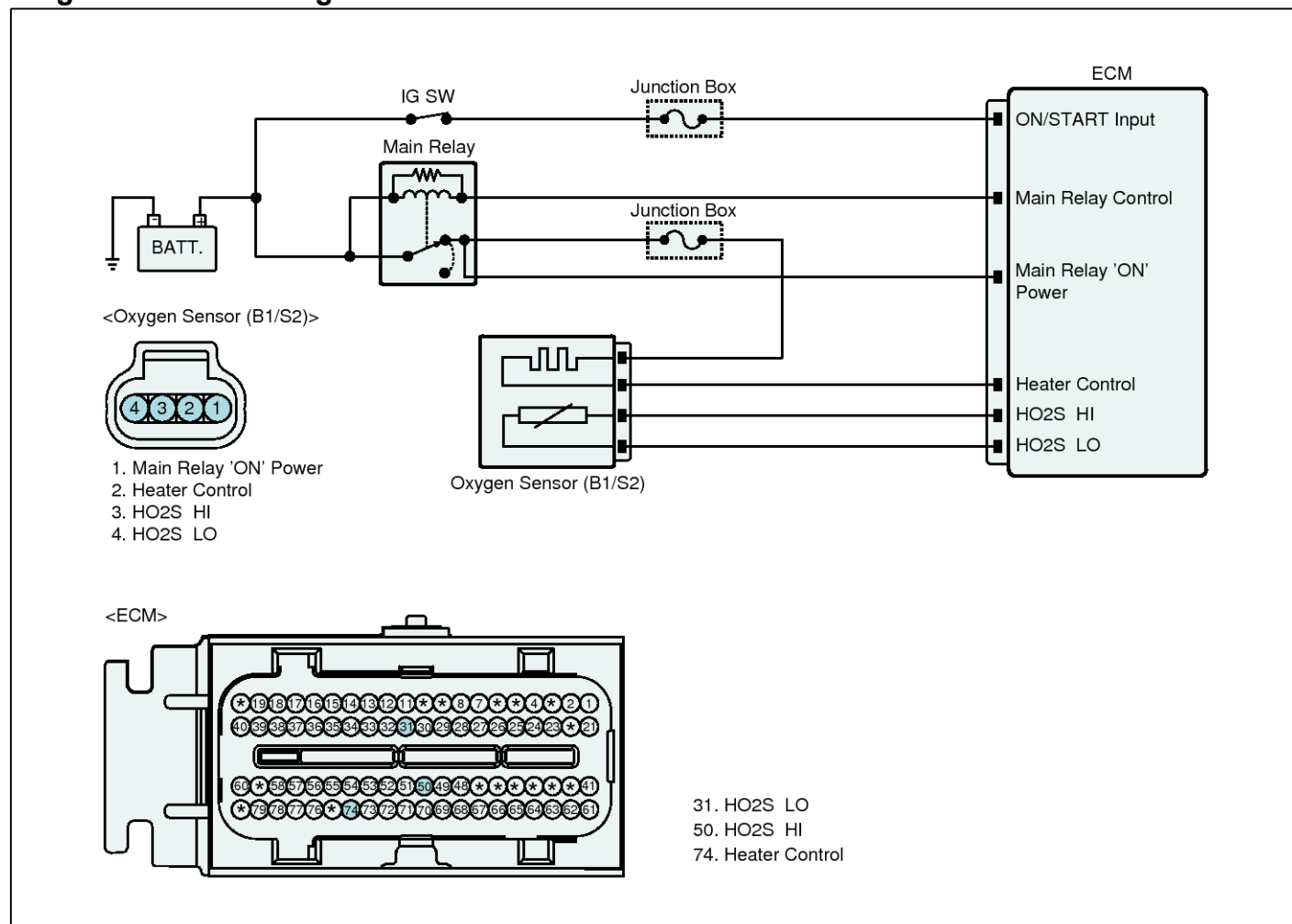
Engine Control System

FL-327

Specification (Reference only)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is commonly switching from rich to lean more than 3 times in 10 sec.	Signal is commonly above 0.6V.
HO2S signal at open circuit(Pumping current OFF)	Approx. 0.45V	
HO2S signal at open circuit(Pumping current ON)	Approx. 3.5V	

Diagnostic Circuit Diagram



SBHFL9509L

Signal Waveform & Data

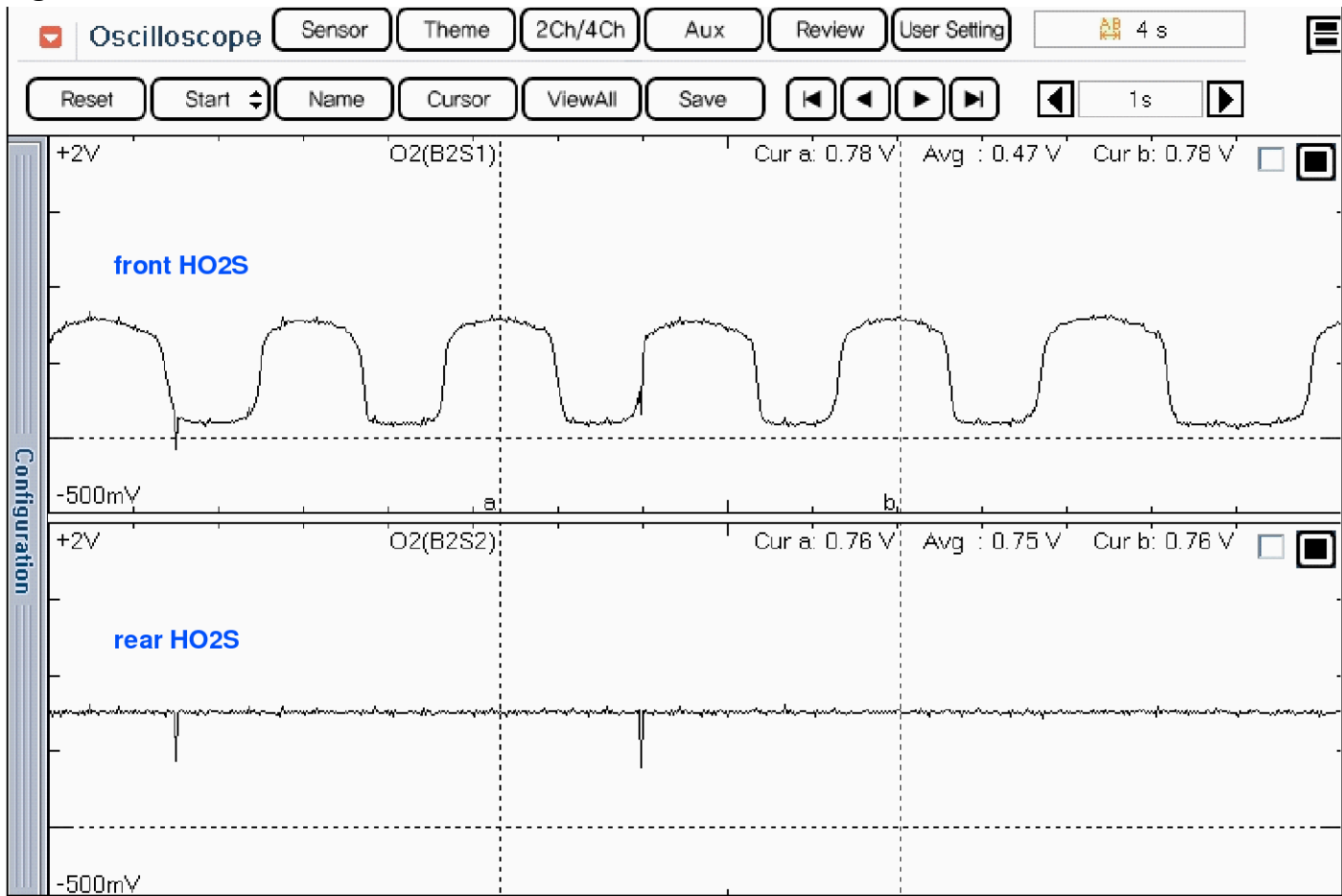


Fig.1

SBHFL9698L

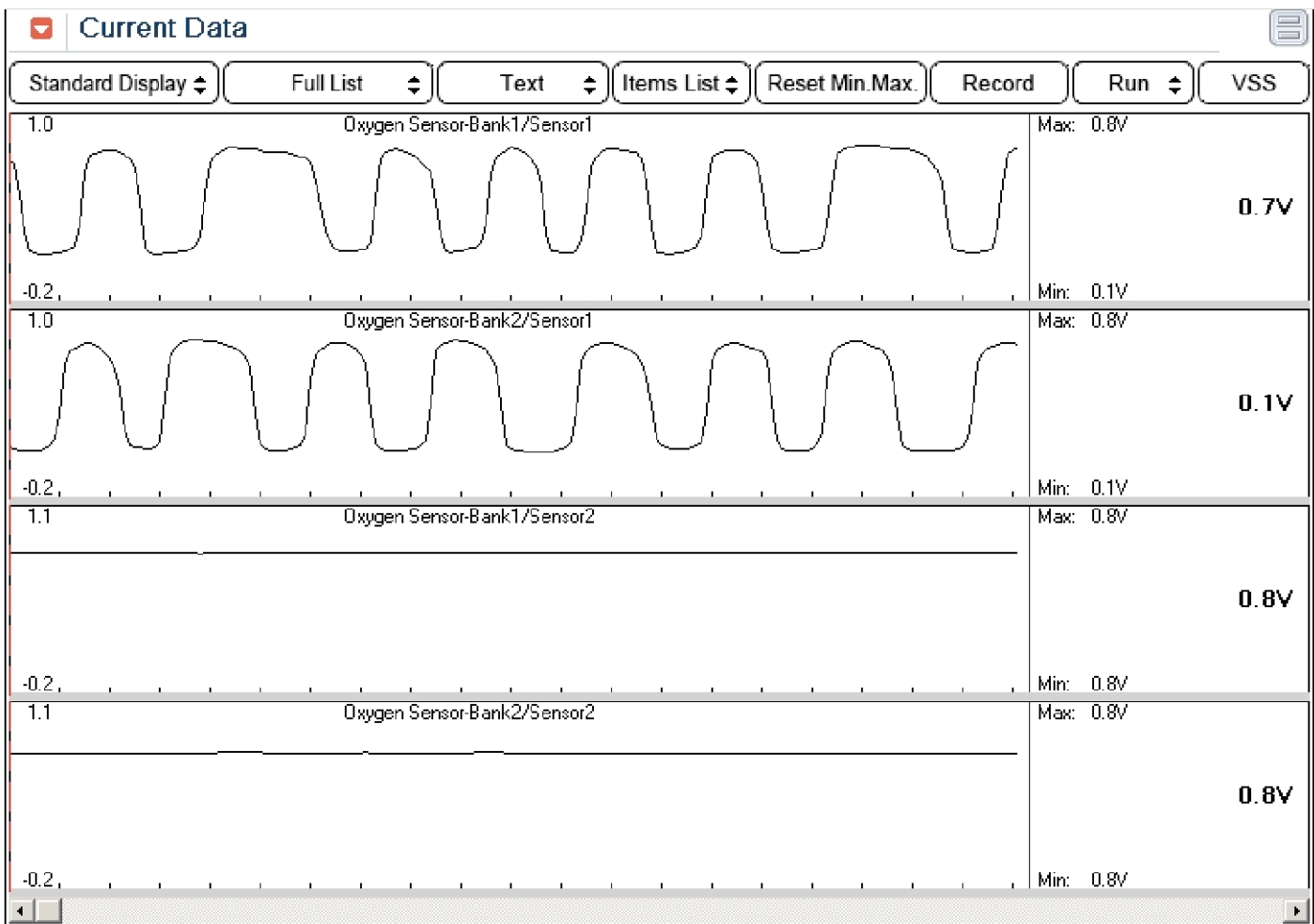


Fig.2

SBHFL9639L

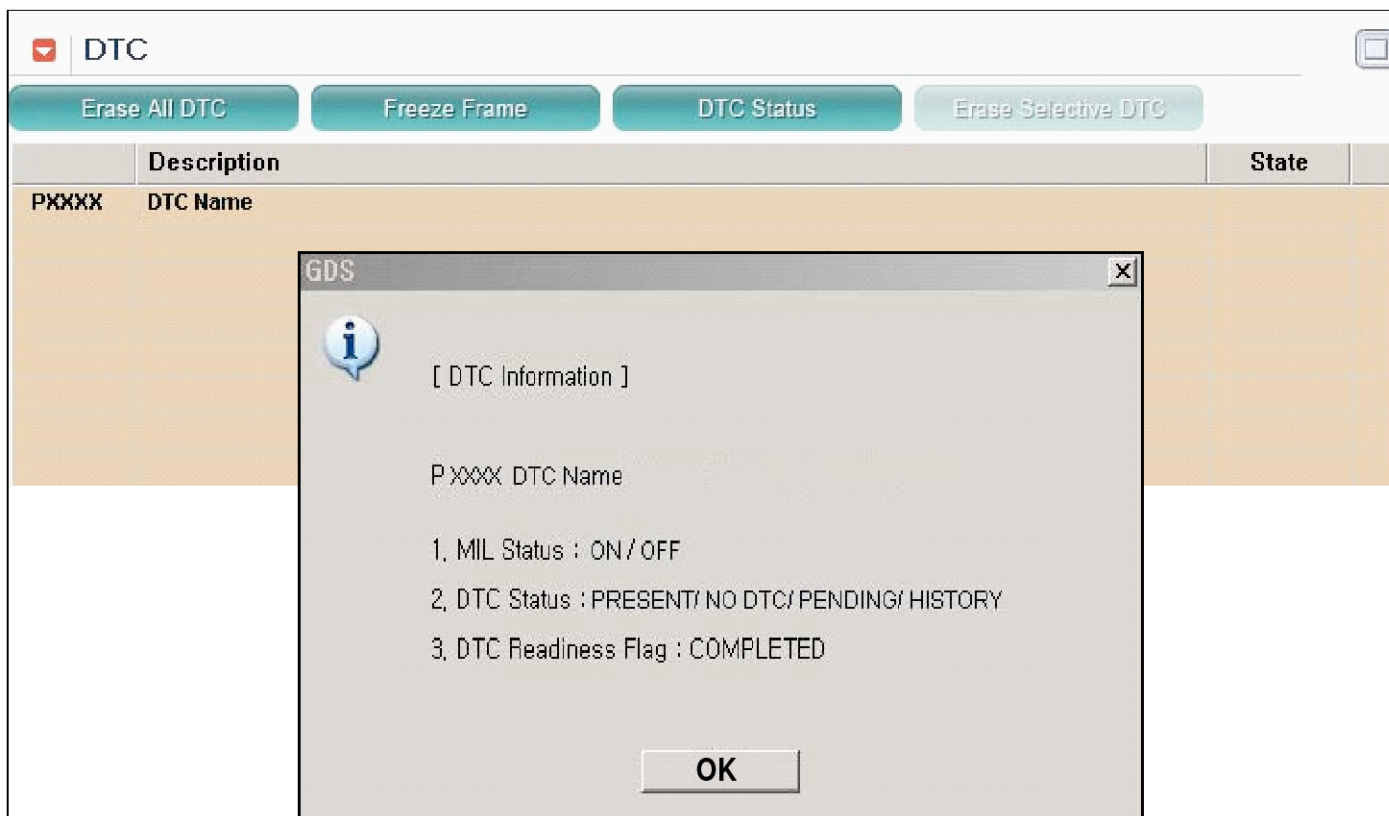
Fig 1) Normal waveforms of front HO2S(the upper) and rear HO2S(the lower)

Fig 2) Normal graph of front HO2S and rear HO2S at idle.

After warming-up, if accelerator pedal is released suddenly around 4000rpm, the HO2S signal reading will be lower than 200mV resulting from Fuel cut-off for the moment. Conversely, if suddenly accelerator pedal is depressed, HO2S signal reading will be around 0.6V ~1.0V. At idle, Normally HO2S signal will switch from lean to rich with 3 Hz. And as racing, Its frequency rises.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Signal Circuit Inspection" procedure.

Signal Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect HO2S(B1/S2) connector.
2. IG "ON".
3. Measure voltage between signal terminal of HO2S(B1/S2) harness connector and chassis ground.

Specification : Approx. 3.5V - when pumping current is ON

Approx. 0.45V - when pumping current is

OFF

4. Is the measured voltage within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

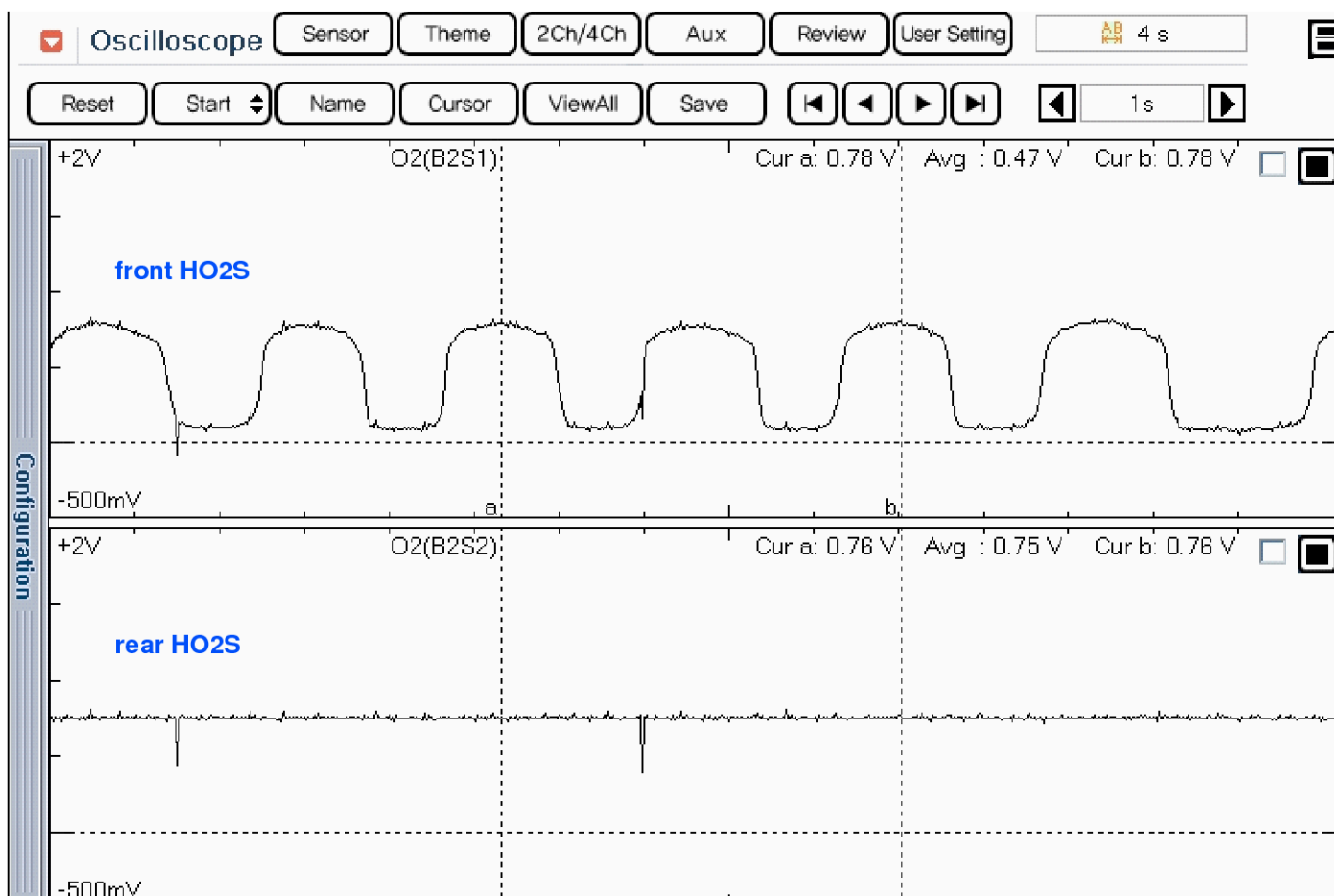
Component Inspection

■ Check the Signal waveform of HO2S

1. IG "OFF" and connect HO2S connector.
2. Engine start.
3. After warming-up, monitor signal waveform of HO2S with scantool.

Engine Control System

FL-331



SBHFL9640L

4. Is the sensor switching properly?

YES ► Go to "Check HO2S" as below.

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Check HO2S

1. IG "OFF" and disconnect HO2S connector.
2. Check that the HO2S is securely installed.
3. Check the HO2S for contamination or damage
4. Is the sensor normal?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-333

P0138 O2 Sensor Circuit High Voltage (Bank 1 / Sensor 2)

Component Location

Refer to DTC P0137 : O2 Sensor Circuit Low Voltage (Bank 1/Sensor 2)

General Description

Refer to DTC P0137 : O2 Sensor Circuit Low Voltage (Bank 1/Sensor 2)

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitor signal voltage	- Poor connection - Short to battery in harness - HO2S(B1/S2) - ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running ≥ 60 sec - Engine warm-up state	
Threshold value	The voltage of HO2S(B1/S2) $> 1.3V$	
Diagnosis Time	Continuous (more than 12.5 sec.failure for every 15 sec. test)	
MIL On Condition	2 Driving Cycles	

Specification

Refer to DTC P0137 : O2 Sensor Circuit Low Voltage (Bank 1/Sensor 2)

Diagnostic Circuit Diagram

Refer to DTC P0137 : O2 Sensor Circuit Low Voltage (Bank 1/Sensor 2)

Signal Waveform & Data

Refer to DTC P0137 : O2 Sensor Circuit Low Voltage (Bank 1/Sensor 2)

Monitor Scantool Data

Refer to DTC P0137 : O2 Sensor Circuit Low Voltage (Bank 1/Sensor 2)

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Signal Circuit Inspection " procedure .

DTC Description

Checking output signals from HO2S under detecting condition, if an output signal is above 1.3V for more than predeterminate time, ECM sets P0138. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

Signal Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect HO2S(B1/S2) connector.
- IG "ON".
- Measure voltage between signal terminal of HO2S(B1/S2) harness connector and chassis ground.

Specification : Approx. 3.5V - when pumping current is ON

Approx. 0.45V - when pumping current is OFF

- Is the measured voltage within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

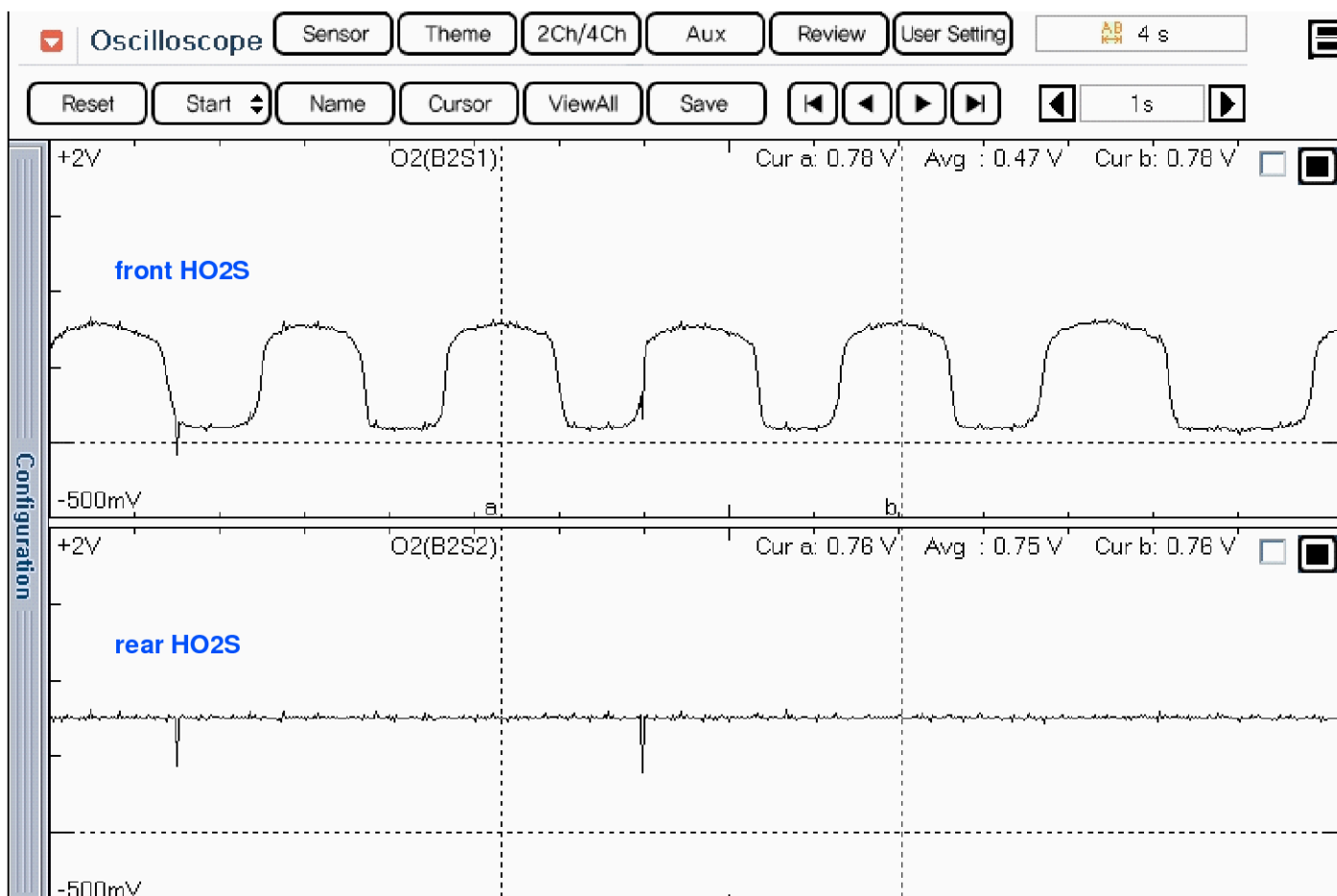
Component Inspection

■ Check the Signal waveform of HO2S

- IG "OFF" and connect HO2S connector.
- Engine start.
- After warming-up, monitor signal waveform of HO2S with scantool.

FL-334

Fuel System



SBHFL9640L

4. Is the sensor switching properly?

YES ► Go to "Check HO2S" as below.

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

■ Check HO2S

1. IG "OFF" and disconnect HO2S connector.
2. Check that the HO2S is securely installed.
3. Check the HO2S for contamination or damage
4. Is the sensor normal?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

📌 NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0137 : O2 Sensor Circuit Low Voltage (Bank 1/Sensor 2)

Engine Control System

FL-335

P0140 O2 Sensor Circuit No Activity Detected (Bank 1 / Sensor 2)

Component Location

Refer to DTC P0137 : O2 Sensor Circuit Low Voltage (Bank 1/Sensor 2)

General Description

Refer to DTC P0137 : O2 Sensor Circuit Low Voltage (Bank 1/Sensor 2)

DTC Description

Checking output signals from HO2S under detecting condition, if an output voltage is approx.0.45V or 3.5V for more than predetermine time, ECM sets P0140. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		• Monitor signal voltage	• Poor connection • Open in harness • HO2S(B1/S2) • ECM
Enable Conditions		• Battery voltage $\geq 10V$ • Engine running ≥ 60 sec • Engine warm-up state • No disable faults	
Threshold value	Case 1	• $1.2V \leq \text{Voltage of HO2S} \leq 3.9V$ (at pumping current ON)	
	Case 2	• $0.415V \leq \text{Voltage of HO2S} \leq 0.515V$ (at pumping current OFF)	
Diagnosis Time		• Continuous (more than 76.5 sec.failure for every 90 sec .test)	
MIL On Condition		• 2 Driving Cycles	

Specification

Refer to DTC P0137 : O2 Sensor Circuit Low Voltage (Bank 1/Sensor 2)

Diagnostic Circuit Diagram

Refer to DTC P0137 : O2 Sensor Circuit Low Voltage (Bank 1/Sensor 2)

Signal Waveform & Data

Refer to DTC P0137 : O2 Sensor Circuit Low Voltage (Bank 1/Sensor 2)

Monitor Scantool Data

Refer to DTC P0137 : O2 Sensor Circuit Low Voltage (Bank 1/Sensor 2)

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Signal Circuit Inspection " procedure .

Signal Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect HO2S(B1/S2) connector.
2. IG "ON".
3. Measure voltage between signal terminal of HO2S(B1/S2) harness connector and chassis ground.

Specification : Approx. 3.5V - when pumping current is ON

Approx. 0.45V - when pumping current is OFF

4. Is the measured voltage within specification ?

YES ▶ Go to "Ground circuit inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

FL-336

Fuel System

Ground Circuit Inspection

■ Check open in harness

1. IG "ON" and disconnect HO2S(B1/S2) connector.
2. Measure voltage between signal terminal of HO2S(B1/S2) harness connector and chassis ground.(Measurement "A")
3. Measure voltage between signal and ground terminals of HO2S(B1/S2) harness connector.(Measurement "B")

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

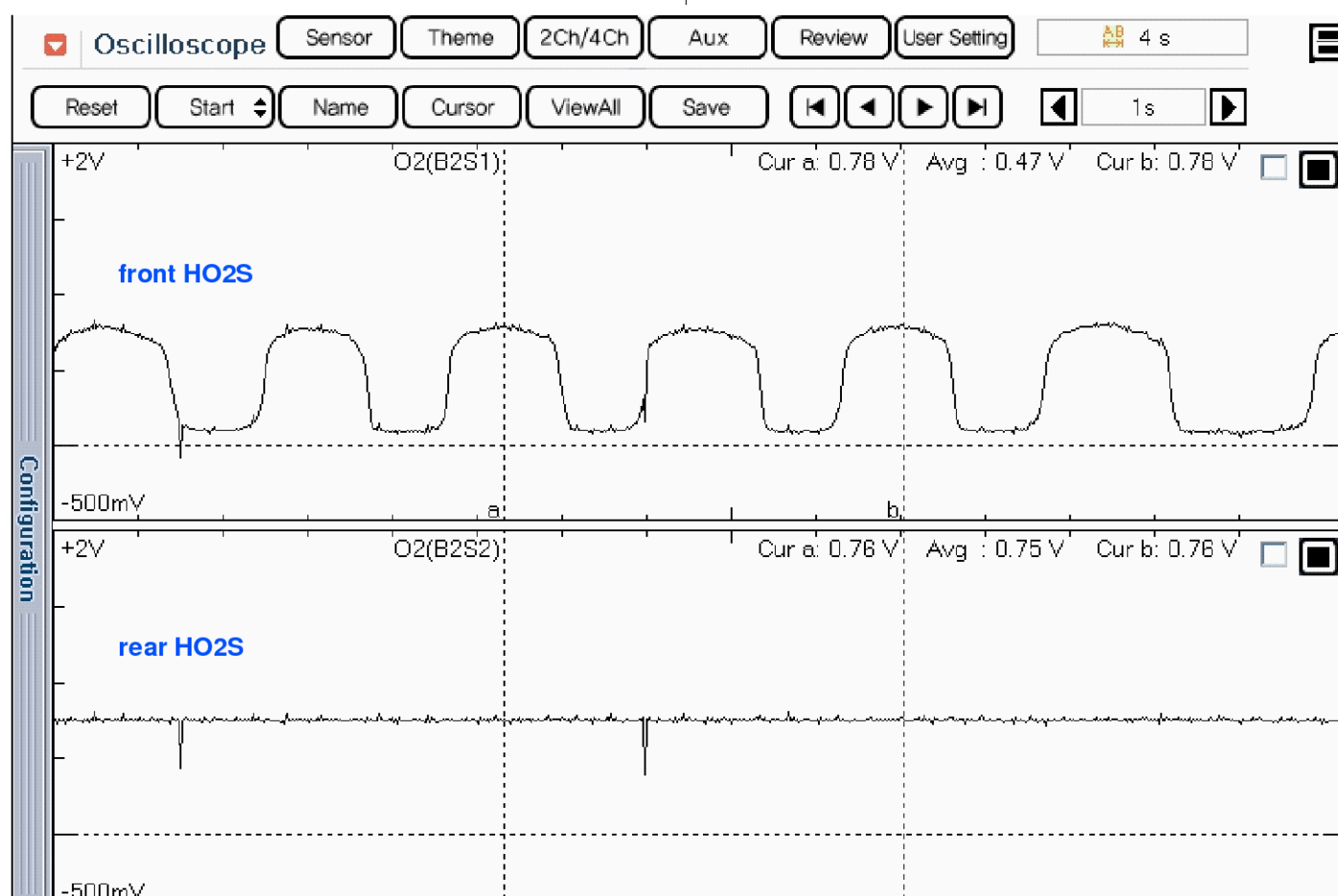
YES ► Go to "Component Inspection" procedure.

NO ► Repair contact resistance or open in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check the Signal waveform of HO2S

1. IG "OFF" and connect HO2S connector.
2. Engine start.
3. After warming-up, monitor signal waveform of HO2S with scantool.



SBHFL9640L

4. Is the sensor switching properly?

YES ► Go to "Check HO2S" as below.

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Engine Control System

FL-337

■ Check HO2S

1. IG "OFF" and disconnect HO2S connector.
2. Check that the HO2S is securely installed.
3. Check the HO2S for contamination or damage
4. Is the sensor normal?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

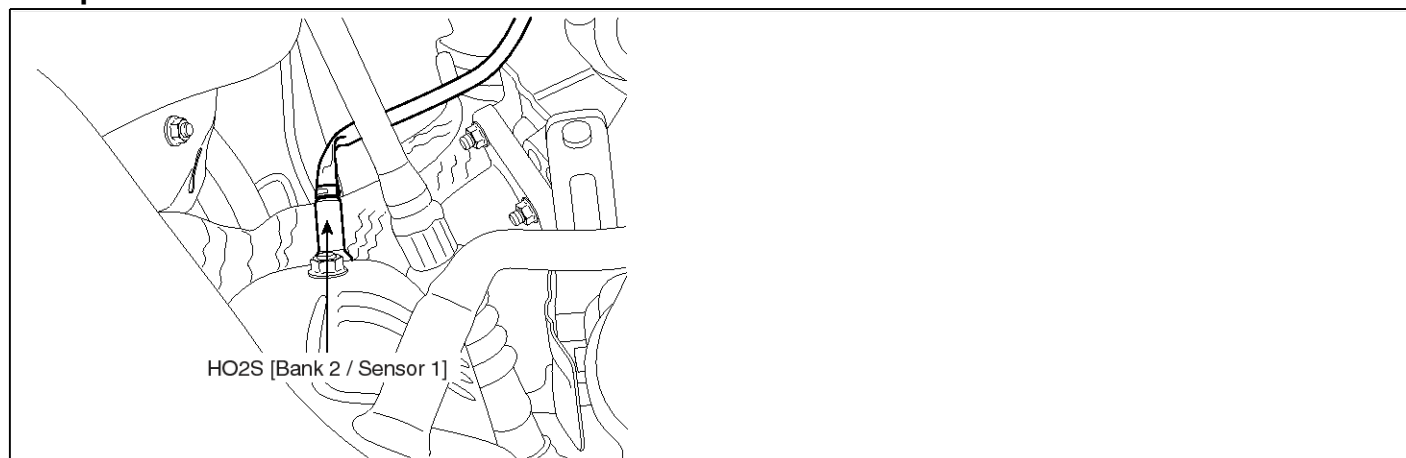
Refer to DTC P0137 : O2 Sensor Circuit Low Voltage (Bank 1/Sensor 2)

FL-338

Fuel System

P0151 O2 Sensor Circuit Low Voltage (Bank 2 / Sensor 1)

Component Location



SBHFL9313L

General Description

In order to control emissions of the CO, HC and NOx components of the exhaust gas, heated oxygen sensor (HO2S), mounted on the front side and rear side of catalytic converter, detects the oxygen content in the exhaust gas. The front HO2S signal is used to control air/fuel ratio (closed loop fuel control) and the rear HO2S signal is used to monitor front HO2S and catalyst for proper operation. The HO2S requires a minimum temperature to operate properly and provide a closed loop fuel control system. The HO2S contains the heater element to reduce its warming-up time and ensure its performance during all driving conditions. The oxygen sensor generates a voltage that indicates the difference between the oxygen content of the exhaust stream and the oxygen content of ambient air. When the exhaust stream is "rich," there is more oxygen in the ambient air than in the exhaust stream, so the voltage will be higher.

DTC Description

Checking output signals from HO2S under detecting condition, if an output signal is below 0.04V for more than predetermine time, ECM sets P0151. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitor signal voltage	- Poor connection - Short to ground in harness - HO2S(B2/S1) - ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running ≥ 60 sec - Engine warm-up state	
Threshold value	The voltage of HO2S(B2/S1) $< 0.04V$	
Diagnosis Time	Continuous (more than 12.5 sec. failure for every 15 s-ec.test)	
MIL On Condition	2 Driving Cycles	

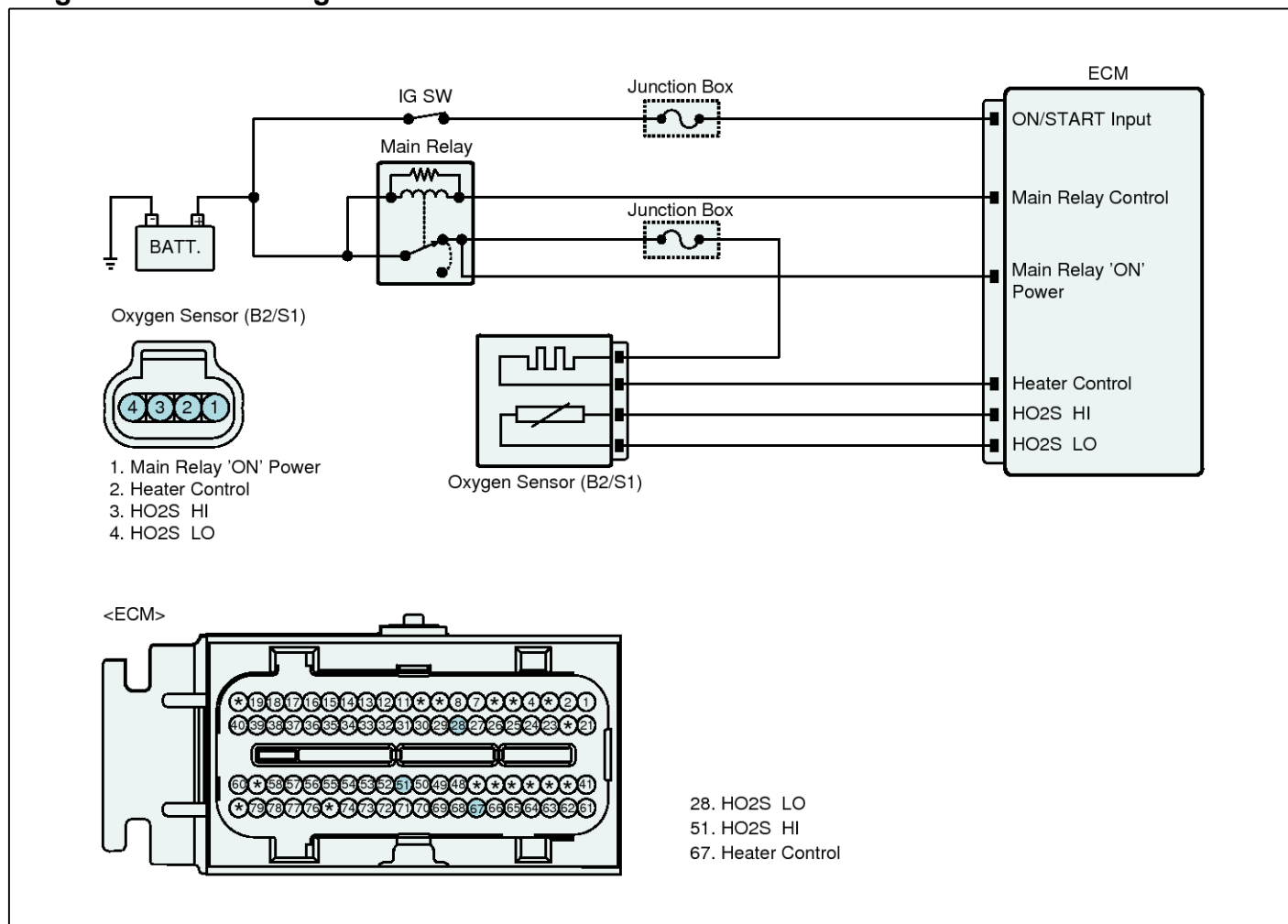
Engine Control System

FL-339

Specification (Reference only)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is commonly switching from rich to lean more than 3 times in 10 sec.	Signal is commonly above 0.6V.
HO2S signal at open circuit(Pumping current OFF)	Approx. 0.45V	
HO2S signal at open circuit(Pumping current ON)	Approx. 3.5V	

Diagnostic Circuit Diagram



SBHFL9510L

Signal Waveform & Data

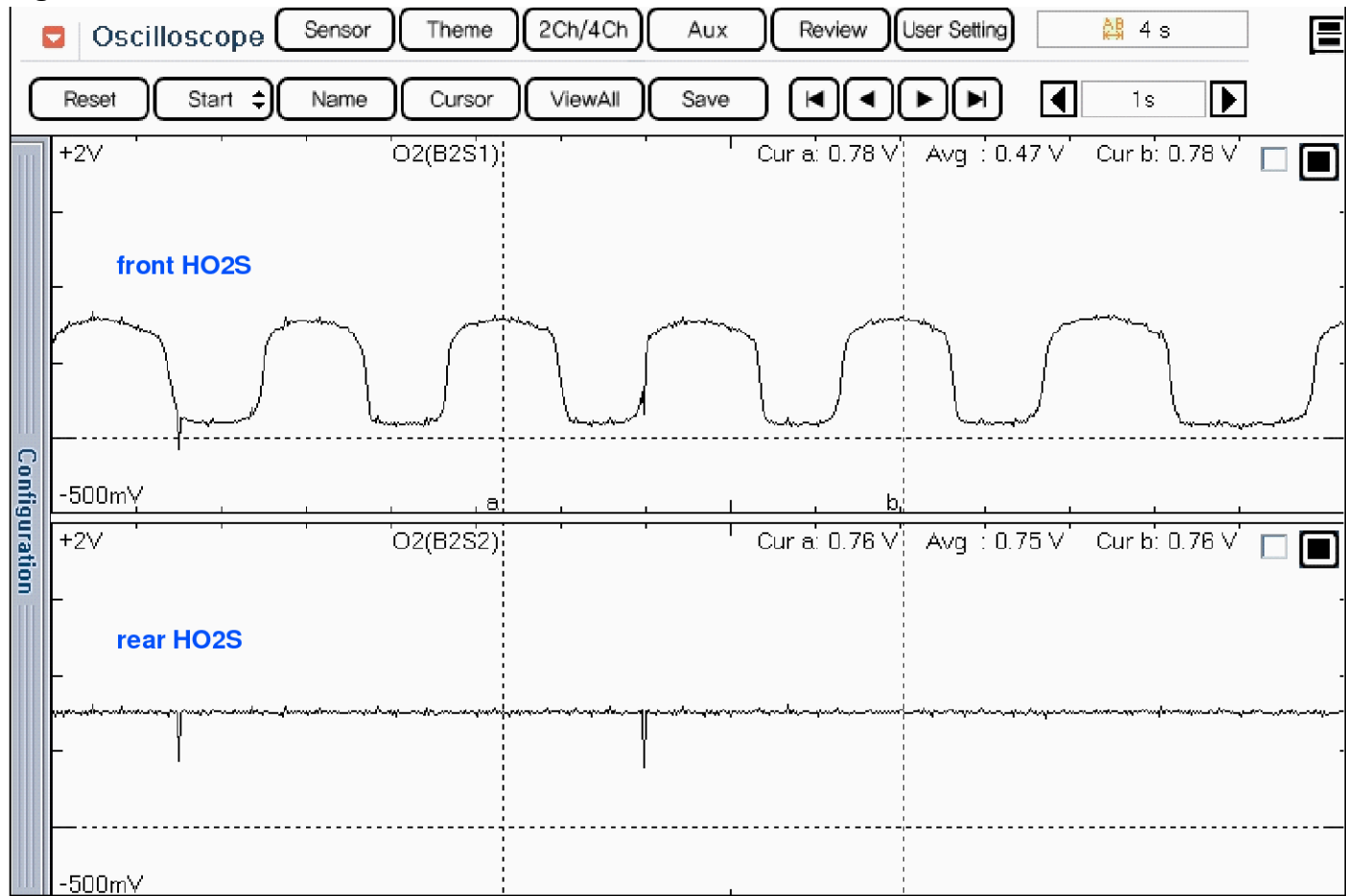


Fig.1

SBHFL9698L

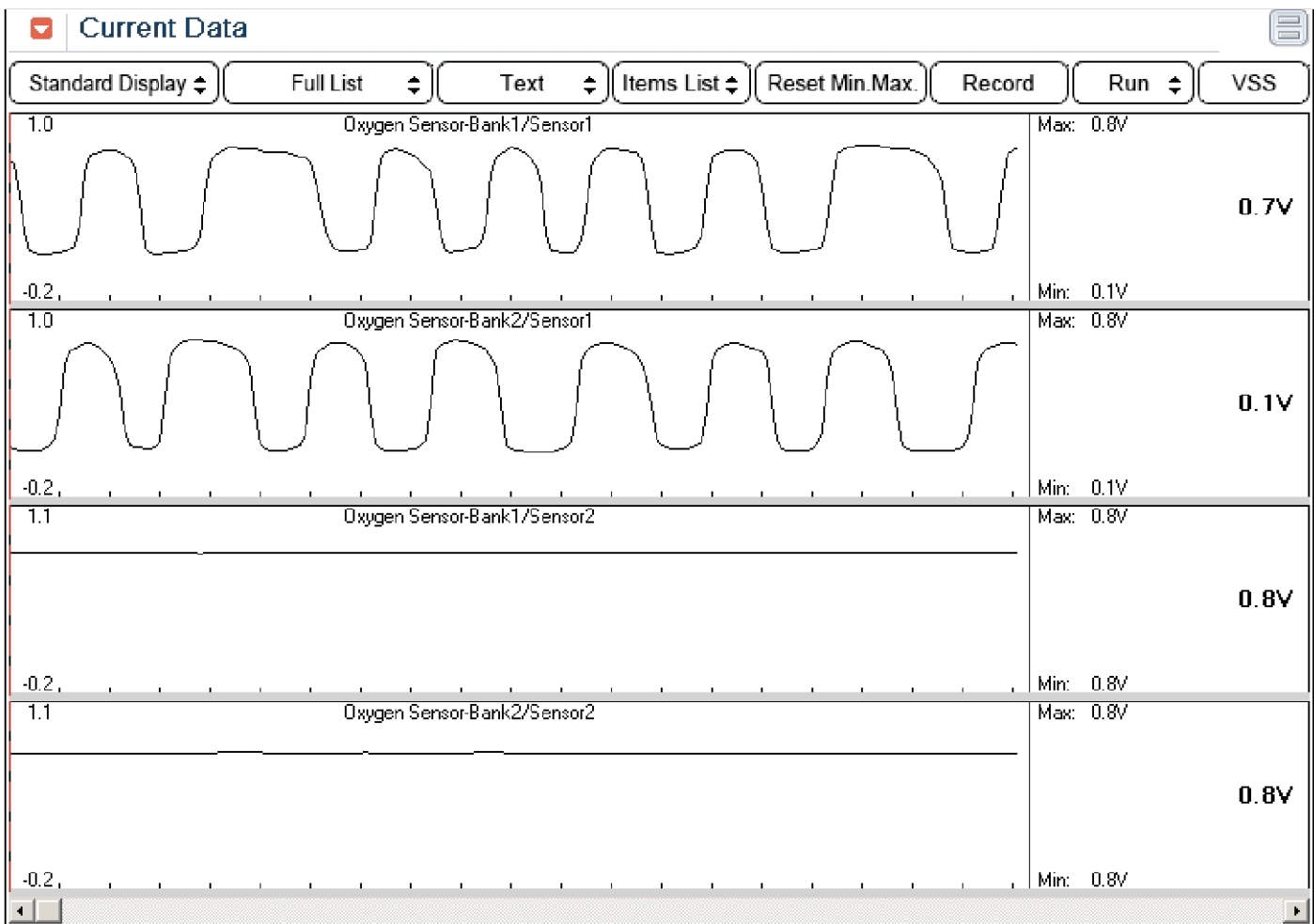


Fig.2

SBHFL9639L

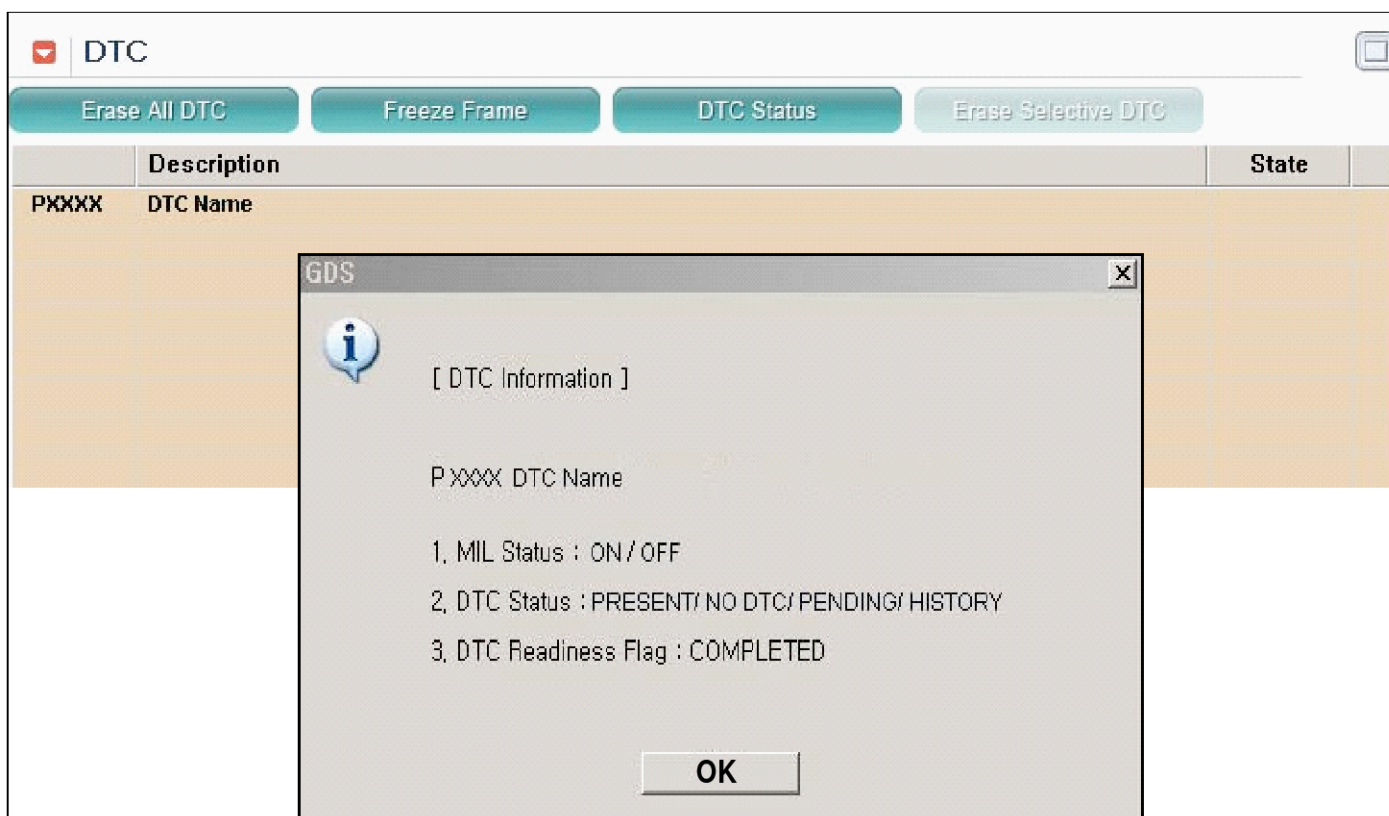
Fig 1) Normal waveforms of front HO2S(the upper) and rear HO2S(the lower)

Fig 2) Normal graph of front HO2S and rear HO2S at idle.

After warming-up, if accelerator pedal is released suddenly around 4000rpm, the HO2S signal reading will be lower than 200mV resulting from Fuel cut-off for the moment. Conversely, if suddenly accelerator pedal is depressed, HO2S signal reading will be around 0.6V ~1.0V. At idle, Normally HO2S signal will switch from lean to rich with 3 Hz. And as racing, Its frequency rises.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ▶ Go to "Terminal and Connector inspection" procedure.

NO ▶ Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Signal Circuit Inspection " procedure .

Signal Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect HO2S(B2/S1) connector.
2. IG "ON".
3. Measure voltage between signal terminal of HO2S(B2/S1) harness connector and chassis ground.

Specification : Approx. 3.5V - when pumping current is ON

Approx. 0.45V - when pumping current is

OFF

4. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

Engine Control System

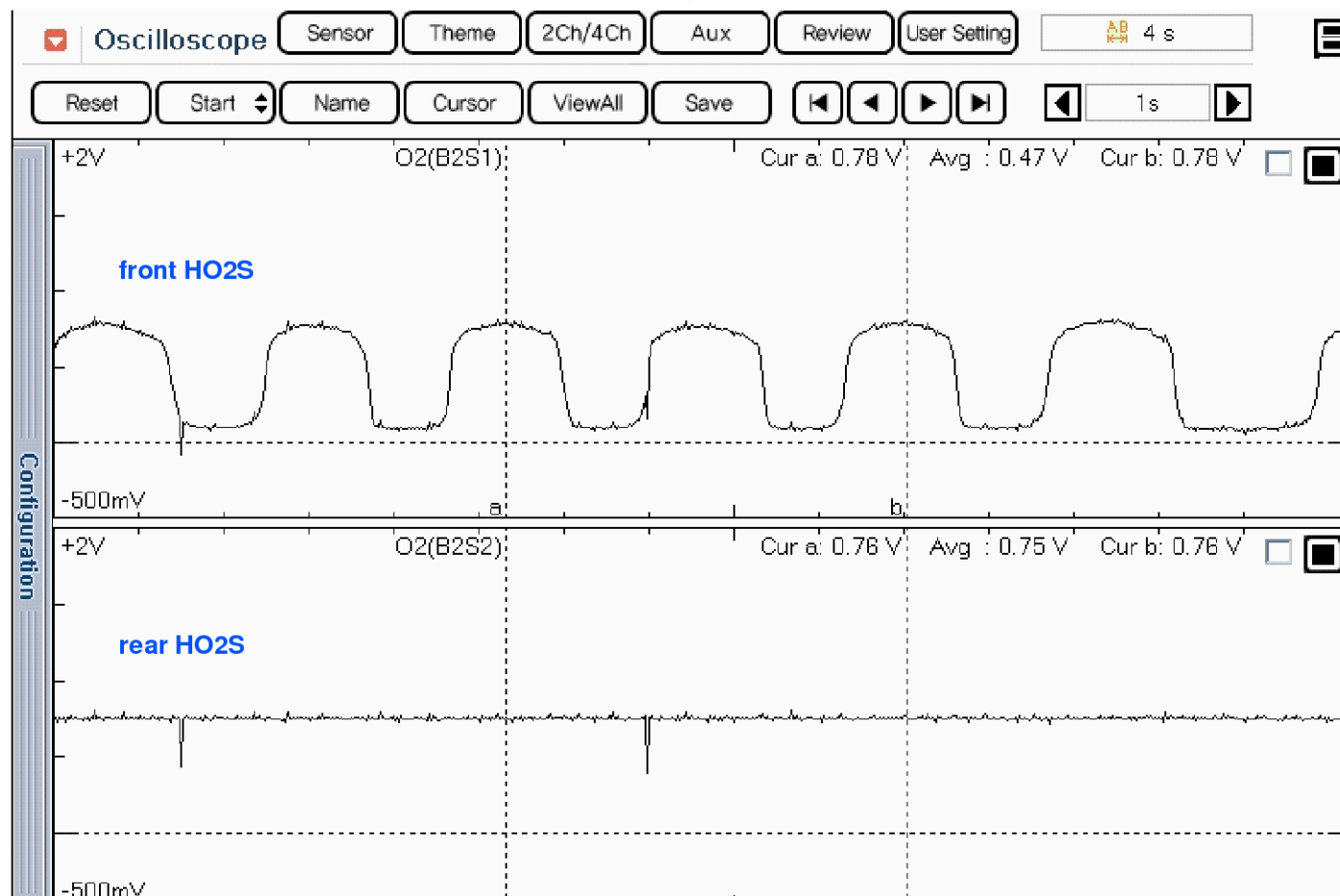
FL-343

Component Inspection

■ Check the Signal waveform of HO2S

1. IG "OFF" and connect HO2S connector.
2. Engine start.

3. After warming-up, monitor signal waveform of HO2S with scantool.



SBHFL9640L

4. Is the sensor switching properly?

YES ▶ Go to "Check HO2S" as below.

NO ▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

■ Check HO2S

1. IG "OFF" and disconnect HO2S connector.
2. Check that the HO2S is securely installed.
3. Check the HO2S for contamination or damage
4. Is the sensor normal?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

⚠ NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-345

P0152 O2 Sensor Circuit High Voltage (Bank 2 / Sensor 1)

Component Location

Refer to DTC P0151 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 1)

General Description

Refer to DTC P0151 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 1)

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitor signal voltage	- Poor connection - Short to battery in harness - HO2S(B2/S1) - ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running ≥ 60 sec - Engine warm-up state	
Threshold value	The voltage of HO2S(B2/S1) $> 1.3V$	
Diagnosis Time	Continuous (more than 12.5 sec.failure for every 15 sec. test)	
MIL On Condition	2 Driving Cycles	

Specification

Refer to DTC P0151 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 1)

Diagnostic Circuit Diagram

Refer to DTC P0151 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 1)

Signal Waveform & Data

Refer to DTC P0151 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 1)

Monitor Scantool Data

Refer to DTC P0151 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 1)

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Signal Circuit Inspection " procedure .

DTC Description

Checking output signals from HO2S under detecting condition, if an output signal is above 1.3V for more than predeterminate time, ECM sets P0152. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

Signal Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect HO2S(B2/S1) connector.
- IG "ON".
- Measure voltage between signal terminal of HO2S(B2/S1) harness connector and chassis ground.

Specification : Approx. 3.5V - when pumping current is ON

Approx. 0.45V - when pumping current is OFF

- Is the measured voltage within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

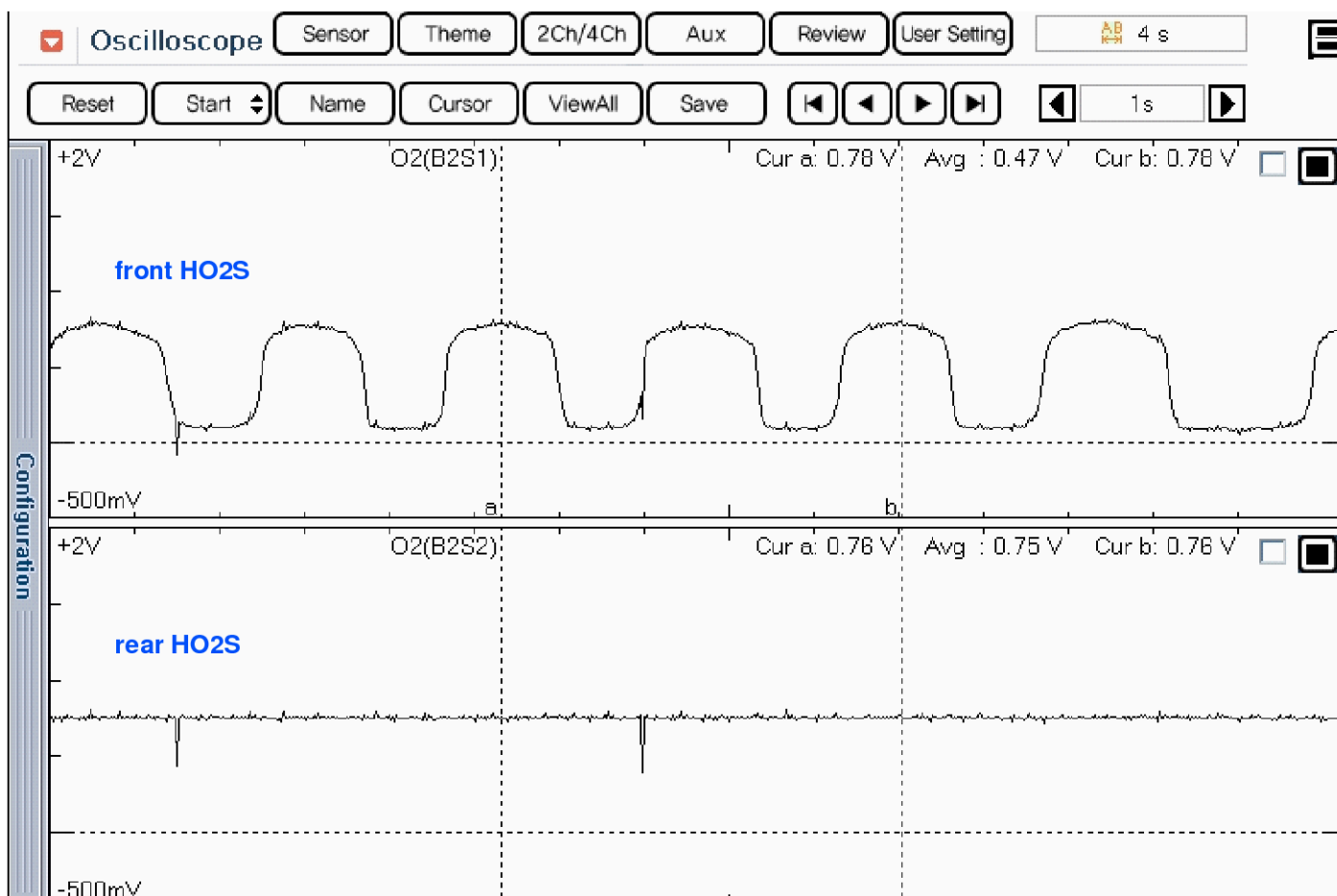
Component Inspection

■ Check the Signal waveform of HO2S

- IG "OFF" and connect HO2S connector.
- Engine start.
- After warming-up, monitor signal waveform of HO2S with scantool.

FL-346

Fuel System



SBHFL9640L

4. Is the sensor switching properly?

YES ► Go to "Check HO2S" as below.

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

■ Check HO2S

1. IG "OFF" and disconnect HO2S connector.
2. Check that the HO2S is securely installed.
3. Check the HO2S for contamination or damage
4. Is the sensor normal?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

📌 NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0151 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 1)

Engine Control System

FL-347

P0153 O2 Sensor Circuit Slow Response (Bank 2 / Sensor 1)

Component Location

Refer to DTC P0151 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 1)

General Description

Refer to DTC P0151 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 1)

DTC Description

Checking output signals from HO2S under detecting condition, if ECM judges it's signals too slow, ECM sets P0153. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitor HO2S's response rate	- Poor connection - Faulty HO2S - Faulty ECM
Enable Conditions	- Engine warm-up sufficiently - Engine run time > 60sec - Drive at a steady speed between 45-55 mph(72-88 km/h) - Engine Coolant > 70 °C(158 °F) - No disabling faults	
Threshold value	The calculated response rate is too slow (out of threshold in ECM)	
Diagnosis Time	Continuous	
MIL On Condition	2 Driving Cycles	

Specification

Refer to DTC P0151 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 1)

Diagnostic Circuit Diagram

Refer to DTC P0151 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 1)

Signal Waveform & Data

Refer to DTC P0151 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 1)

Monitor Scantool Data

Refer to DTC P0151 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 1)

Component Inspection

1. Replace the HO2S.
2. Clear DTC with scantool.
3. Start the engine and warm it up until the radiator fan comes on(more than at least 10 minutes).
4. Drive at a steady speed between 45-55 mph(72-88 km/h) for 120 sec.
5. Stop and then maintain idle state.
6. Check if O2 sensor monitoring readiness is complete.

7. Does the scan tool show DTC P0153?

YES

► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO

► Troubleshooting is finished.

Verification of Vehicle Repair

Refer to DTC P0151 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 1)

FL-348

Fuel System

P0154 O2 Sensor Circuit No Activity Detected (Bank 2 / Sensor 1)

Component Location

Refer to DTC P0151 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 1)

General Description

Refer to DTC P0151 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 1)

DTC Description

Checking output signals from HO2S under detecting condition, if an output voltage is approx.0.45V or 3.5V for more than predetermine time, ECM sets P0154. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		• Monitor signal voltage	• Poor connection • Open in harness • HO2S(B2/S1) • ECM
Enable Conditions		• Battery voltage $\geq 10V$ • Engine running ≥ 60 sec • Engine warm-up state • No disable faults	
Threshold value	Case 1	• $1.2V \leq \text{Voltage of HO2S} \leq 3.9V$ (at pumping current ON)	
	Case 2	• $0.415V \leq \text{Voltage of HO2S} \leq 0.515V$ (at pumping current OFF)	
Diagnosis Time		• Continuous (more than 76.5 sec.failure for every 90 sec .test)	
MIL On Condition		• 2 Driving Cycles	

Specification

Refer to DTC P0151 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 1)

Diagnostic Circuit Diagram

Refer to DTC P0151 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 1)

Signal Waveform & Data

Refer to DTC P0151 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 1)

Monitor Scantool Data

Refer to DTC P0151 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 1)

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Signal Circuit Inspection " procedure .

Signal Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect HO2S(B2/S1) connector.
- IG "ON".
- Measure voltage between signal terminal of HO2S(B2/S1) harness connector and chassis ground.

Specification : Approx. 3.5V - when pumping current is ON

Approx. 0.45V - when pumping current is OFF

4. Is the measured voltage within specification ?

YES ▶ Go to "Ground circuit inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Engine Control System

FL-349

Ground Circuit Inspection

■ Check open in harness

1. IG "ON" and disconnect HO2S(B2/S1) connector.
2. Measure voltage between signal terminal of HO2S(B2/S1) harness connector and chassis ground. (Measurement "A")
3. Measure voltage between signal and ground terminals of HO2S(B2/S1) harness connector. (Measurement "B")

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

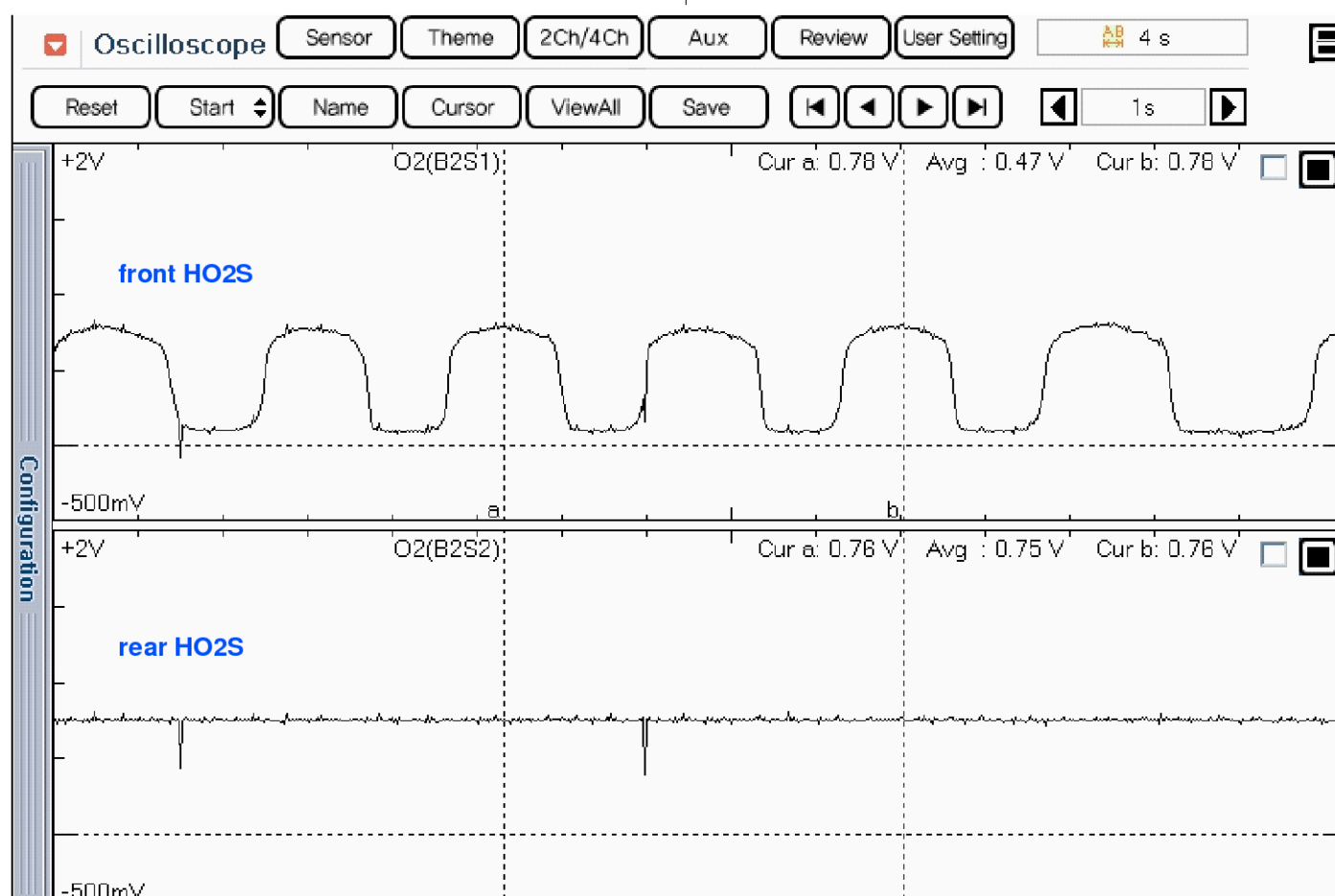
YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair contact resistance or open in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check the Signal waveform of HO2S

1. IG "OFF" and connect HO2S connector.
2. Engine start.
3. After warming-up, monitor signal waveform of HO2S with scantool.



SBHFL9640L

4. Is the sensor switching properly?

YES ▶ Go to "Check HO2S" as below.

NO ▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

FL-350

Fuel System

■ Check HO2S

1. IG "OFF" and disconnect HO2S connector.
2. Check that the HO2S is securely installed.
3. Check the HO2S for contamination or damage
4. Is the sensor normal?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

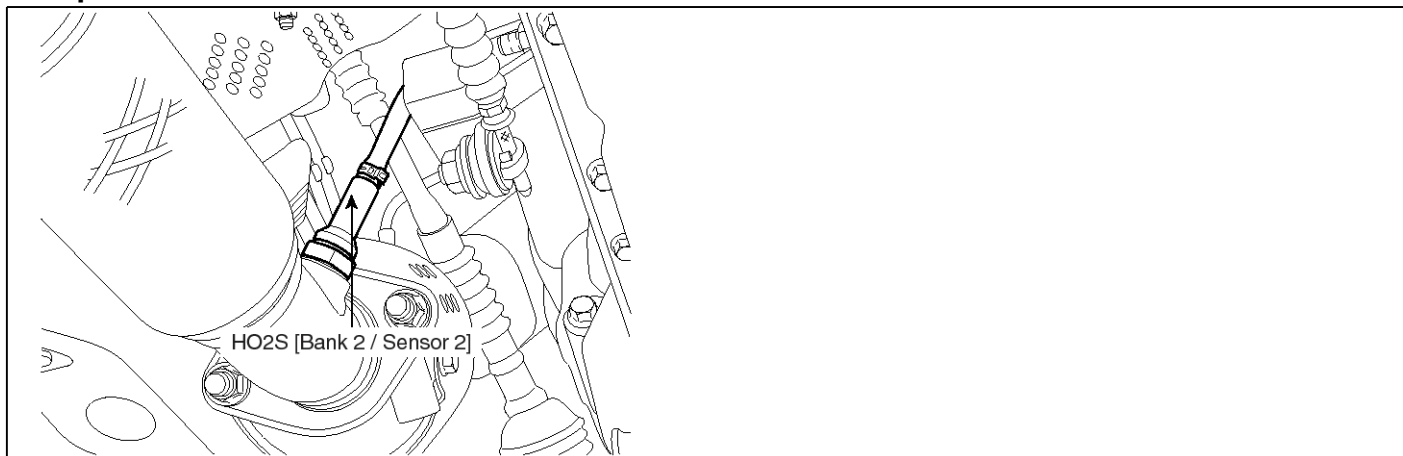
Refer to DTC P0151 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 1)

Engine Control System

FL-351

P0157 O2 Sensor Circuit Low Voltage (Bank 2 / Sensor 2)

Component Location



SBHFL9314L

General Description

The rear heated oxygen sensor is mounted on the rear side of the Catalytic Converter (warm-up catalytic converter) or in the rear exhaust pipe, which is able to detect catalyst efficiency. The rear heated oxygen sensor (HO2S) produces a voltage between 0V and 1V. This rear heated oxygen sensor is used to estimate the oxygen storage capability. If a catalyst has good conversion properties, the oxygen fluctuations are smoothed by the oxygen storage capacity of the catalyst. If the conversion provided by the catalyst is low due to aging, poisoning or misfiring, then the oxygen fluctuations are similar to signals from the front oxygen sensor.

DTC Description

Checking output signals from HO2S under detecting condition, if an output signal is below 0.04V for more than predetermine time, ECM sets P0157. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitor signal voltage	- Poor connection - Short to ground in harness - HO2S(B2/S2) - ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running ≥ 60 sec - Engine warm-up state	
Threshold value	The voltage of HO2S(B2/S2) $< 0.04V$	
Diagnosis Time	Continuous (more than 12.5 sec. failure for every 15 s-ec.test)	
MIL On Condition	2 Driving Cycles	

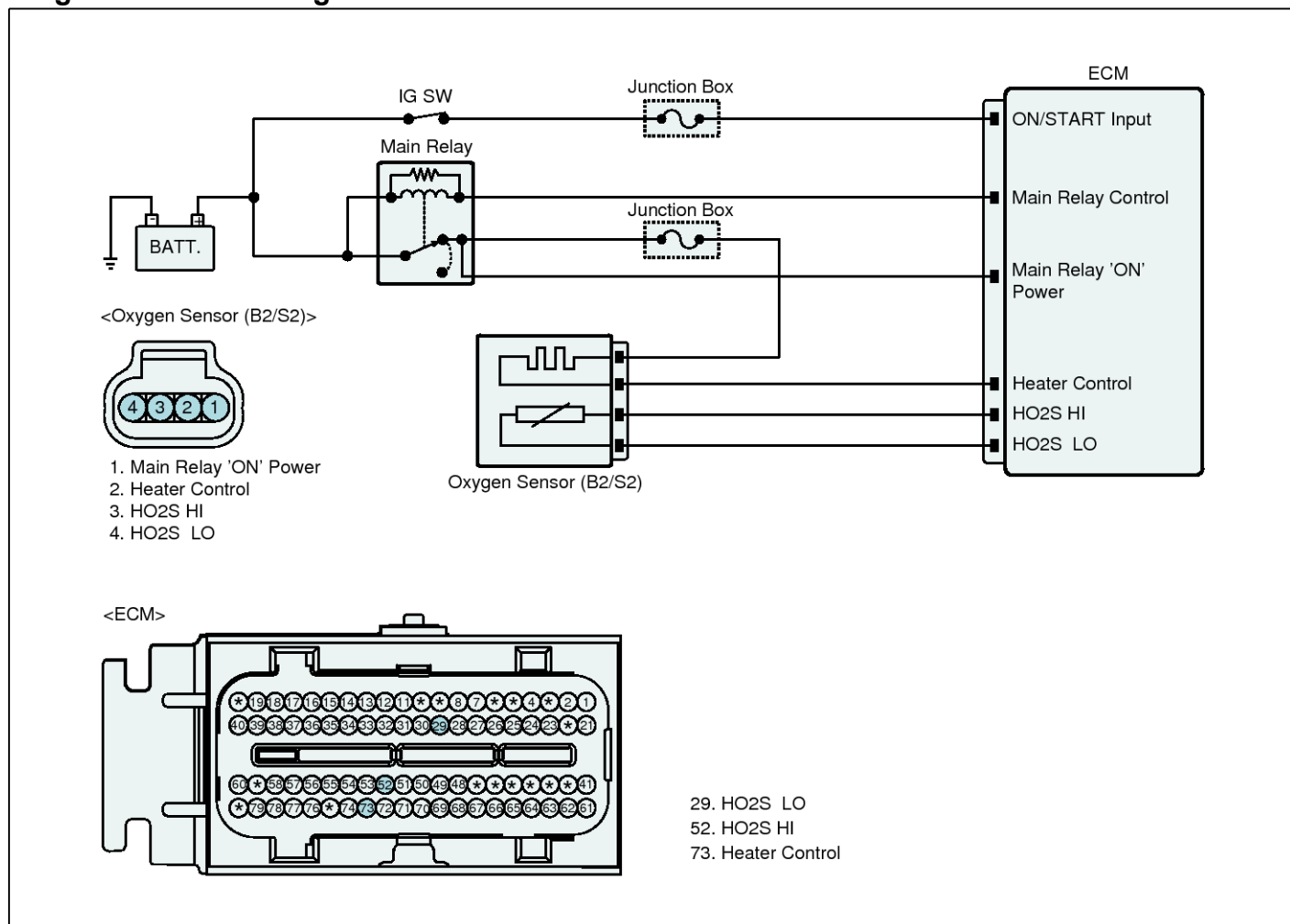
FL-352

Fuel System

Specification (Reference only)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is commonly switching from rich to lean more than 3 times in 10 sec.	Signal is commonly above 0.6V.
HO2S signal at open circuit(Pumping current OFF)	Approx. 0.45V	
HO2S signal at open circuit(Pumping current ON)	Approx. 3.5V	

Diagnostic Circuit Diagram



SBHFL9511L

Signal Waveform & Data

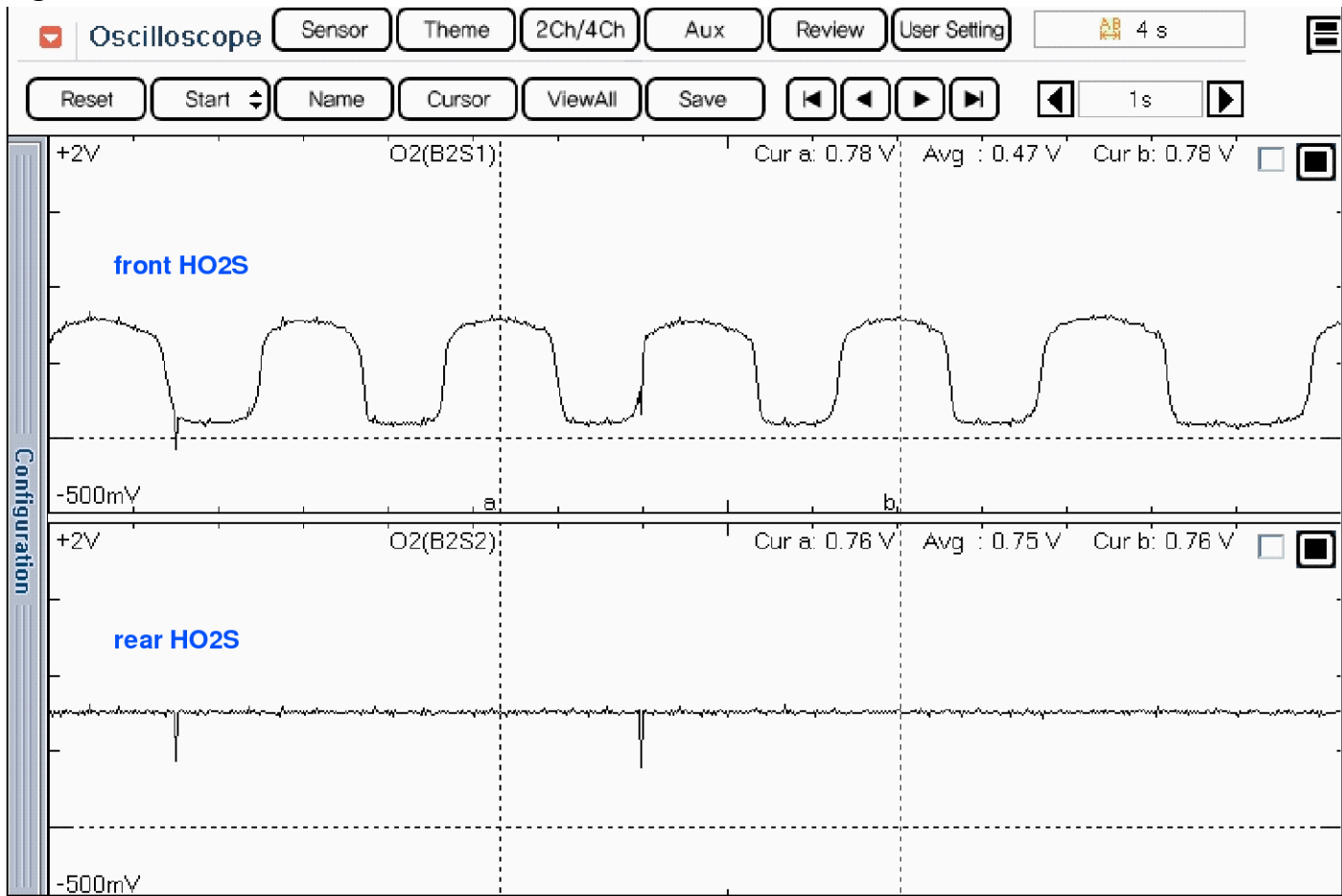


Fig.1

SBHFL9698L

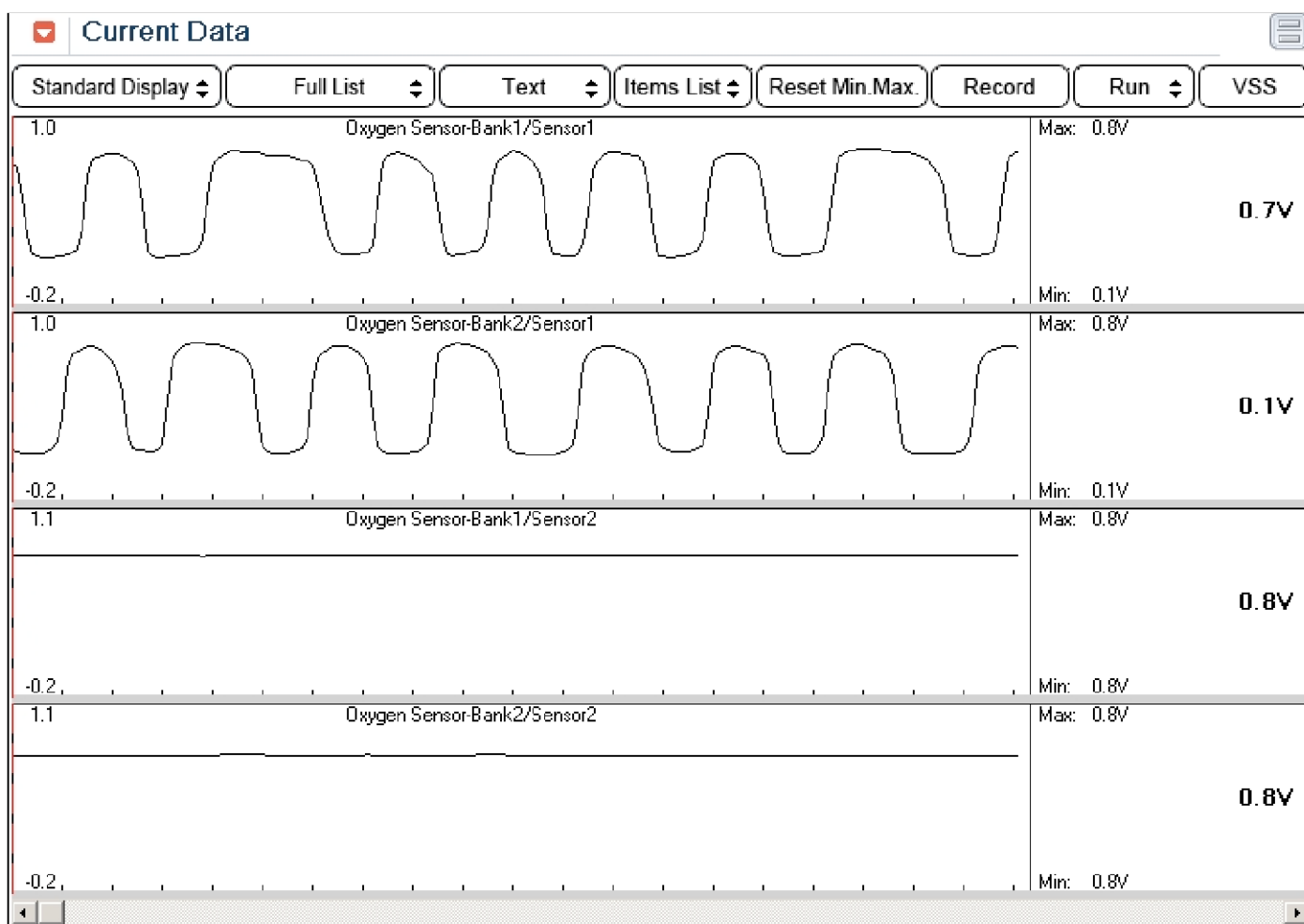


Fig.2

SBHFL9639L

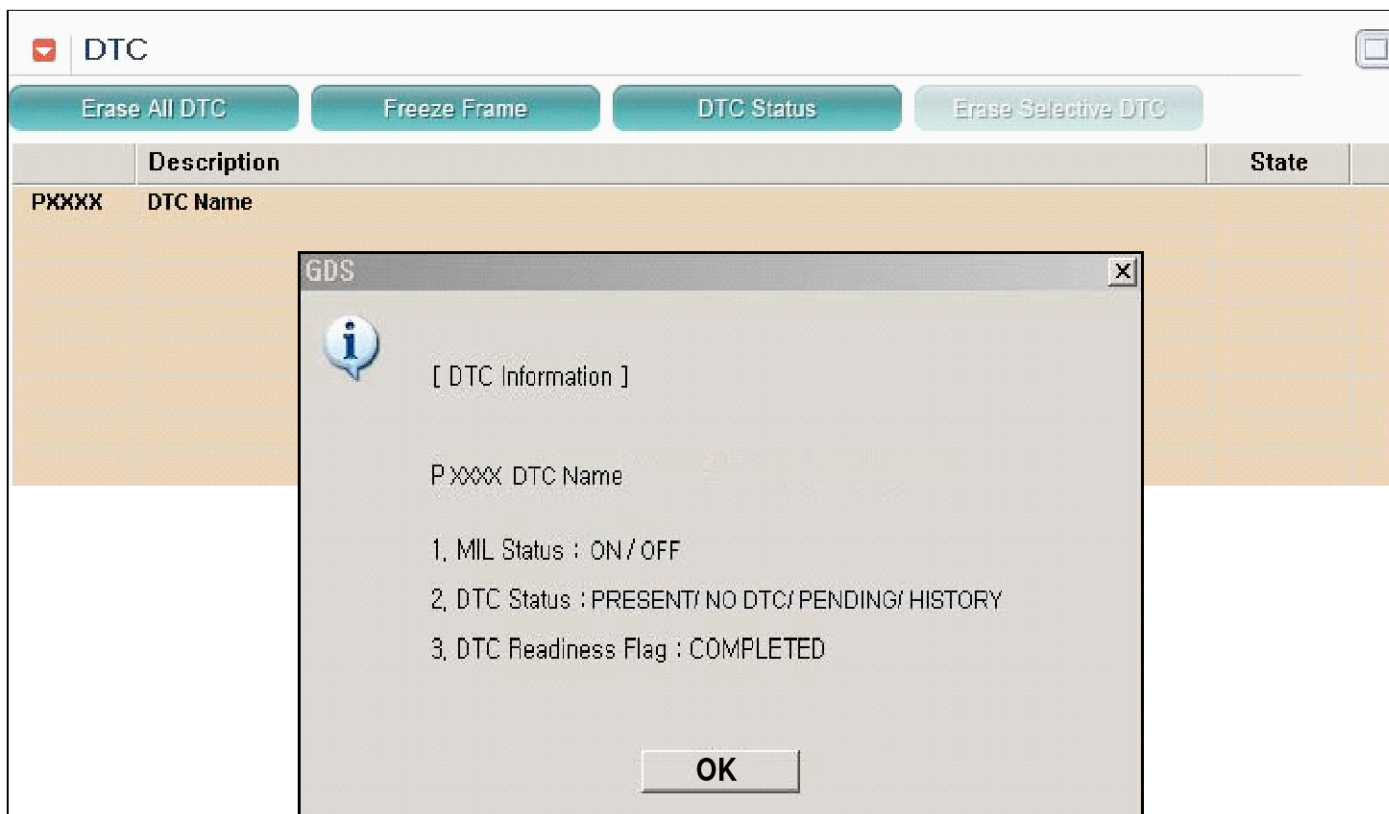
Fig 1) Normal waveforms of front HO2S(the upper) and rear HO2S(the lower)

Fig 2) Normal graph of front HO2S and rear HO2S at idle.

After warming-up, if accelerator pedal is released suddenly around 4000rpm, the HO2S signal reading will be lower than 200mV resulting from Fuel cut-off for the moment. Conversely, if suddenly accelerator pedal is depressed, HO2S signal reading will be around 0.6V ~1.0V. At idle, Normally HO2S signal will switch from lean to rich with 3 Hz. And as racing, Its frequency rises.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Signal Circuit Inspection " procedure

Signal Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect HO2S(B2/S2) connector.
2. IG "ON".
3. Measure voltage between signal terminal of HO2S(B2/S2) harness connector and chassis ground.

Specification : Approx. 3.5V - when pumping current is ON

Approx. 0.45V - when pumping current is

OFF

4. Is the measured voltage within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

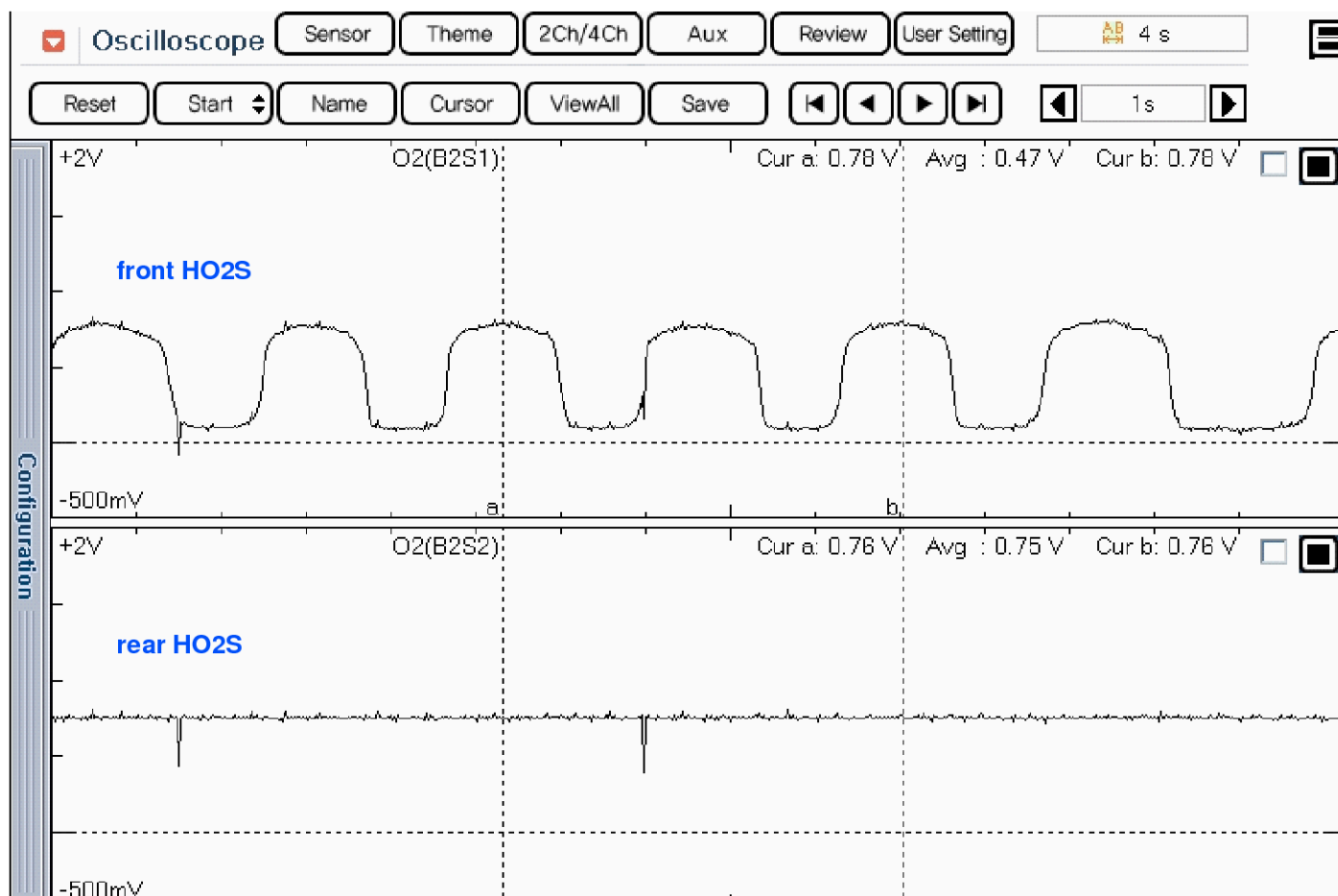
Component Inspection

■ Check the Signal waveform of HO2S

1. IG "OFF" and connect HO2S connector.
2. Engine start.
3. After warming-up, monitor signal waveform of HO2S with scantool.

FL-356

Fuel System



SBHFL9640L

4. Is the sensor switching properly?

YES ► Go to "Check HO2S" as below.

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Check HO2S

1. IG "OFF" and disconnect HO2S connector.
2. Check that the HO2S is securely installed.
3. Check the HO2S for contamination or damage
4. Is the sensor normal?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Engine Control System

FL-357

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

FL-358

Fuel System

P0158 O2 Sensor Circuit High Voltage (Bank 2 / Sensor 2)

Component Location

Refer to DTC P0157 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 2)

General Description

Refer to DTC P0157 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 2)

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitor signal voltage	- Poor connection - Short to battery in harness - HO2S(B2/S2) - ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running ≥ 60 sec - Engine warm-up state	
Threshold value	The voltage of HO2S(B2/S2) $> 1.3V$	
Diagnosis Time	Continuous (more than 12.5 sec.failure for every 15 sec. test)	
MIL On Condition	2 Driving Cycles	

Specification

Refer to DTC P0157 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 2)

Diagnostic Circuit Diagram

Refer to DTC P0157 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 2)

Signal Waveform & Data

Refer to DTC P0157 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 2)

Monitor Scantool Data

Refer to DTC P0157 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 2)

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Signal Circuit Inspection " procedure .

DTC Description

Checking output signals from HO2S under detecting condition, if an output signal is above 1.3V for more than predeterminate time, ECM sets P0158. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

Signal Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect HO2S(B2/S2) connector.
- IG "ON".
- Measure voltage between signal terminal of HO2S(B2/S2) harness connector and chassis ground.

Specification : Approx. 3.5V - when pumping current is ON

Approx. 0.45V - when pumping current is OFF

- Is the measured voltage within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

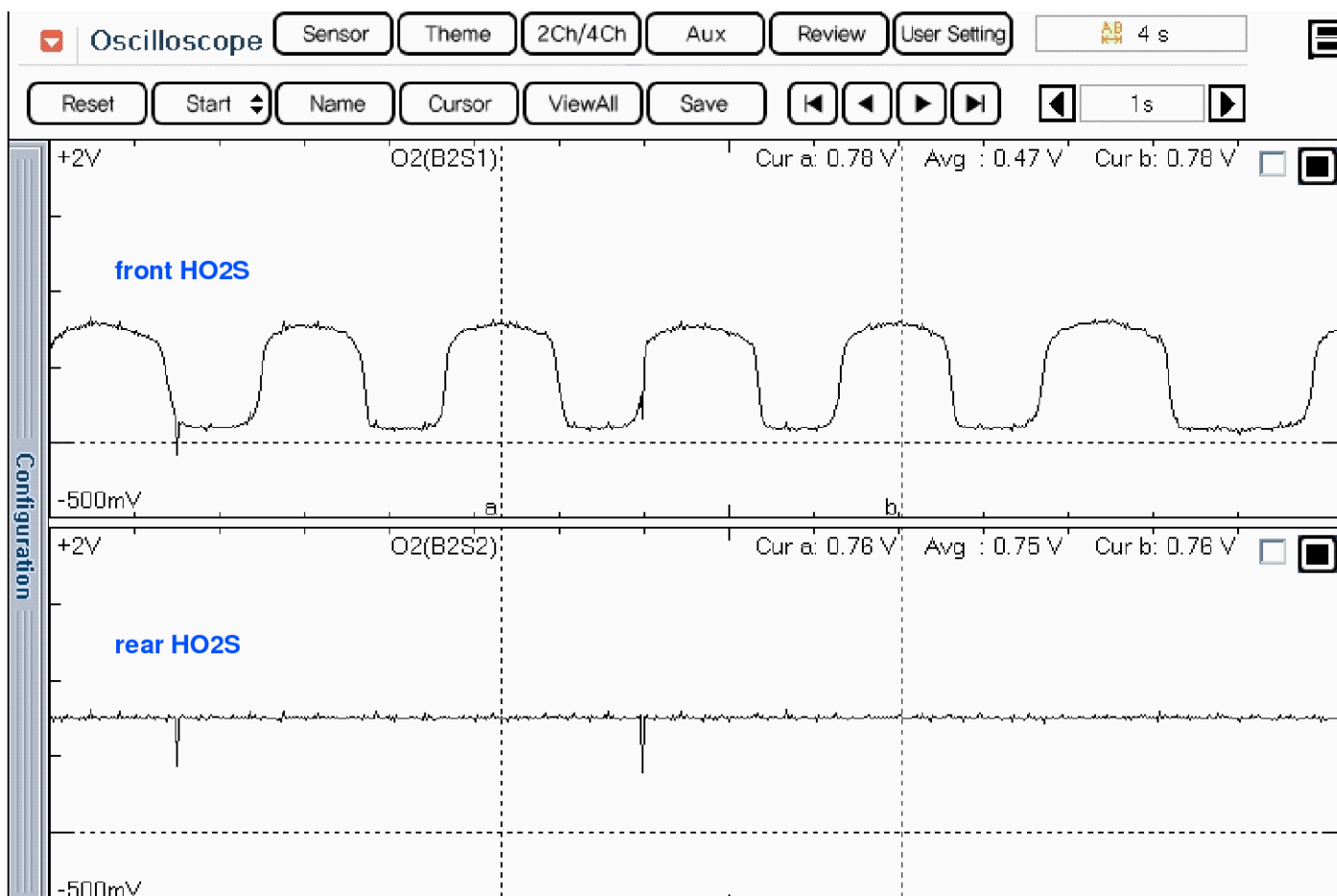
Component Inspection

■ Check the Signal waveform of HO2S

- IG "OFF" and connect HO2S connector.
- Engine start.
- After warming-up, monitor signal waveform of HO2S with scantool.

Engine Control System

FL-359



SBHFL9640L

4. Is the sensor switching properly?

YES ► Go to "Check HO2S" as below.

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Check HO2S

1. IG "OFF" and disconnect HO2S connector.
2. Check that the HO2S is securely installed.
3. Check the HO2S for contamination or damage
4. Is the sensor normal?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0157 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 2)

FL-360

Fuel System

P0160 O2 Sensor Circuit No Activity Detected (Bank 2 / Sensor 2)

Component Location

Refer to DTC P0157 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 2)

General Description

Refer to DTC P0157 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 2)

DTC Description

Checking output signals from HO2S under detecting condition, if an output voltage is approx.0.45V or 3.5V for more than predetermine time, ECM sets P0160. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		• Monitor signal voltage	• Poor connection • Open in harness • HO2S(B2/S2) • ECM
Enable Conditions		• Battery voltage $\geq 10V$ • Engine running ≥ 60 sec • Engine warm-up state • No disable faults	
Threshold value	Case 1	• $1.2V \leq \text{Voltage of HO2S} \leq 3.9V$ (at pumping current ON)	
	Case 2	• $0.415V \leq \text{Voltage of HO2S} \leq 0.515V$ (at pumping current OFF)	
Diagnosis Time		• Continuous (more than 76.5 sec.failure for every 90 sec .test)	
MIL On Condition		• 2 Driving Cycles	

Specification

Refer to DTC P0157 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 2)

Diagnostic Circuit Diagram

Refer to DTC P0157 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 2)

Signal Waveform & Data

Refer to DTC P0157 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 2)

Monitor Scantool Data

Refer to DTC P0157 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 2)

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Signal Circuit Inspection " procedure .

Signal Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect HO2S(B2/S1) connector.
2. IG "ON".
3. Measure voltage between signal terminal of HO2S(B2/S2) harness connector and chassis ground.

Specification : Approx. 3.5V - when pumping current is ON

Approx. 0.45V - when pumping current is OFF

4. Is the measured voltage within specification ?

YES ▶ Go to "Ground circuit inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Engine Control System

FL-361

Ground Circuit Inspection

■ Check open in harness

1. IG "ON" and disconnect HO2S(B2/S2) connector.
2. Measure voltage between signal terminal of HO2S(B2/S2) harness connector and chassis ground.(Measurement "A")
3. Measure voltage between signal and ground terminals of HO2S(B2/S2) harness connector.(Measurement "B")

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

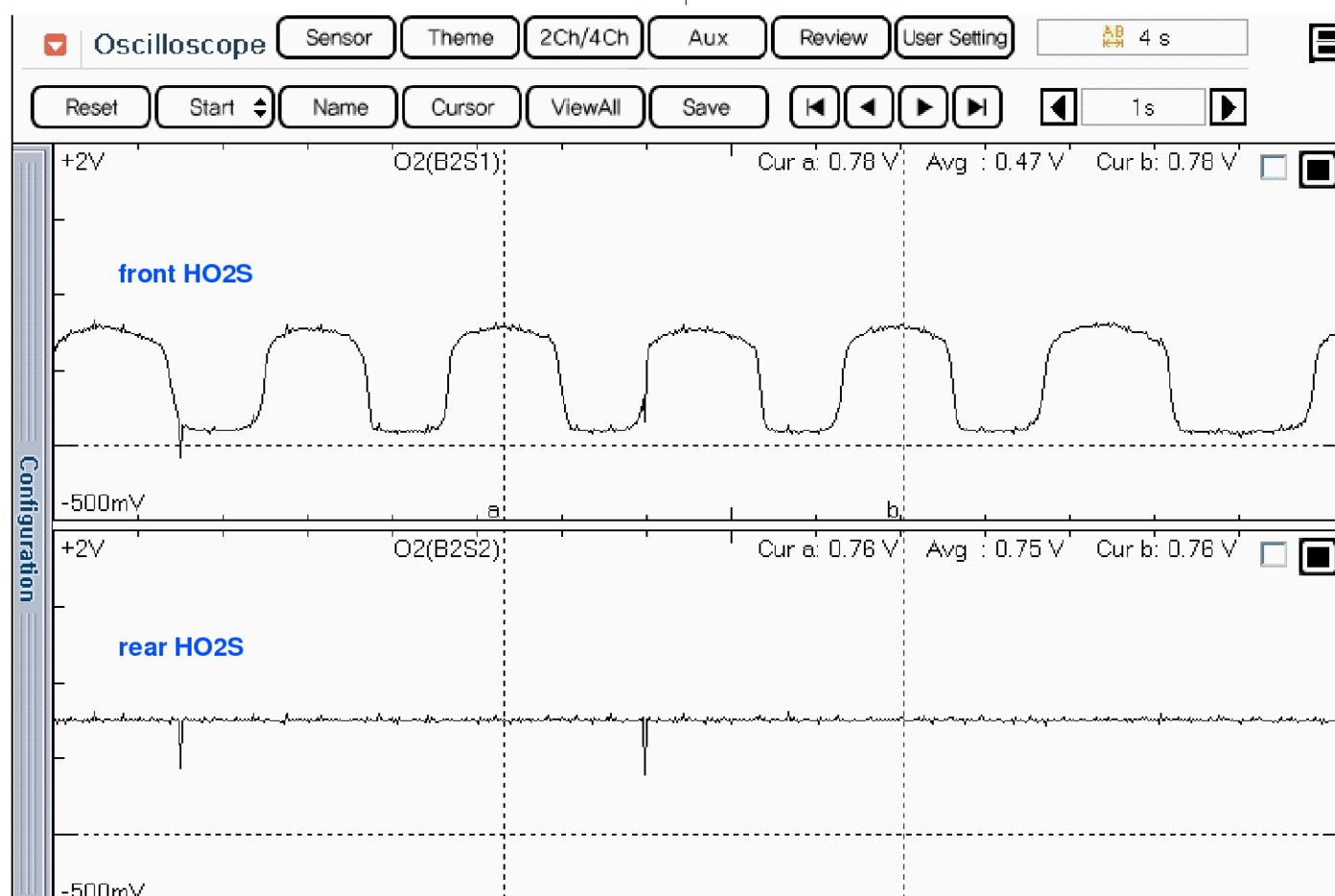
YES ► Go to "Component Inspection" procedure.

NO ► Repair contact resistance or open in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check the Signal waveform of HO2S

1. IG "OFF" and connect HO2S connector.
2. Engine start.
3. After warming-up, monitor signal waveform of HO2S with scantool.



SBHFL9640L

4. Is the sensor switching properly?

YES ► Go to "Check HO2S" as below.

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

FL-362

Fuel System

■ Check HO2S

1. IG "OFF" and disconnect HO2S connector.
2. Check that the HO2S is securely installed.
3. Check the HO2S for contamination or damage
4. Is the sensor normal?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0157 : O2 Sensor Circuit Low Voltage (Bank 2/Sensor 2)

Engine Control System

FL-363

P0171 System too Lean (Bank 1)

General Description

In order to provide the best possible combination of drivability, fuel economy and emission control, the PCM uses a closed loop air/fuel metering system. The PCM monitors the HO2S signal voltage and adjusts fuel delivery based on it in closed loop fuel control. Changes in fuel delivery will be indicated by the long-term and the short-term fuel trim values. The ideal fuel trim value is around 0%. The PCM will add fuel when the HO2S signal is indicating a lean condition. Additional fuel is indicated by fuel trim values that are above 0%. The PCM will reduce fuel when the HO2S signal is indicating a rich condition. Reduction in fuel is indicated by fuel trim values that are below 0%. The DTC relevant to fuel trim will be set when the amount reaches excessive levels because of a lean or rich condition.

DTC Description

Checking the fuel trim value under detecting condition, if its average exceeds the limit over certain period, PCM sets P0171.

MIL (Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitor the fuel trim value	- Air leakage - Improper fuel pressure - PCV valve stuck - Clogging of injector
Enable Conditions	- Engine warm-up sufficiently - Drive at a steady speed over 5 minutes (Vehicle speed $\leq 130\text{km/h}$) $60^{\circ}\text{C}(140^{\circ}\text{F}) \leq \text{Engine coolant temperature} \leq 115^{\circ}\text{C}(239^{\circ}\text{F})$ - No disabling faults (DTCs related to HO2S, purge valve, catalyst)	
Threshold value	Average of short term fuel trim > 0.8 and Average of long term fuel trim > 1.2	
Diagnosis Time	Continuous	
MIL On Condition	2 Driving Cycles	

Monitor Scantool Data

- Monitor DTCs related to MAFS, MAPS, ECTS, Injector or CVVT items with scantool.
- Are there the DTCs above-mentioned?

YES ▶ Do all repairs associated with those codes before proceeding with this procedure.

NO ▶ Go to "System Inspection" procedure

System Inspection

■ Check air leakage

- Visually/physically inspect the air leakage in intake/exhaust system for following items.

▶ Vacuum hoses for splits, kinks and improper connections.

▶ Throttle body gasket

▶ Gasket between intake manifold and cylinder head

▶ Seals between intake manifold and fuel injectors

▶ Exhaust system between HO2S and three way catalyst for air leakage

- Has a problem found in this procedure?

YES ▶ Repair or replace it which has a problem, and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check the fuel line" as follows.

FL-364

Fuel System

■ Check the fuel line

1. Check the fuel line for following items
 - ▶ Connector connection state
 - ▶ Damage/ connection state for vacuum hoses connected to fuel line
 - ▶ Bent/ pressed/ twisted fuel line or fuel leakage
2. Has a problem found in this procedure?

YES ▶ Repair or replace it which has a problem, and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check fuel pressure" as follows.

■ Check fuel pressure

NOTICE

1. *Be cautious that Fuel is explosive and an empty fuel tank can still contain explosive gases. When working on fuel system make sure to supply adequate ventilation to the work area. Do not smoke, and keep sparks and open flames away.*
 2. *The fuel system remains under pressure when the engine is not running. Release fuel system pressure before disconnecting any fuel line to reduce the chance of personal injury or fire damage to vehicle components.*
1. IG "OFF" and disconnect Fuel Pump Relay in Junction Box.
 2. Start-up and wait until it stops itself.
 3. IG "OFF" and connect Fuel Pump Relay.
 4. Install the fuel pressure gauge to the delivery pipe with the fuel pressure gauge adaptor.
 5. Activate the fuel pump, and with fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.
 6. Measure the fuel pressure at idle.

Specification : 374.6 ~ 384.4 kPa(3.82 ~ 3.92 kg/cm², 54.3 ~ 55.8 psi)

7. Is the measured fuel pressure within specifications ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair or replace according to the below table. And then, go to "Verification of Vehicle Repair" procedure.

Condition	Possible Cause
Fuel Pressure is too low	Fuel filter, fuel pressure regulator, in-tank fuel hose or the fuel pump
Fuel Pressure is too high	Fuel pressure regulator, hose or pipe

Component Inspection

■ Check PCV

1. IG "OFF" and remove PCV valve from rocker cover.
2. Insert a thin stick into the PCV valve from the threaded side and verify that the plunger is moving.
3. Is the PCV valve normally moving?

YES ▶ Go to "Check injector" as follows

NO ▶ Replace it, and go to "Verification of Vehicle Repair" procedure.

■ Check injector for normal operation

1. Start engine.
2. Check its RPM decrease when doing the injector's actuation test.
3. Is there any cylinder with no change in RPM or only a small change in RPM?

YES ▶ Replace injector, and go to "Verification of Vehicle Repair" procedure.

NO ▶ Clear DTC and Test-drive under enable conditions above-mentioned. After the test, If this DTC is set, go to "Inspection & Repair" procedure. If not, troubleshooting is completed.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-365

P0172 System too Rich (Bank 1)

General Description

Refer to DTC P0171 : System too Lean (Bank 1)

DTC Description

Checking the fuel trim value under detecting condition, if its average exceeds the limit over certain period, PCM sets P0172.

MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitor the fuel trim value	- Blocking of intake system - Fuel leakage in injector - Improper fuel pressure
Enable Conditions	- Engine warm-up sufficiently - Drive at a steady speed over 5 minutes (Vehicle speed $\leq 130\text{km/h}$) $60^{\circ}\text{C}(140^{\circ}\text{F}) \leq \text{Engine coolant temperature} \leq 115^{\circ}\text{C}(239^{\circ}\text{F})$ - No disabling faults (DTCs related to HO₂S, purge valve ,catalyst)	
Threshold value	Average of short term fuel trim < 1.2 and Average of long term fuel trim < 0.8	
Diagnosis Time	Continuous	
MIL On Condition	2 Driving Cycles	

Monitor Scantool Data

Refer to DTC P0171 : System too Lean (Bank 1)

System Inspection

■ Check blocking of intake system

1. Visually/physically inspect the blocking in intake system for following items.

- ▶ Throttle body gasket and damage
- ▶ Blocking in intake manifold and injector caused by any foreign substance

2. Has a problem found in this procedure?

YES ▶ Repair or replace it which has a problem, and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to " Check fuel pressure" as follows.

■ Check fuel pressure

NOTICE

1. Be cautious that Fuel is explosive and an empty fuel tank can still contain explosive gases. When working on fuel system make sure to supply adequate ventilation to the work area. Do not smoke, and keep sparks and open flames away.

2. The fuel system remains under pressure when the engine is not running. Release fuel system pressure before disconnecting any fuel line to reduce the chance of personal injury or fire damage to vehicle components.

1. IG "OFF" and disconnect Fuel Pump Relay in Junction Box.
2. Start-up and wait until it stops itself.
3. IG "OFF" and connect Fuel Pump Relay.
4. Install the fuel pressure gauge to the delivery pipe with the fuel pressure gauge adaptor.
5. Activate the fuel pump, and with fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.
6. Measure the fuel pressure at idle.

Specification : $374.6 \sim 384.4 \text{ kPa}(3.82 \sim 3.92 \text{ kg/cm}^2, 54.3 \sim 55.8 \text{ psi})$

7. Is the measured fuel pressure within specifications ?

YES ▶ Go to "Check fuel leakage in injector" as follow.

NO ▶ Repair or replace according to the below table. And then, go to " Verification of Vehicle Repair" procedure.

FL-366

Fuel System

Condition	Possible Cause
Fuel Pressure is too low	Fuel filter, fuel pressure regulator, in-tank fuel hose or the fuel pump
Fuel Pressure is too high	Fuel pressure regulator, hose or pipe

■ Check fuel leakage in injector

1. IG "OFF" after checking the fuel pressure test.
2. Stop engine and check for a change in the fuel pressure gauge reading for 5 minutes.

Specification : After engine stops, fuel gauge reading is maintained for 5 minutes.

3. Is the fuel gauge reading maintained ?

YES ► Clear DTC and Test-drive under enable conditions above-mentioned. After the test, If this DTC is set, go to "Inspection & Repair" procedure. If not, troubleshooting is completed.

NO ► There is a fuel leakage in injector. Replace it , and go to " Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0171 : System too Lean (Bank 1)

Engine Control System

FL-367

P0174 System too Lean (Bank 2)

General Description

Refer to DTC P0171 : System too Lean (Bank 1)

DTC Description

Checking the fuel trim value under detecting condition, if its average exceeds the limit over certain period, PCM sets P0174.

MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitor the fuel trim value	- Air leakage - Improper fuel pressure - PCV valve stuck - Clogging of injector
Enable Conditions	- Engine warm-up sufficiently - Drive at a steady speed over 5 minutes (Vehicle speed $\leq 130\text{km/h}$) $60^{\circ}\text{C}(140^{\circ}\text{F}) \leq \text{Engine coolant temperature} \leq 115^{\circ}\text{C}(239^{\circ}\text{F})$ - No disabling faults (DTCs related to HO2S, purge valve ,catalyst)	
Threshold value	Average of short term fuel trim > 0.8 and Average of long term fuel trim > 1.2	
Diagnosis Time	Continuous	
MIL On Condition	2 Driving Cycles	

Monitor Scantool Data

Refer to DTC P0171 : System too Lean (Bank 1)

System Inspection

■ Check air leakage

1. Visually/physically inspect the air leakage in intake/exhaust system for following items.

- ▶ Vacuum hoses for splits, kinks and improper connections.
- ▶ Throttle body gasket
- ▶ Gasket between intake manifold and cylinder head
- ▶ Seals between intake manifold and fuel injectors
- ▶ Exhaust system between HO2S and three way catalyst for air leakage

2. Has a problem found in this procedure?

YES ▶ Repair or replace it which has a problem, and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check the fuel line" as follows.

■ Check the fuel line

1. Check the fuel line for following items
 - ▶ Connector connection state
 - ▶ Damage/ connection state for vacuum hoses connected to fuel line
 - ▶ Bent/ pressed/ twisted fuel line or fuel leakage
2. Has a problem found in this procedure?

YES ▶ Repair or replace it which has a problem, and go to " Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check fuel pressure" as follows.

■ Check fuel pressure

NOTICE

1. Be cautious that Fuel is explosive and an empty fuel tank can still contain explosive gases. When working on fuel system make sure to supply adequate ventilation to the work area. Do not smoke, and keep sparks and open flames away.

FL-368

Fuel System

2. The fuel system remains under pressure when the engine is not running. Release fuel system pressure before disconnecting any fuel line to reduce the chance of personal injury or fire damage to vehicle components.
1. IG "OFF" and disconnect Fuel Pump Relay in Junction Box.
2. Start-up and wait until it stops itself.
3. IG "OFF" and connect Fuel Pump Relay.
4. Install the fuel pressure gauge to the delivery pipe with the fuel pressure gauge adaptor.
5. Activate the fuel pump, and with fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.
6. Measure the fuel pressure at idle.

Specification : 374.6 ~ 384.4 kPa(3.82 ~ 3.92 kg/cm², 54.3 ~ 55.8 psi)

7. Is the measured fuel pressure within specifications ?

YES ► Go to "Component Inspection" procedure.

NO ► Repair or replace according to the below table. And then, go to "Verification of Vehicle Repair" procedure.

Condition	Possible Cause
Fuel Pressure is too low	Fuel filter, fuel pressure regulator, in-tank fuel hose or the fuel pump
Fuel Pressure is too high	Fuel pressure regulator, hose or pipe

Component Inspection

■ Check PCV

1. IG "OFF" and remove PCV valve from rocker cover.
2. Insert a thin stick into the PCV valve from the threaded side and verify that the plunger is moving.
3. Is the PCV valve normally moving?

YES ► Go to "Check injector" as follows

NO ► Replace it, and go to "Verification of Vehicle Repair" procedure.

■ Check injector for normal operation

1. Start engine.
2. Check its RPM decrease when doing the injector's actuation test.
3. Is there any cylinder with no change in RPM or only a small change in RPM?

YES ► Replace injector, and go to "Verification of Vehicle Repair" procedure.

NO ► Clear DTC and Test-drive under enable conditions above-mentioned. After the test, If this DTC is set, go to "Inspection & Repair" procedure. If not, troubleshooting is completed.

Verification of Vehicle Repair

Refer to DTC P0171 : System too Lean (Bank 1)

Engine Control System

FL-369

P0175 System too Rich (Bank 2)

General Description

Refer to DTC P0171 : System too Lean (Bank 1)

DTC Description

Checking the fuel trime value under detecting condition, if its average exceeds the limit over certain period, PCM sets P0175.

MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitor the fuel trim value	- Blocking of intake system - Fuel leakage in injector - Improper fuel pressure
Enable Conditions	- Engine warm-up sufficiently - Drive at a steady speed over 5 minutes (Vehicle speed $\leq 130\text{km/h}$) $60^{\circ}\text{C}(140^{\circ}\text{F}) \leq \text{Engine coolant temperature} \leq 115^{\circ}\text{C}(239^{\circ}\text{F})$ - No disabling faults (DTCs related to HO₂S, purge valve ,catalyst)	
Threshold value	Average of short term fuel trim < 1.2 and Average of l-ong term fuel trim < 0.8	
Diagnosis Time	Continuous	
MIL On Condition	2 Driving Cycles	

Monitor Scantool Data

Refer to DTC P0171 : System too Lean (Bank 1)

System Inspection

■ Check blocking of intake system

1. Visually/physically inspect the blocking in intake system for following items.
 - ▶ Throttle body gasket and damage
 - ▶ Blocking in intake manifold and injector caused by any foreign substance
2. Has a problem found in this procedure?

YES ▶ Repair or replace it which has a problem, and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to " Check fuel pressure" as follows.

■ Check fuel pressure

NOTICE

1. Be cautious that Fuel is explosive and an empty fuel tank can still contain explosive gases. When working on fuel system make sure to supply adequate ventilation to the work area. Do not smoke, and keep sparks and open flames away.

2. The fuel system remains under pressure when the engine is not running. Release fuel system pressure before disconnecting any fuel line to reduce the chance of presonal injury or fire damage to vehicle components.

1. IG "OFF" and disconnect Fuel Pump Relay in Junction Box.
2. Start-up and wait until it stops itself.
3. IG "OFF" and connect Fuel Pump Relay.
4. Install the fuel pressure gauge to the delivery pipe with the fuel pressure gauge adaptor.
5. Activate the fuel pump, and with fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.
6. Measure the fuel pressure at idle.

Specification : 374.6 ~ 384.4 kPa(3.82 ~ 3.92 kg/cm², 54.3 ~ 55.8 psi)

7. Is the measured fuel pressure within specifications ?

YES ▶ Go to "Check fuel leakage in injector" as follow.

NO ▶ Repair or replace according to the below table. And then, go to " Verification of Vehicle Repair" procedure.

FL-370

Fuel System

Condition	Possible Cause
Fuel Pressure is too low	Fuel filter, fuel pressure regulator, in-tank fuel hose or the fuel pump
Fuel Pressure is too high	Fuel pressure regulator, hose or pipe

■ Check fuel leakage in injector

1. IG "OFF" after checking the fuel pressure test.
2. Stop engine and check for a change in the fuel pressure gauge reading for 5 minutes.

Specification : After engine stops, fuel gauge reading is maintained for 5 minutes.

3. Is the fuel gauge reading maintained ?

YES ► Clear DTC and Test-drive under enable conditions above-mentioned. After the test, If this DTC is set, go to "Inspection & Repair" procedure. If not, troubleshooting is completed.

NO ► There is a fuel leakage in injector. Replace it , and go to " Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

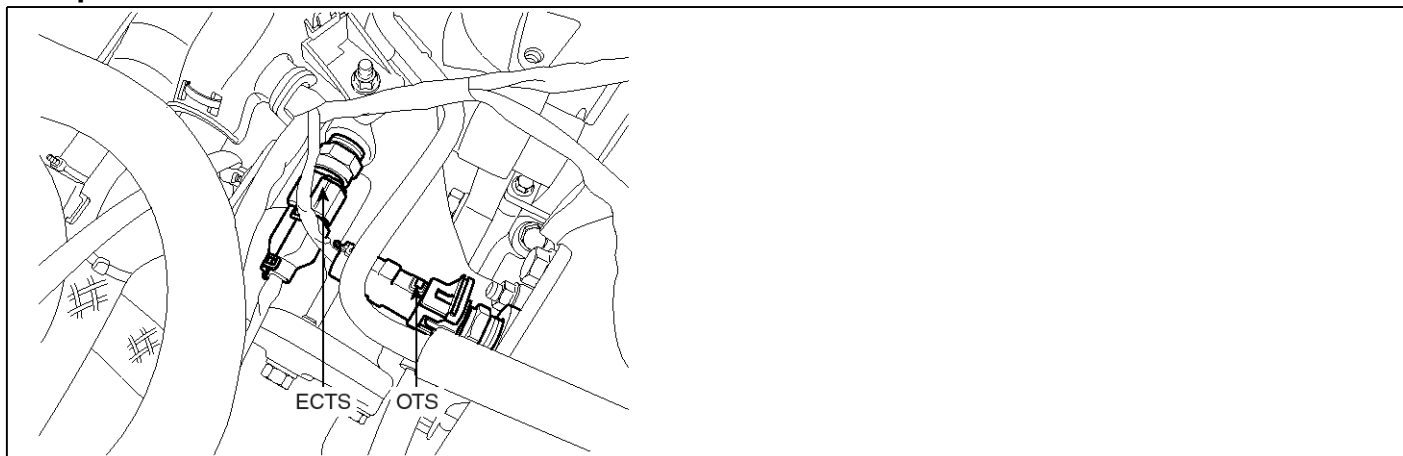
Refer to DTC P0171 : System too Lean (Bank 1)

Engine Control System

FL-371

P0196 Engine Oil Temperature Sensor-Range / Performance

Component Location



SBHFL9303L

General Description

The fluid of the CVVT is the engine oil and its density changes according to the engine oil temperature. At this time the Oil Temperature Sensor (OTS) helps compensation against the temperature differences. The Oil Temperature Sensor measures the engine oil temperature before the engine oil comes into the Oil-flow Control Valve (OCV).

According to the measured temperature, the Engine Control Module (ECM) compensates the oil-flow control valve operation time.

DTC Description

Checking the oil temperature , coolant temperature and intake air temperature every 25 sec. under detecting condition, if the difference in temperature at start-up exceeds threshold value, ECM sets P0196. MIL(Malfunction Indicatin Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		Determines if the oil temperature value is rational, compared to coolant and intake air temperature.	Faulty OTS
Enable Conditions	Case 1	- Engine run time after startup < 30 sec - Soak period required > 300 min	
	Case 2	Minimum engine run time > 800 sec	
Threshold value	Case 1	The difference in temperature between oil and coolant temperatures at startup. > 35°C(63°F)	
	Case 2	The difference in temperature between oil temperature and intake air temperature at startup > 35°C(63°F)	
Diagnosis Time		Continuous (More than 800 sec.)	
MIL On Condition		NO MIL ON(DTC only)	

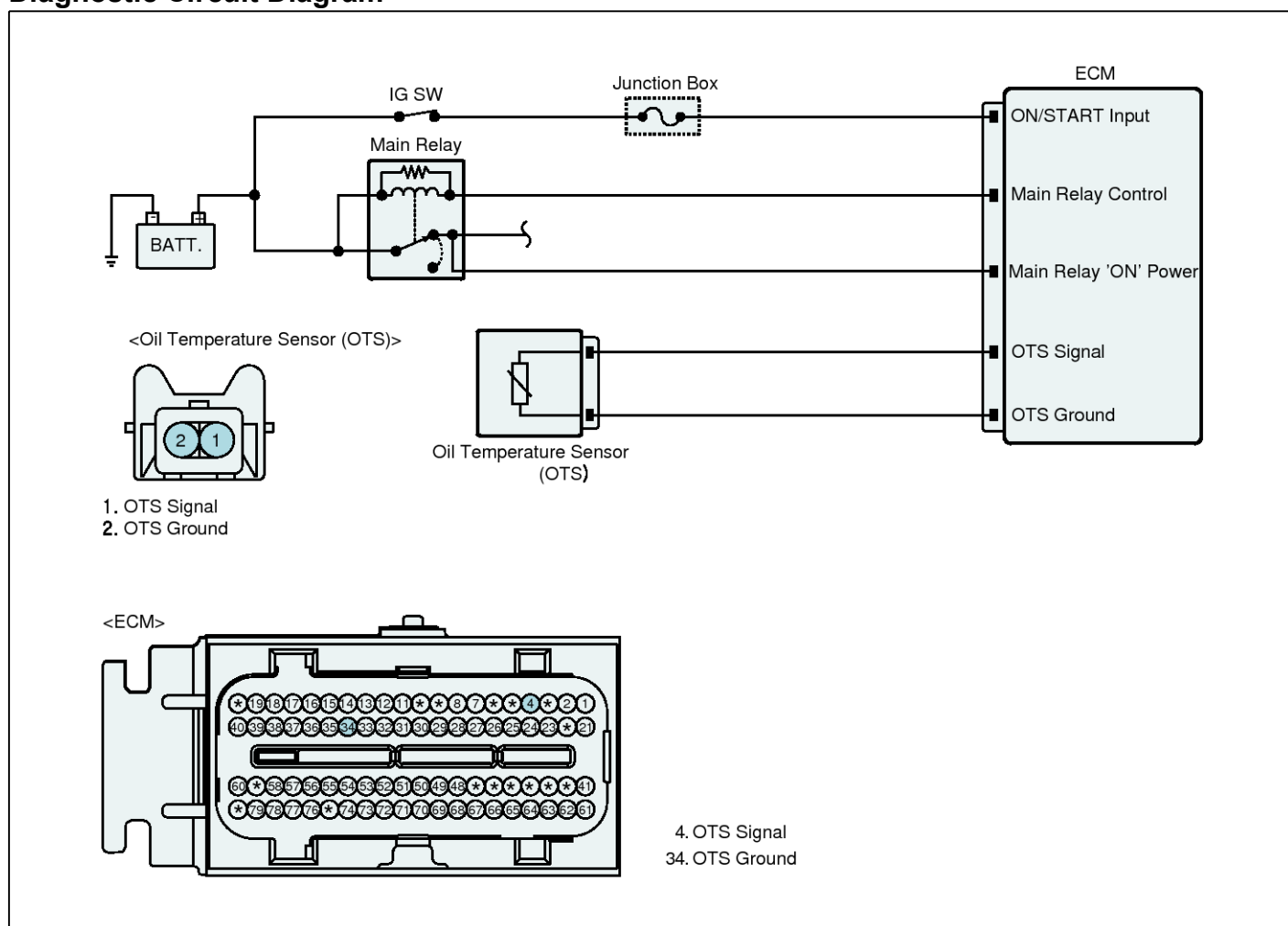
FL-372

Fuel System

Specification

Temperature(°C/°F)	Resistance(kΩ)
-40℃	52.15kΩ
-20℃	16.52kΩ
0℃	6.0kΩ
20℃	2.45kΩ
40℃	1.11kΩ
60℃	0.54kΩ
80℃	0.29kΩ

Diagnostic Circuit Diagram



SBHFL9517L

Engine Control System

FL-373

Signal Waveform & Data

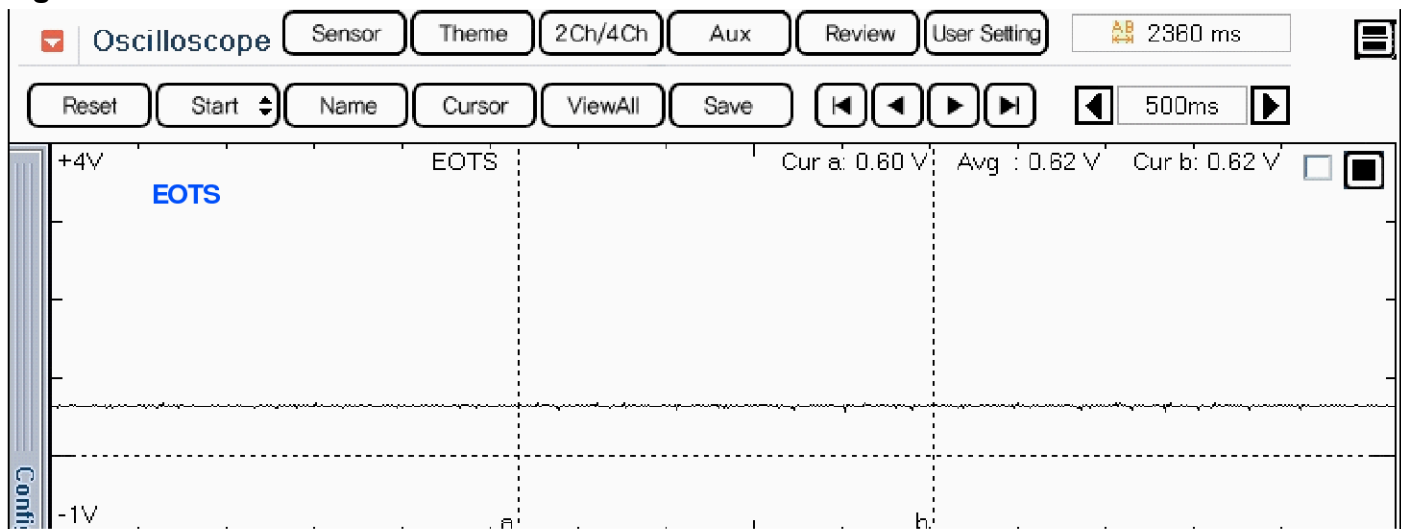


Fig.1

SBHFL9641L

Current Data		
Standard Display	Full List	Graph
Items List	Reset Min.Max.	Record
Stop	VSS	
Sensor Name	Value	Unit
☐ Engine Coolant Temperature Sensor	10.5	'C
☐ Intake Air Temperature Sensor	12.0	'C
☐ Oil Temperature Sensor	10.5	'C

Fig.2

SBHFL9631L

Sensor Name	Value	Unit
☒ Engine Speed	640	RPM
☒ Engine Coolant Temperature Sensor	90.8	'C
☒ Intake Air Temperature Sensor	27.8	'C
☒ Oil Temperature Sensor	88.5	'C

Fig.3

SBHFL9632L

Sensor Name	Value	Unit
☒ Engine Coolant Temperature Sensor	82.5	'C
☒ Intake Air Temperature Sensor	15.8	'C
☒ Oil Temperature Sensor	9.8	'C
☒ Engine Speed	600	RPM

Fig.4

SBHFL9642L

FL-374

Fuel System

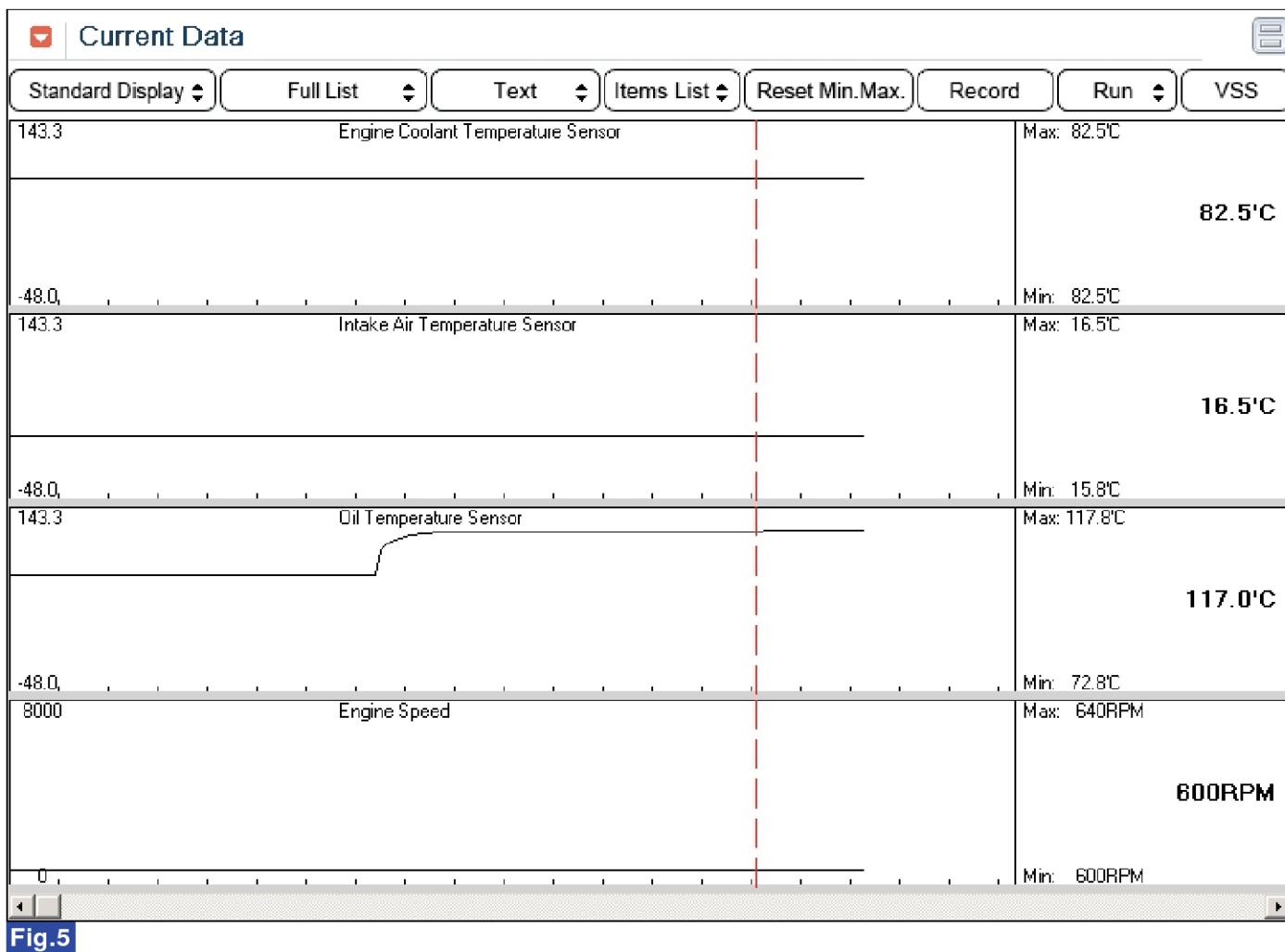


Fig.5

SBHFL9643L

Fig 1) Normal waveform of EOTS at 88.5°C (191°F)

Fig 2) Normal data of IATS & ECTS & EOTS(51°F) at ig on

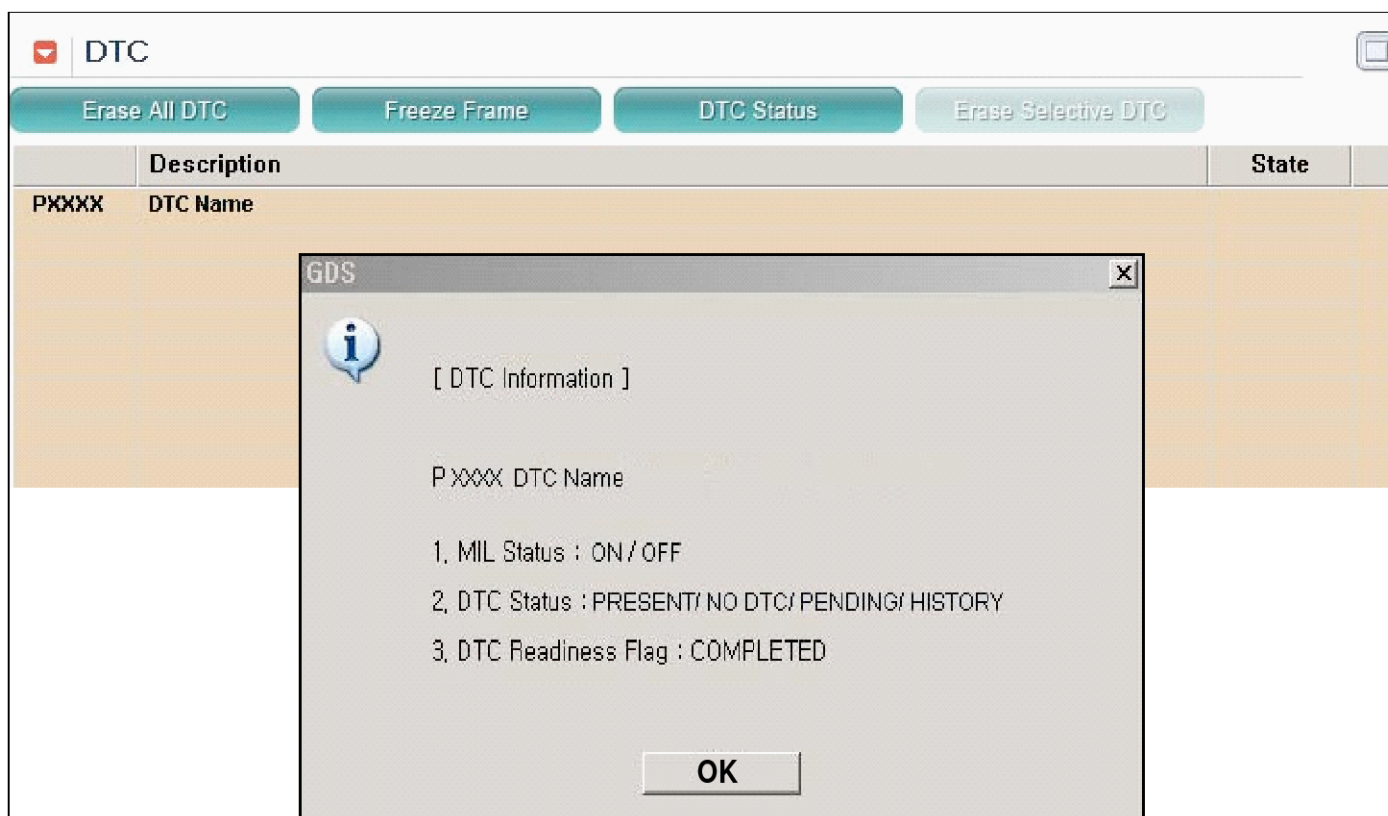
Fig 3) Normal data of IATS & ECTS & EOTS(191°F) after warming up.

Fig 4) Abnormal data of EOTS when EOTS circuit open.

Fig 5) Abnormal data of EOTS when EOTS circuit short to ground.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Component Inspection" procedure.

NO ► Fault is intermittent caused by ECM memory was not cleared after repair. Erase DTC and drive the vehicle to satisfy the enable condition then, go to "Component Inspection" procedure.

Component Inspection

■ Check OTS resistance

1. IG "OFF" and disconnect OTS connector.
2. Measure resistance between signal and ground terminals of OTS connector after checking out the temperature of EOTS with scantool (Component Side)

Specification :

Temperature(°C/°F)	Resistance(kΩ)
-40 °C	52.15kΩ
-20 °C	16.52kΩ
0 °C	6.0kΩ
20 °C	2.45kΩ
40 °C	1.11kΩ
60 °C	0.54kΩ
80 °C	0.29kΩ

3. Is the measured resistance within specification ?

YES ► Go to "Verification of Vehicle Repair" procedure.

NO ► Substitute with a known - good OTS and check for proper operation. If the problem is corrected, replace OTS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-377

P0197 Engine Oil Temperature Sensor Low Input

Component Location

Refer to DTC P0196 : Engine Oil Temperature Sensor-Range/Performance

General Description

Refer to DTC P0196 : Engine Oil Temperature Sensor-Range/Performance

DTC Description

Checking output signals from oil temperature sensor every 15 sec. under detecting condition, if an signal is low for more than 12.5 sec., ECM sets P0197. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		• Signal low	• Poor connection • Short to ground in harness • Oil temp.sensor • ECM
Enable Conditions	Case 1	• Engine running state > 60 sec • Coolant temperature < 110 °C(230°F)	
	Case 2	• Engine running state > 90 sec	
Threshold value		• Oil temperature sensor's signal < 0.1V	
Diagnosis Time		• Continuous (More than 12.5 sec.failure for every 15 sec .test)	
MIL On Condition		• 2 Driving Cycles	

Specification

Refer to DTC P0196 : Engine Oil Temperature Sensor-Range/Performance

Diagnostic Circuit Diagram

Refer to DTC P0196 : Engine Oil Temperature Sensor-Range/Performance

Signal Waveform & Data

Refer to DTC P0196 : Engine Oil Temperature Sensor-Range/Performance

Monitor Scantool Data

Refer to DTC P0196 : Engine Oil Temperature Sensor-Range/Performance

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Signal Circuit Inspection " procedure

Signal Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect OTS connector.
2. IG "ON"
3. Measure voltage between signal terminal of OTS harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ▶ Go to " Component Inspection" procedure.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check OTS resistance

1. IG "OFF" and disconnect OTS connector.
2. Measure resistance between signal and ground terminals of OTS connector after checking out the temperature of EOTS with scantool (Component Side)

FL-378

Fuel System

Specification :

Temperature(°C/°F)	Resistance(kΩ)
-40 °C	52.15kΩ
-20 °C	16.52kΩ
0 °C	6.0kΩ
20 °C	2.45kΩ
40 °C	1.11kΩ
60 °C	0.54kΩ
80 °C	0.29kΩ

3. Is the measured resistance within specification ?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Substitute with a known - good OTS and check for proper operation. If the problem is corrected, replace OTS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0196 : Engine Oil Temperature Sensor-Range/Performance

Engine Control System

FL-379

P0198 Engine Oil Temperature Sensor High Input

Component Location

Refer to DTC P0196 : Engine Oil Temperature Sensor-Range/Performance

General Description

Refer to DTC P0196 : Engine Oil Temperature Sensor-Range/Performance

DTC Description

Checking output signals from oil temperature sensor every 15 sec. under detecting condition, if an signal is high for more than 12.5 sec., ECM sets P0198. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		• Signal High	• Poor connection • Open or short to battery in signal harness • Open in ground harness • Oil temp.sensor • ECM
Enable Conditions	Case 1	• Engine running state > 60 sec • Coolant temperature < 110 °C(230°F)	
	Case 2	• Engine running state > 90 sec	
Threshold value		• Oil temperature sensor's signal > 4.9V	
Diagnosis Time		• Continuous (More than 12.5 sec.failure for every 15 sec .test)	
MIL On Condition		• 2 Driving Cycles	

Specification

Refer to DTC P0196 : Engine Oil Temperature Sensor-Range/Performance

Diagnostic Circuit Diagram

Refer to DTC P0196 : Engine Oil Temperature Sensor-Range/Performance

Signal Waveform & Data

Refer to DTC P0196 : Engine Oil Temperature Sensor-Range/Performance

Monitor Scantool Data

Refer to DTC P0196 : Engine Oil Temperature Sensor-Range/Performance

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Signal Circuit Inspection " procedure

Signal Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect OTS connector.
2. IG "ON"
3. Measure voltage between signal terminal of OTS harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ► Go to "Ground Circuit Inspection" procedure.

NO ► Go to "Check open in harness" as follow.

■ Check open in harness

1. IG "OFF" and disconnect OTS connector and ECM connector.
2. Measure resistance between signal terminal of OTS harness connector and OTS signal terminal of ECM harness connector.

Specification : Below 1Ω

FL-380

Fuel System

3. Is the measured resistance within specification ?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Repair open in harness and go to "Verification of Vehicle Repair" procedure.

Ground Circuit Inspection

■ Check open in harness

1. IG "OFF" and disconnect OTS connector and then IG "ON".
2. Measure voltage between signal terminal of OTS harness connector and chassis ground.(Measurement "A")
3. Measure voltage between signal and ground terminals of OTS harness connector.(Measurement "B")

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair contact resistance or open in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check OTS resistance

1. IG "OFF" and disconnect OTS connector.
2. Measure resistance between signal and ground terminals of OTS connector after checking out the temperature of EOTS with scantool (Component Side)

Specification :

Temperature(°C/°F)	Resistance(kΩ)
-40 °C	52.15kΩ
-20 °C	16.52kΩ
0 °C	6.0kΩ
20 °C	2.45kΩ
40 °C	1.11kΩ
60 °C	0.54kΩ
80 °C	0.29kΩ

3. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good OTS and check for proper operation. If the problem is corrected, replace OTS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

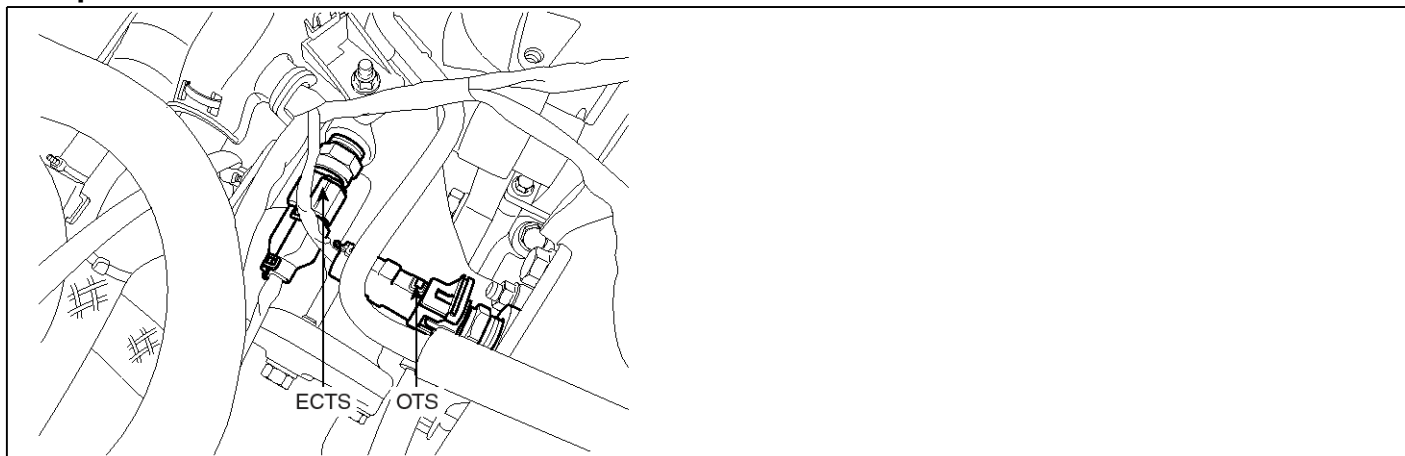
Refer to DTC P0196 : Engine Oil Temperature Sensor-Range/Performance

Engine Control System

FL-381

P0217 Engine Coolant Over Temperature Condition

Component Location



SBHFL9303L

General Description

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

DTC Description

Checking the coolant temperature under detecting condition, if the coolant temperature exceeds the threshold temperature under normal operation loads, ECM sets P0217. MIL (Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

FL-382

Fuel System

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Monitor the coolant temperature	ECTS
Enable Conditions	- Coolant sensor is normal - No disabling faults present(DTCs related to MAFS/MAPS, c-atalyst, fuel system or engine oil temperature sensor) - Coolant Temperature at startup < 45°C (113 °F) - Engine running state - Coolant temperature > 50°C (122 °F) - Intake air temperature < 35°C (95 °F)	
Threshold value	Coolant temperature ≥ 110 °C (230 °F)(Average airflow< 30 g/sec and filtered airflow< 50 g/sec)	
Diagnosis Time	Once per driving cycle (about 2 minutes)	
MIL On Condition	NO MIL ON(DTC only)	

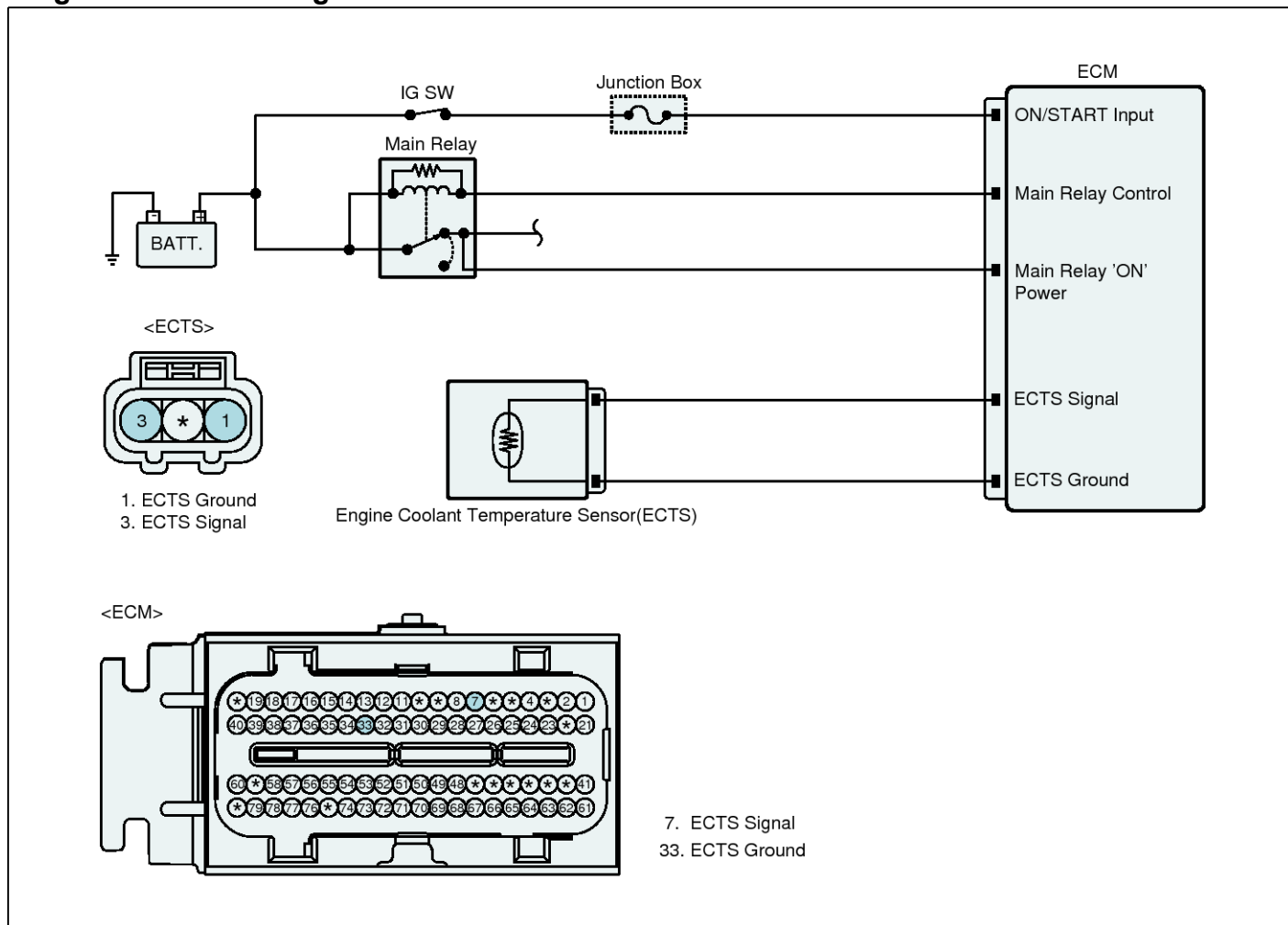
Specification

Temp. (°C)	Resistance (kΩ)	Temp. (°C)	Resistance (kΩ)
-40	48.14	40	1.15
-20	14.13 ~ 16.83	60	0.59
0	5.79	80	0.32
20	2.31 ~ 2.59		

Engine Control System

FL-383

Diagnostic Circuit Diagram



SBHFL9515L

Signal Waveform & Data

Sensor Name	Value	Unit
☒ Engine Speed	640	RPM
☒ Engine Coolant Temperature Sensor	90.8	'C
☒ Intake Air Temperature Sensor	27.8	'C
☒ Oil Temperature Sensor	88.5	'C

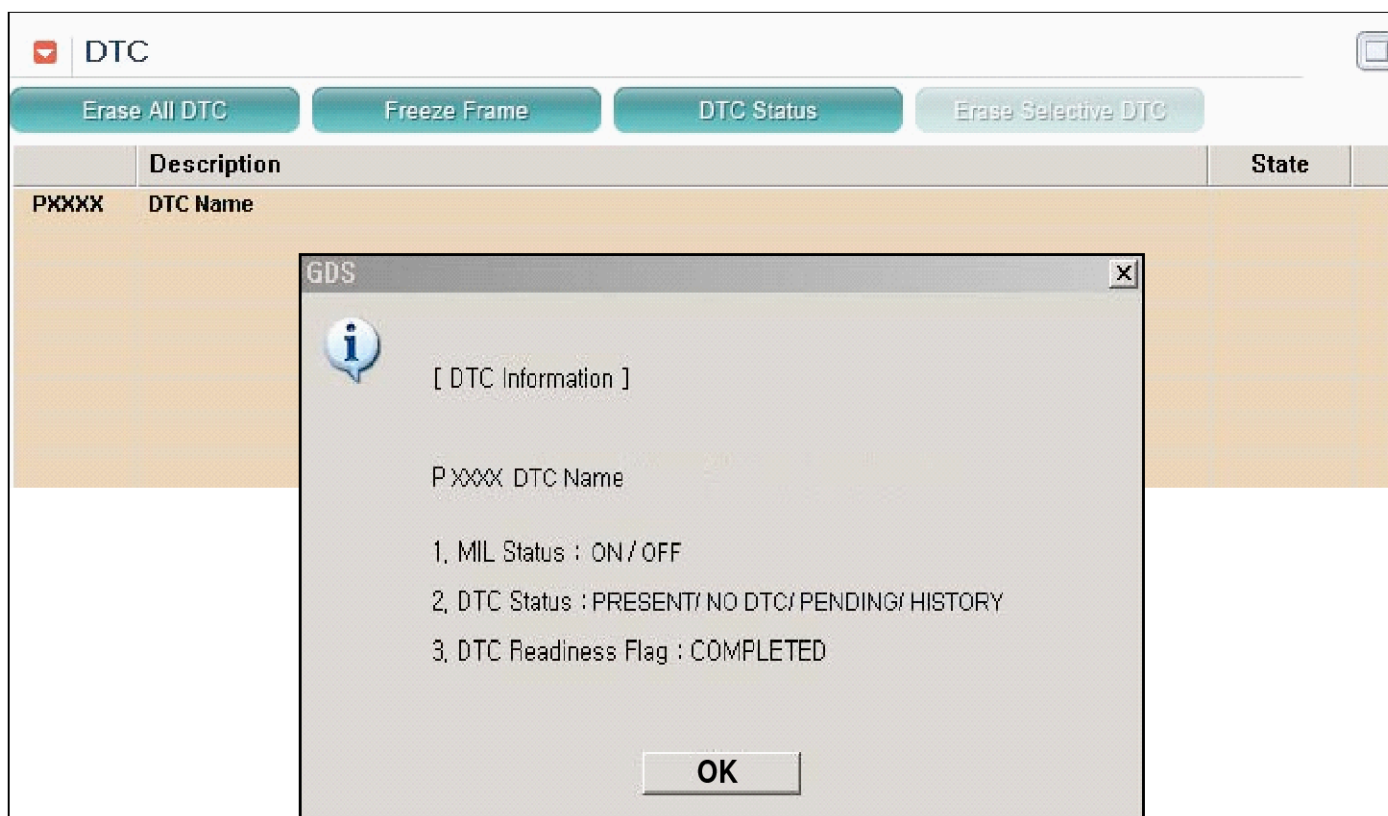
Fig.1

SBHFL9644L

Fig 1) Normal data of IATS(82°F) & ECTS(195°F) & EOTS(191°F) after warming up.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Component Inspection" procedure.

NO ► Fault is intermittent caused by ECM memory was not cleared after repair. Erase DTC and drive the vehicle to satisfy the enable condition then, go to "Component Inspection" procedure.

Component Inspection

■ Check EOTS resistance

1. IG "OFF" and disconnect ECTS connector.
2. Measure resistance between signal and ground terminals of EOTS connector after checking out the temperature of EOTS with scantool (Component Side)

Specification :

Temp. (°C)	Resistance (kΩ)
-40	48.14
-20	14.13 ~ 16.83
0	5.79
20	2.31 ~ 2.59
40	1.15
60	0.59
80	0.32

3. Is the measured resistance within specification ?

YES ► Clear DTC and Test-drive under enable conditions above-mentioned. After the test, If this DTC is set, recheck it thoroughly. If not, it is intermittent fault, go to "Verification of vehicle Repair" procedure.

NO ► Substitute with a known - good ECTS and check for proper operation. If the problem is corrected, Go to "Verification of Vehicle Repair" procedure.

Engine Control System

FL-385

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

P0222 Throttle/Pedal Position Sensor/Switch "B" Circuit Low Input

Component Location



SBHFL9302L

General Description

The Electronic Throttle Control(ETC) system is made of the components throttle body, Throttle Position Sensor(TPS)1&2 and Accelerator Position Sensor(APS) 1&2. TPS1&2 are sharing the same source voltage and ground. The throttle valve opening is control by throttle motor which is controlled by Engine Control Module(ECM). The opposite position indicator shows inverted signal characteristics. TPS1 output voltage increases smoothly in proportion with the throttle valve opening angle after starting. TPS2 output voltage decreases in inverse proportion with the throttle valve opening angle after starting. TPS provides feedback to the ECM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC Description

Checking output signals from TPS2 every 8.5 sec. under detecting condition, if an output signal is below 0.25V for more than 0.1 sec., ECM sets P0222. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Signal low	• Poor connection • Open or short to ground in power harness • Open or Short to ground in signal harness • TPS • ECM
Enable Conditions	• IG "ON"	
Threshold value	• The voltage of TPS < 0.25V	
Diagnosis Time	• Continuous (more than 0.1 sec. failure for every 8.5 sec .test)	
MIL On Condition	• 1 driving cycles	

Engine Control System

FL-387

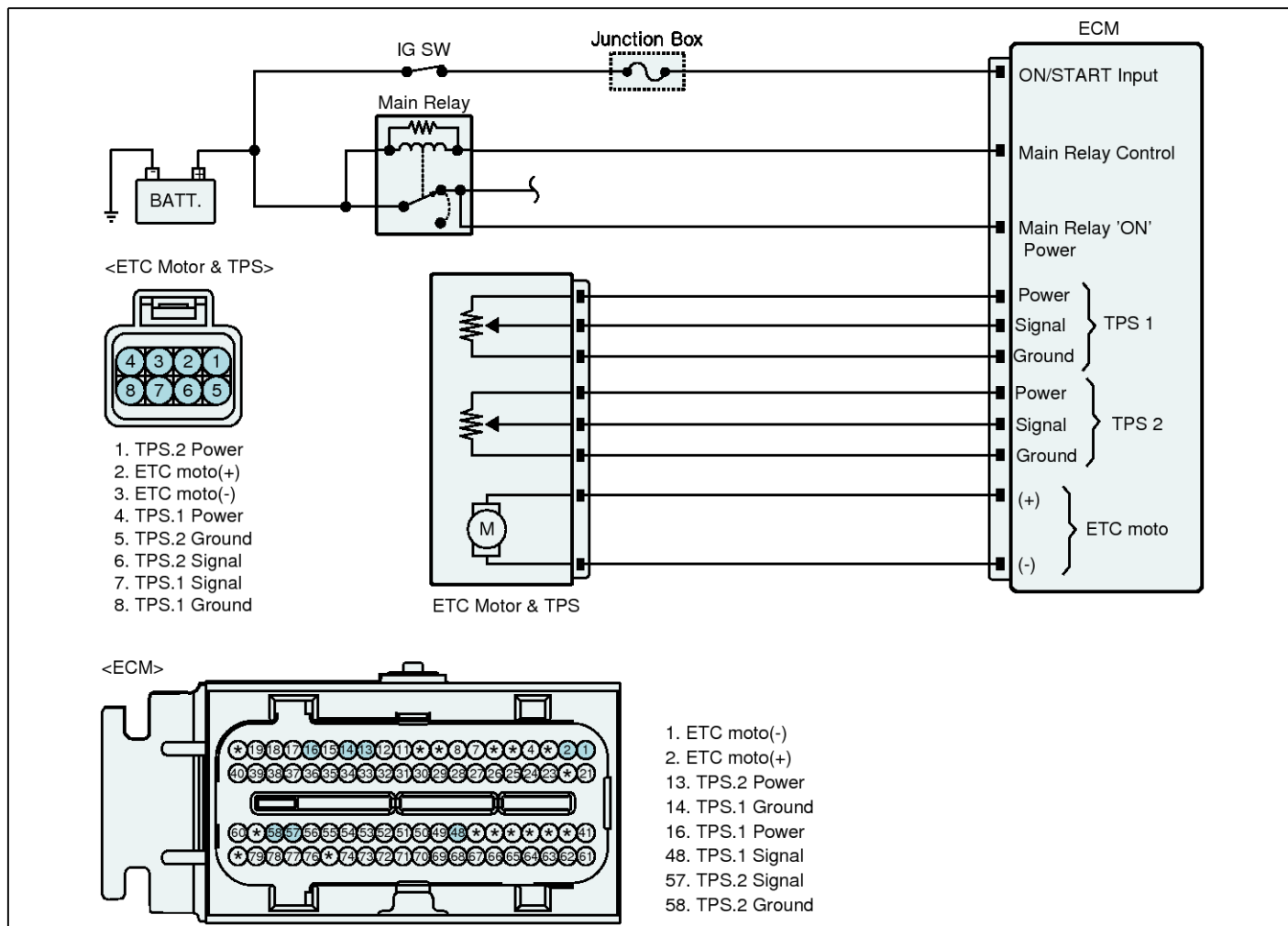
Specification

Throttle Opening (°)	Output Voltage (V) [Vref=5.0]	
	TPS1	TPS2
0°	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	0.0V

Diagnostic Circuit Diagram

FL-388

Fuel System



SBHFL9516L

Signal Waveform & Data

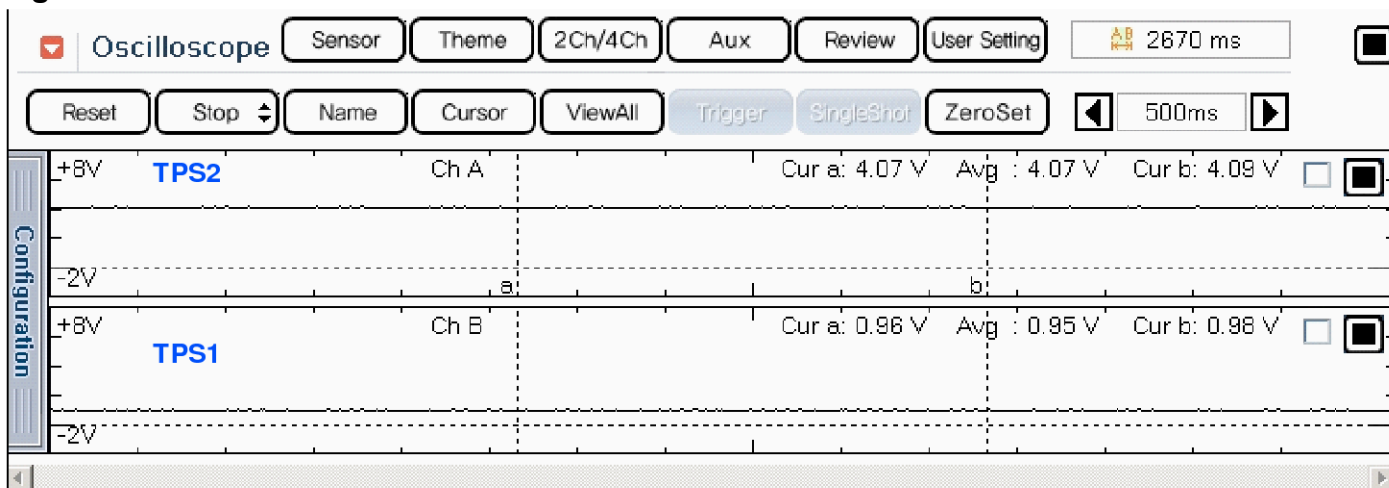


Fig.1

SBHFL9634L

Engine Control System

FL-389

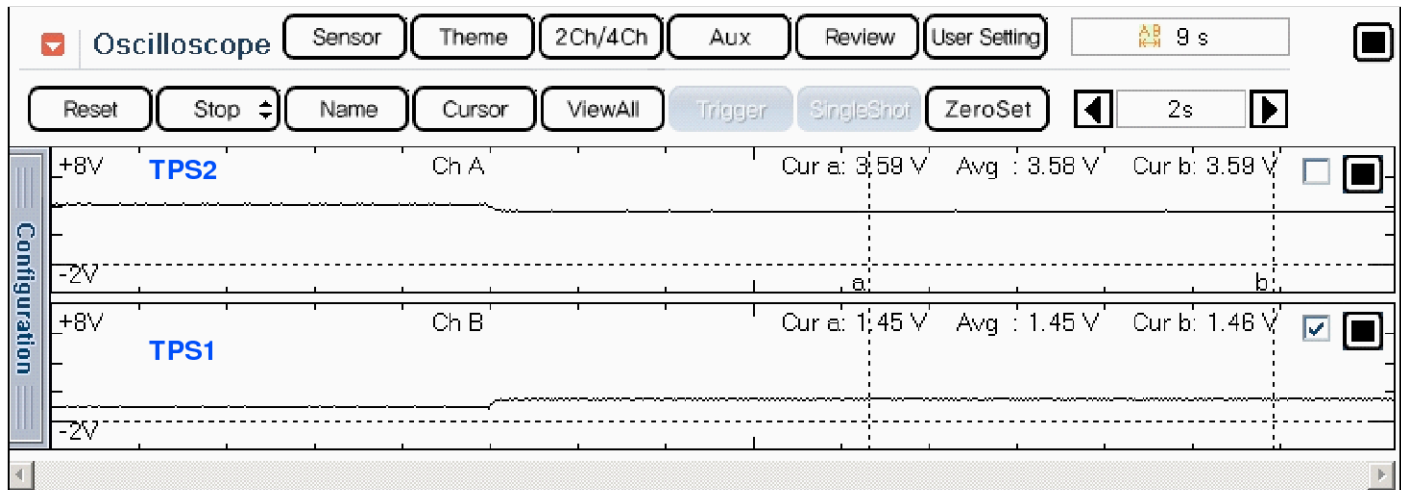


Fig.2

SBHFL9635L

Sensor Name	Value	Unit
☒ ETC Throttle Position	4.1	DEG
☒ Throttle Position1 Duty	5.1	DEG
☒ Throttle Position2 Duty	5.2	DEG
☒ Throttle Position1 Voltage	0.7	V
☒ Throttle Position2 Voltage	4.3	V
☒ ETC Motor Duty	-12	%

Fig.3

SBHFL9636L

Sensor Name	Value	Unit
☒ Engine Speed	0	RPM
☒ ETC Throttle Position	9.9	DEG
☒ Throttle Position1 Duty	130.1	DEG
☒ Throttle Position2 Duty	132.0	DEG
☒ Throttle Position1 Voltage	4.9	V
☒ Throttle Position2 Voltage	0.1	V

Fig.4

SBHFL9637L

Sensor Name	Value	Unit
☒ Throttle Position1 Duty	5.2	DEG
☒ Throttle Position2 Duty	133.5	DEG
☒ Throttle Position1 Voltage	0.7	V
☒ Throttle Position2 Voltage	0.0	V
☒ Engine Speed	640	RPM

Fig.5

SBHFL9645L

Fig 1) Normal waveform of TPS1 & TPS2 with no accel pedal depressed under IG ON condition

Fig 2) Normal waveform of TPS1 & TPS2 with accel pedal depressed under IG ON condition

FL-390

Fuel System

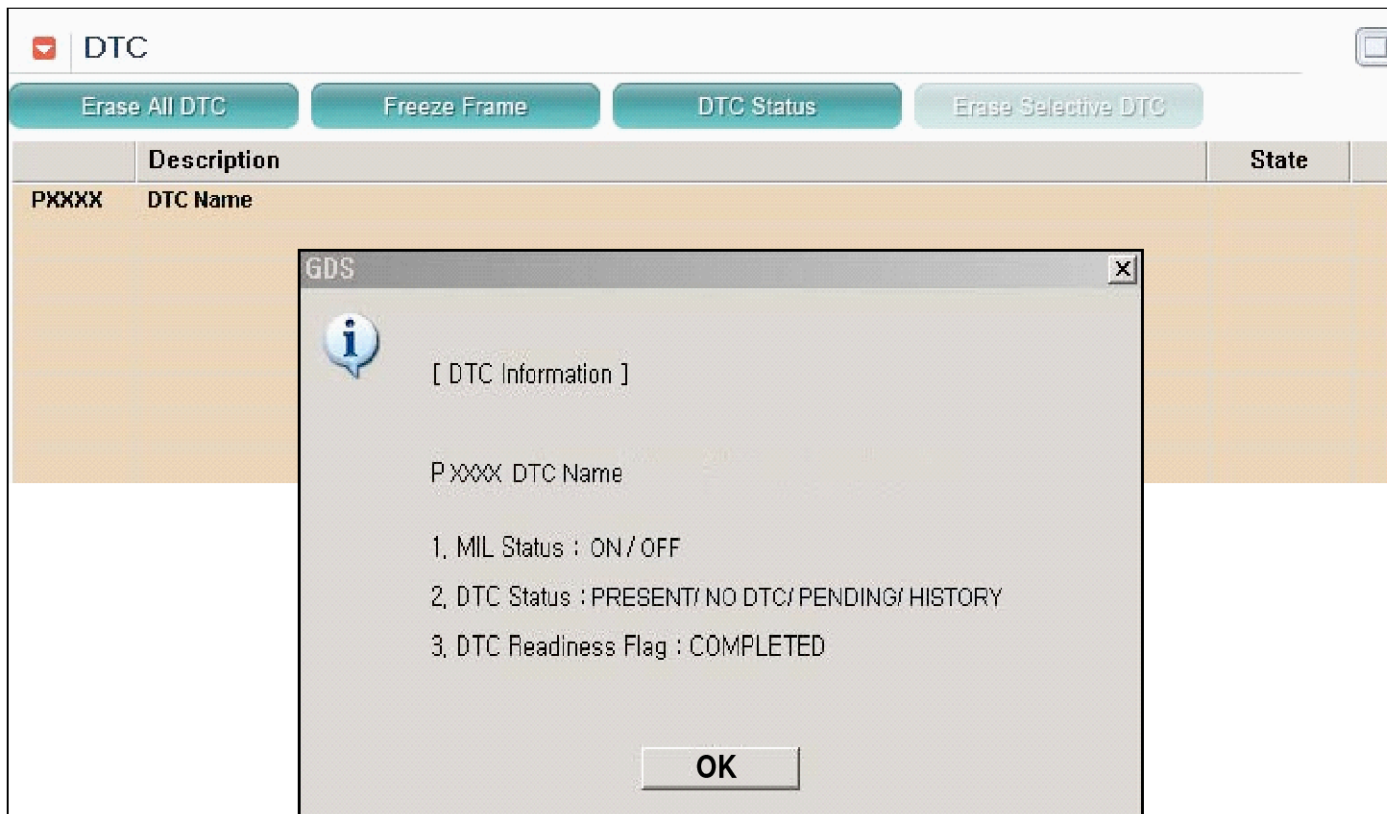
Fig 3) Normal data of TPS1 & TPS2 under IG ON condition

Fig 4) Normal data of TPS1 & TPS2 under open condition

Fig 5) Normal data of TPS1 & TPS2 under short to ground in TSP2 circuit

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination,

deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Power Circuit Inspection" procedure.

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect ETC Motor & TPS connector.
2. IG "ON".
3. Measure voltage between TPS2 power terminal of ETC Motor & TPS harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

Engine Control System

FL-391

YES ► Go to "Signal circuit inspection" procedure.

NO ► Repair open or short to ground in power harness, and go to "Verification of Vehicle Repair" procedure.

Signal Circuit Inspection

■ Check short to ground in harness

1. IG "OFF" and disconnect ETC Motor & TPS connector and ECM connector.
2. Measure resistance between TPS2 signal terminal of ETC Motor & TPS harness connector and chassis ground.(Measurement "A")

FL-392

Fuel System

3. Measure resistance between TPS2 signal and TPS1(2) ground terminals of ETC Motor & TPS harness connector.(Measurement "B")

Specification : Infinite

4. Is the measured resistance within specification ?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect ETC Motor & TPS connector and ECM connector.
2. Measure resistance between TPS2 signal terminal of ETC Motor & TPS harness connector and TPS2 signal terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification ?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check TPS resistance

1. IG "OFF" and disconnect ETC Motor & TPS connector.
2. Measure resistance between TPS2 power and TPS2 ground terminals of ETC Motor & TPS connector.(component side)

Specification : 4 ~ 6kΩ

3. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good ECT motor & TPS and check for proper operation. If the problem is corrected, replace ECT motor & TPS and go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will take 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-393

P0223 Throttle/Pedal Position Sensor/Switch "B" Circuit High Input

Component Location

Refer to DTC P0222 : Throttle/Pedal Position Sensor/Switch "B" Circuit Low Input

General Description

Refer to DTC P0222 : Throttle/Pedal Position Sensor/Switch "B" Circuit Low Input

DTC Description

Checking output signals from TPS2 every 8.5 sec. under detecting condition, if an output signal is above 4.75V for more than 0.1 sec., ECM sets P0223. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Signal high	• Poor connection • Short to battery in signal harness • Open in ground harness • TPS • ECM
Enable Conditions	• IG "ON"	
Threshold value	• The voltage of TPS > 4.75V	
Diagnosis Time	• Continuous (more than 0.1 sec. failure for every 8.5 sec .test)	
MIL On Condition	• 1 driving cycles	

Specification

Refer to DTC P0222 : Throttle/Pedal Position Sensor/Switch "B" Circuit Low Input

Diagnostic Circuit Diagram

Refer to DTC P0222 : Throttle/Pedal Position Sensor/Switch "B" Circuit Low Input

Signal Waveform & Data

Refer to DTC P0222 : Throttle/Pedal Position Sensor/Switch "B" Circuit Low Input

Monitor Scantool Data

Refer to DTC P0222 : Throttle/Pedal Position Sensor/Switch "B" Circuit Low Input

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Signal Circuit Inspection " procedure .

Signal Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect ETC Motor & TPS connector.
2. IG "ON".
3. Measure voltage between TPS2 signal terminal of ETC Motor & TPS harness connector and chassis ground.

Specification : Approx. 0V

4. Is the measured voltage within specification ?

YES ► Go to "Ground Circuit Inspection" procedure.

NO ► Go to "Check short to battery in harness" as follows.

■ Check short to battery in harness

1. IG "OFF" and disconnect ETC Motor & TPS connector and ECM connector.
2. Measure resistance between TPS2 signal and TPS1 power terminals of ETC Motor & TPS harness connector.(Measurement "A")
3. Measure resistance between TPS2 signal and TPS2 power terminals of ETC Motor & TPS harness connector.(Measurement "A")
4. Measure resistance between TPS2 signal and ETC motor(+) terminals of ETC Motor & TPS harness connector.(Measurement "B")

FL-394

Fuel System

5. Measure resistance between TPS2 signal and ETC motor(-) terminals of ETC Motor & TPS harness connector.(Measurement "B")

Specification : Infinite

6. Is the measured resistance within specification ?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

Ground Circuit Inspection

■ Check open in harness

1. IG "OFF" and disconnect ECTS connector and then IG "ON".
2. Measure voltage between TPS2 power terminal of ETC Motor & TPS harness connector and chassis ground.(Measurement "A")
3. Measure voltage between TPS2 power and TPS2 ground terminals of ETC Motor & TPS harness connector.(Measurement "B")

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair contact resistance or open in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check TPS resistance

1. IG "OFF" and disconnect ETC Motor & TPS connector.
2. Measure resistance between TPS2 power and TPS2 ground terminals of ETC Motor & TPS connector.(component side)

Specification : 4 ~ 6kΩ

3. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good ECT motor & TPS and check for proper operation. If the problem is corrected, replace ECT motor & TPS and go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will take 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

Verification of Vehicle Repair

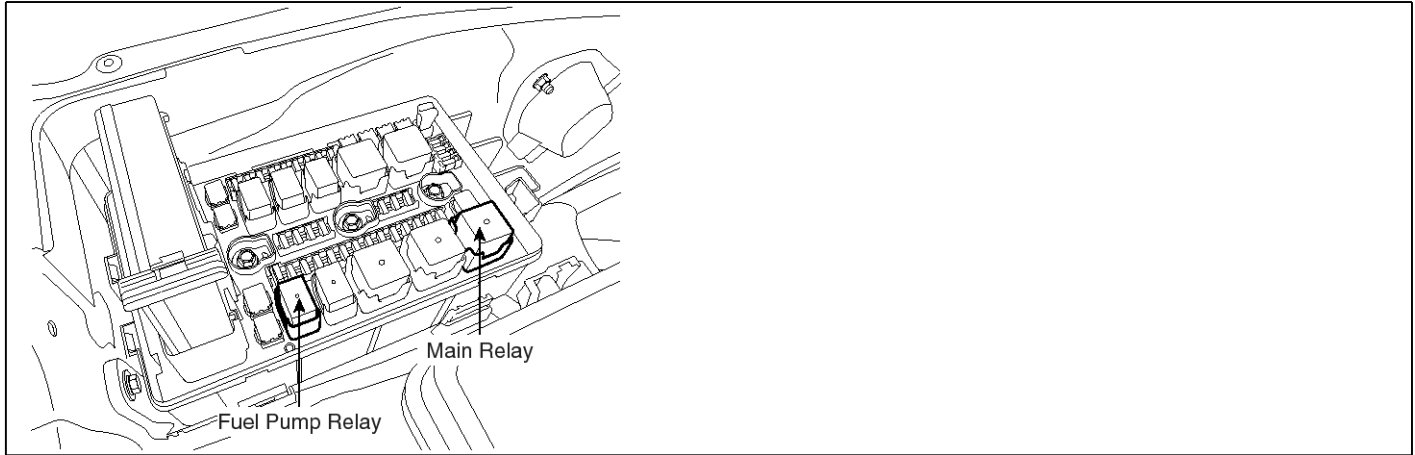
Refer to DTC P0222 : Throttle/Pedal Position Sensor/Switch "B" Circuit Low Input

Engine Control System

FL-395

P0230 Fuel Pump Primary Circuit

Component Location



SBHFL9323L

General Description

The ECM provides ground to one side of the coil in the fuel pump relay to control the fuel pump relay. The other side of the fuel pump relay coil is connected to main relay, which activates when the ignition switch is ON. The ECM monitors the control circuit between the fuel pump relay and the ECM. When the ignition switch is turned ON, the ECM energizes the fuel pump relay, which sends power to the fuel pump.

DTC Description

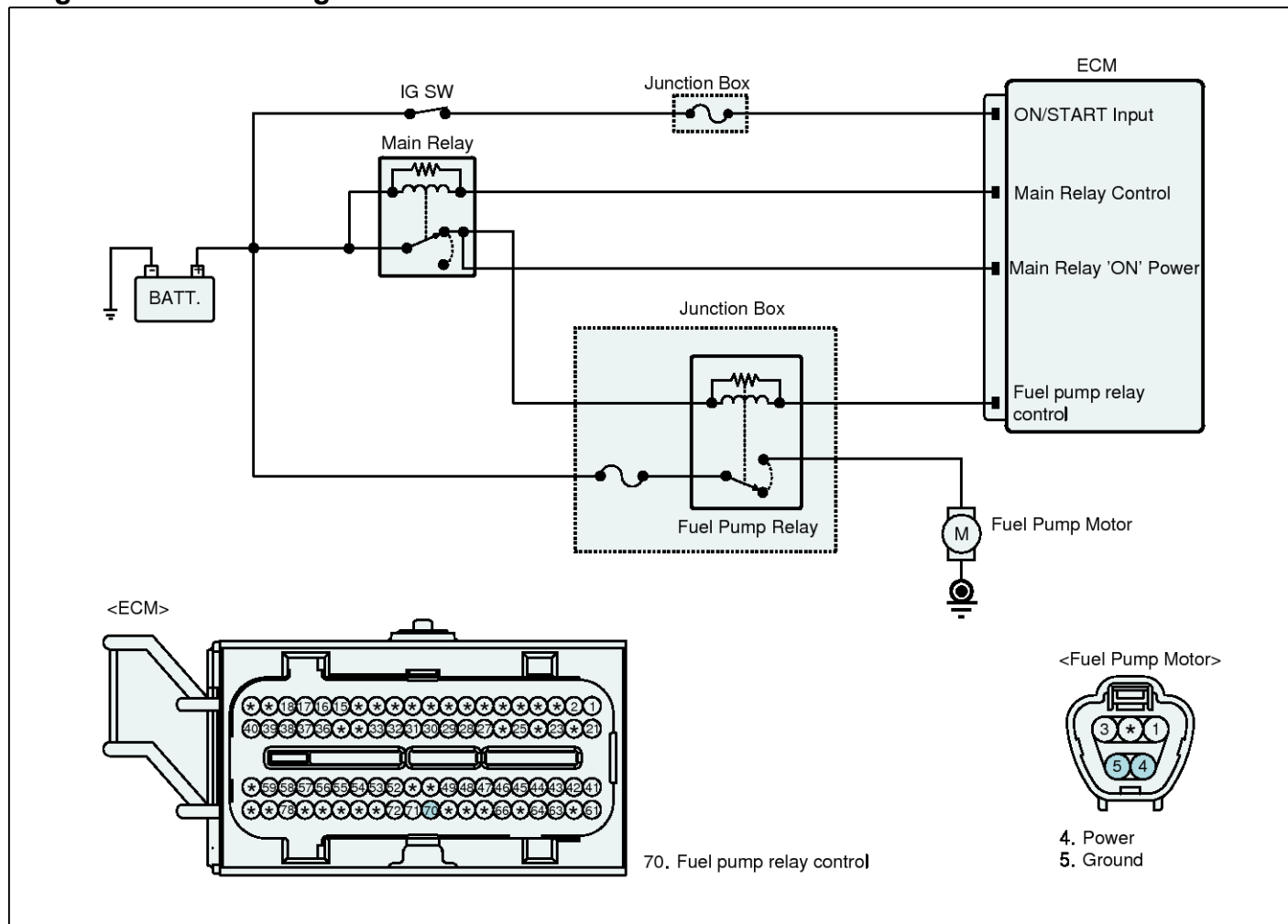
Checking fuel pump relay circuit continuously under detecting condition, if open or short in the circuit is detected ECM sets P0230.

※ In addition, Take note that open circuit in Main Relay may cause this P0230 code.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Signal Low or High	• Poor connection • Open or short in fuel pump relay circuit • Open in Main Relay circuit • Fuel Pump Relay • ECM
Enable Conditions	• $11V \leq \text{Battery Voltage} \leq 16V$	
Threshold value	• Open or short	
Diagnosis Time	• Continuous (more than 5 sec. failure for every 10 sec. test)	
MIL On Condition	• NO MIL ON(DTC only)	

Diagnostic Circuit Diagram



SBHFL9518L

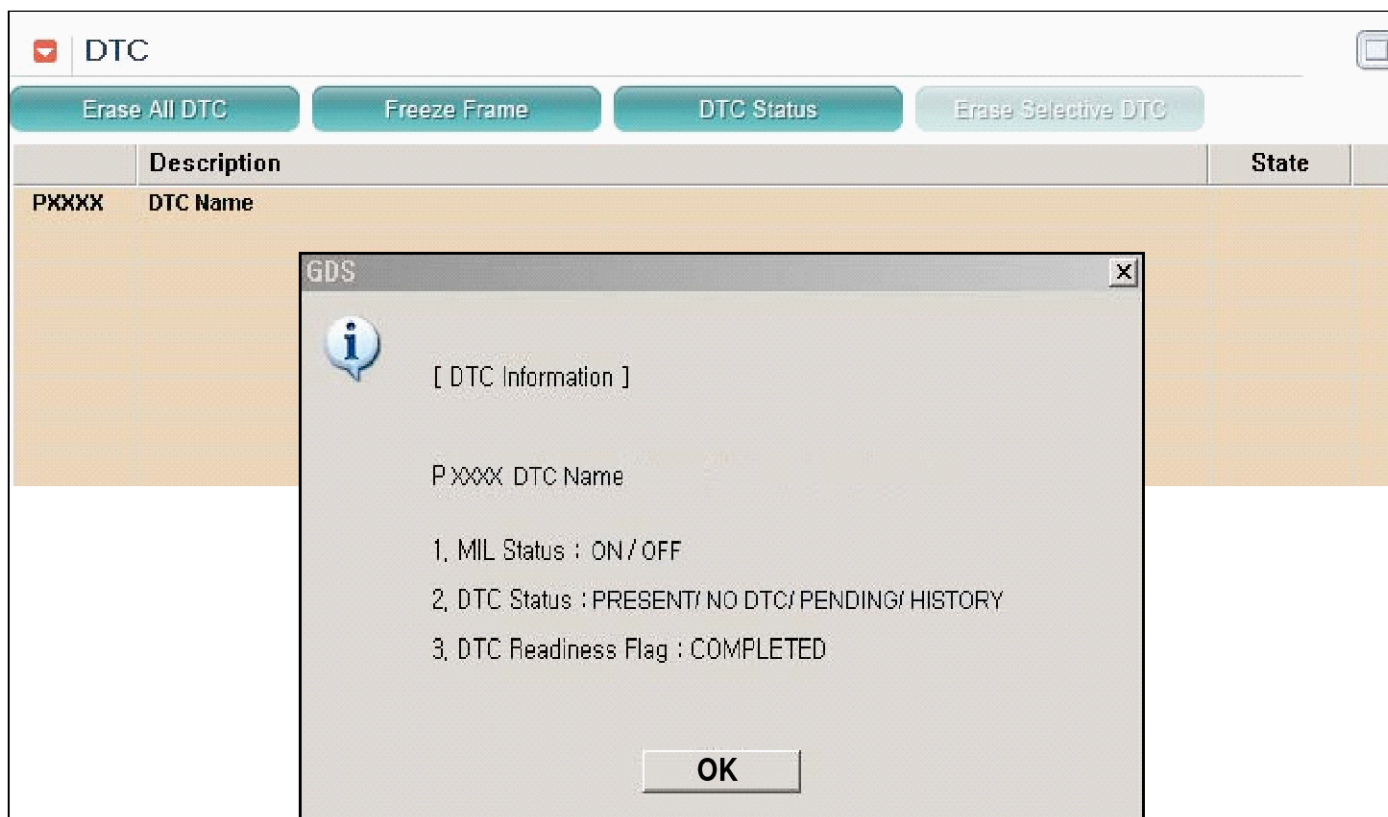
Engine Control System

FL-397

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Power Circuit Inspection " procedure .

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect fuel pump relay connector.
2. IG "ON".
3. Measure voltage between battery power supply terminals of fuel pump relay harness and chassis ground.

Specification : Approx. B+

FL-398

Fuel System

4. Is the measured voltage within specification ?

YES ▶ Go to "Signal circuit inspection" procedure.

NO ▶ Check "Fuse" between fuel pump relay and main relay is not installed or blown off.
▶ Check "Fuse" between fuel pump relay and battery is not installed or blown off.
▶ Check the Main relay that is not installed or blown off.
▶ Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

Control Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect fuel pump relay connector.
2. IG "ON".
3. Measure voltage between fuel pump relay control terminal of Fuel pump relay harness and chassis ground.

Specification : Approx. 2.5V

4. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check fuel pump relay

1. IG "OFF" and disconnect Fuel Pump Relay connector.
2. Measure resistance between battery power supply and power supply to fuel pump motor terminals of fuel pump relay. (Measurement "A")
3. Measure resistance between battery power supply and fuel pump relay control terminals of fuel pump relay. (Measurement "B")

Specification :

Terminal	Continuity
Battery power supply - Power supply to Fuel pump motor	NO
Battery power supply - Fuel pump relay control	YES(Approx. 70Ω ~ 120Ω)

4. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good Fuel Pump Relay and check for proper operation. If the problem is corrected, replace Fuel Pump Relay and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

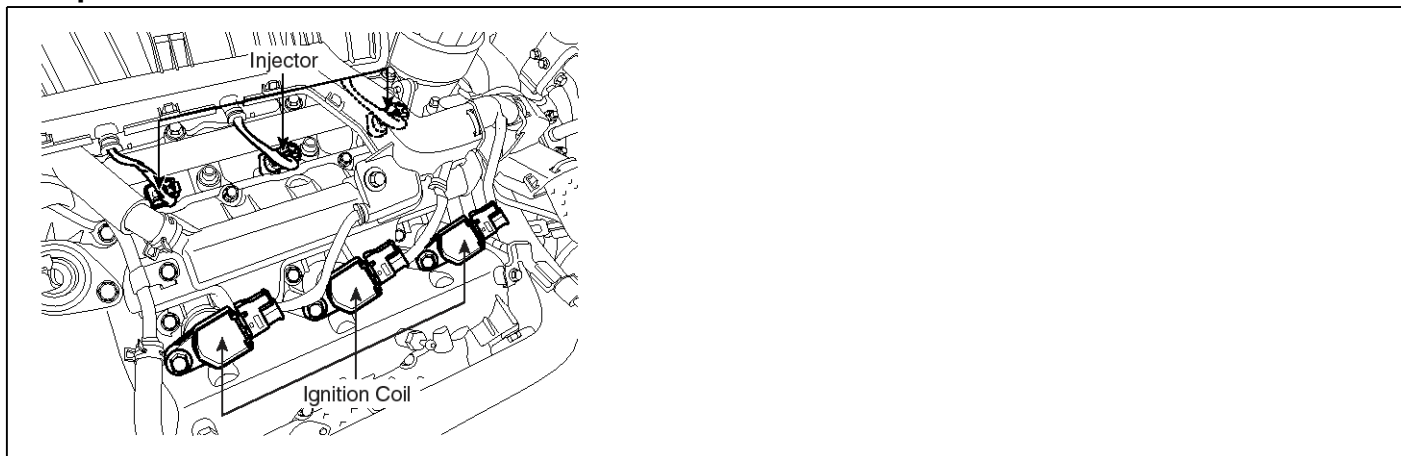
NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-399

P0261 Cylinder 1 Injector Circuit Low

Component Location



SBHFL9318L

General Description

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

DTC Description

Checking output signals from injectors. Under detecting condition, if an output signal is low, ECM sets P0261. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

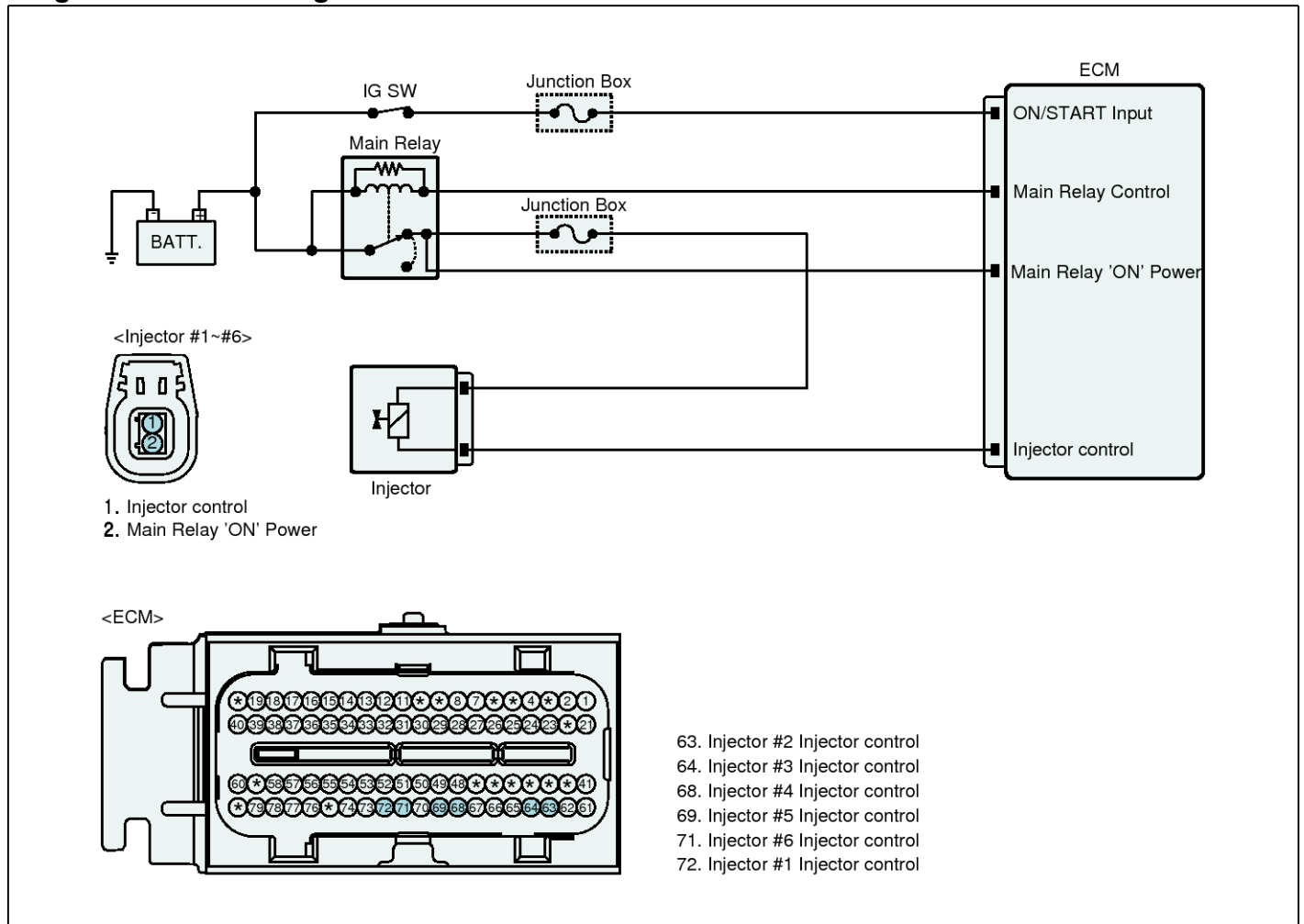
DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal Low	- Poor connection - Open or short to ground in power harness - Open or short to ground in control harness - Injector - ECM
Enable Conditions	- Engine running state $11V \leq \text{Battery voltage} \leq 16V$ - Above conditions are met $> 0.5\text{sec.}$	
Threshold value	Open or short to ground	
Diagnosis Time	Continuous (more than 5 sec. failure for every 10 sec.test)	
MIL On Condition	2 Driving Cycles	

Specification

Item	Coil resistance(Ω)
Injector	11.4 ~ 12.6 Ω (at 20°C/ 68°F)

Diagnostic Circuit Diagram



SBHFL9519L

Signal Waveform & Data

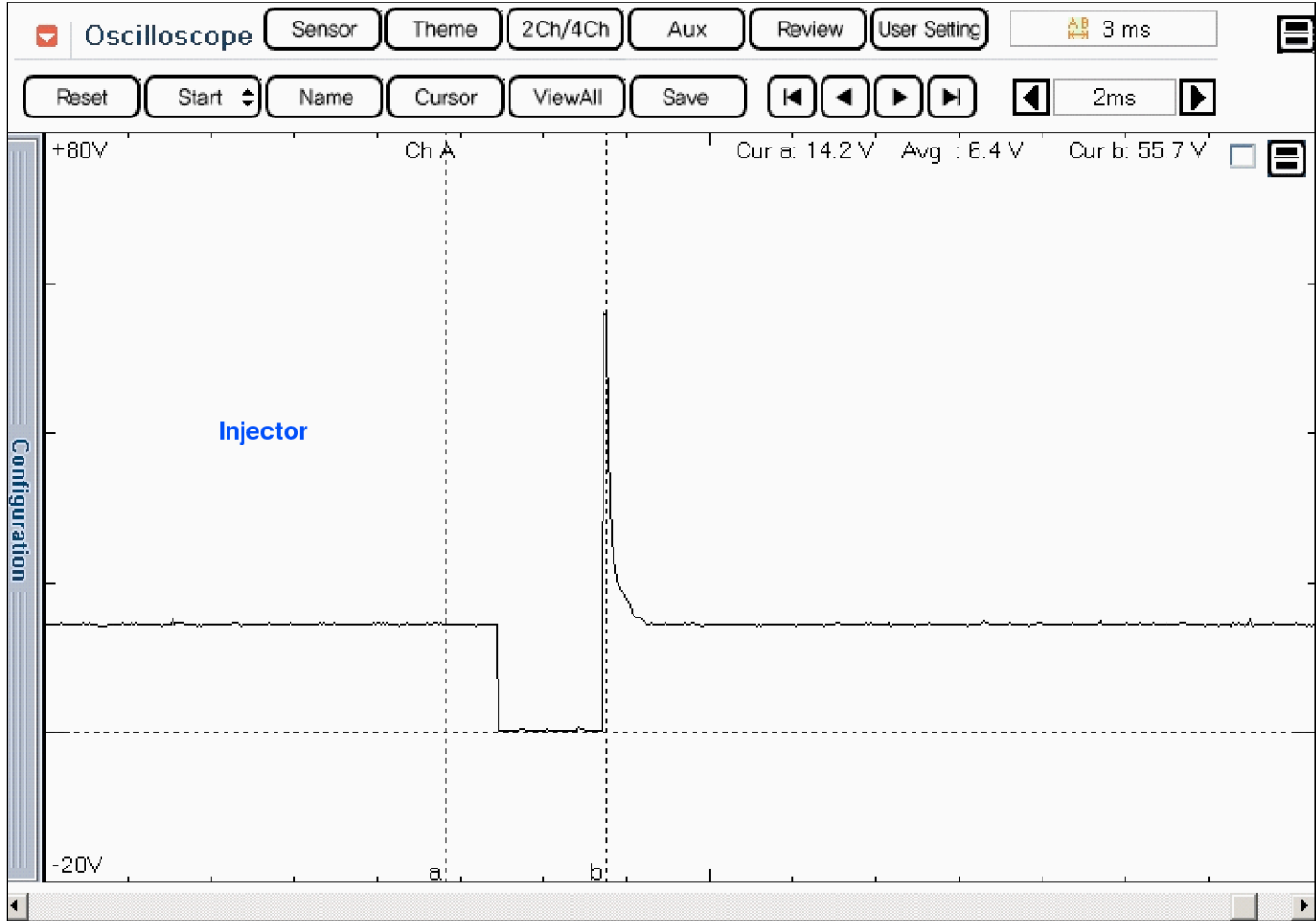


Fig.1

SBHFL9646L

Current Data			
Standard Display	Full List	Graph	Items List
Reset Min.Max.	Record	Stop	VSS
Sensor Name	Value	Unit	
☒ Cylinder 1 Injection Time	0.8	mS	
☒ Cylinder 2 Injection Time	0.8	mS	
☒ Cylinder 3 Injection Time	0.8	mS	
☒ Cylinder 4 Injection Time	0.8	mS	
☒ Cylinder 5 Injection Time	0.8	mS	
☒ Cylinder 6 Injection Time	0.8	mS	

Fig.2

SBHFL9647L

FL-402

Fuel System

Sensor Name	Value	Unit
☒ Cylinder 1 Injection Time	1.6	mS
☒ Cylinder 2 Injection Time	0.0	mS
☒ Cylinder 3 Injection Time	1.6	mS
☒ Cylinder 4 Injection Time	1.6	mS
☒ Cylinder 5 Injection Time	1.6	mS
☒ Cylinder 6 Injection Time	1.6	mS

Fig.3

SBHFL9648L

Fig 1) Normal waveforms of Injector under idle condition.

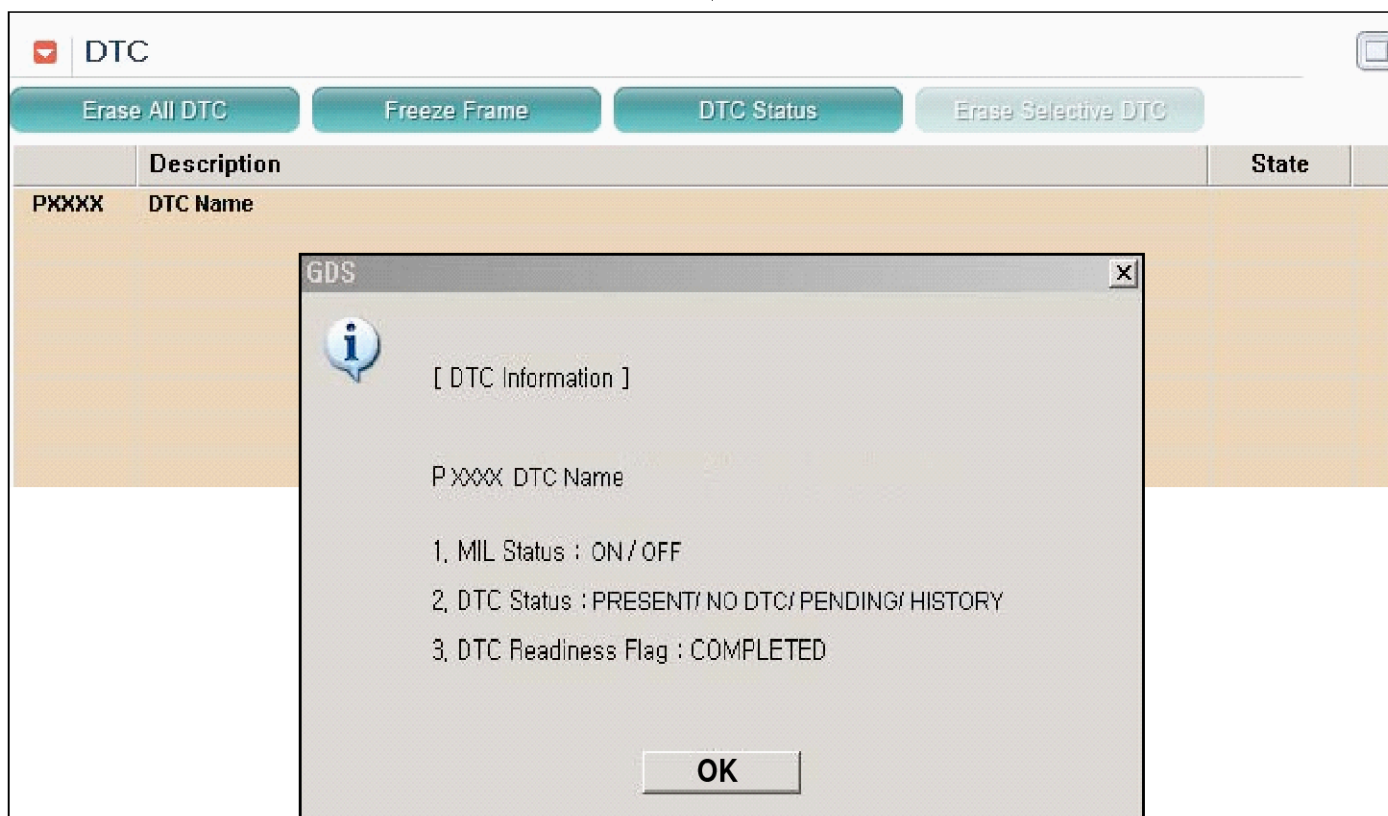
Fig 2) Normal data of Injector at idle.

Fig 3) Abnormal data of Injector when cylinder 2 injector open.

When the ECM energizes the injector by grounding control circuit, the circuit voltage should be low (theoretically 0V) and the fuel is injected. When the ECM de-energizes the injector by opening control circuit, the fuel injector is closed and circuit voltage should be peak at a moment.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

Engine Control System

FL-403

5. Is parameter displayed "Present fault"?

YES ▶ Go to "Terminal and Connector inspection" procedure.

NO ▶ Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Power Circuit Inspection" procedure.

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect injector connector.
2. IG "ON".
3. Measure voltage between power terminal of injector harness connector and chassis ground.

Specification : Approx. B+

4. Is the measured voltage within specification ?

YES ▶ Go to "Control Circuit Inspection" procedure.

NO ▶ Check open or connection of the fuse connected to injector power supply.
▶ Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

Control Circuit Inspection

■ Check short to ground in harness

1. IG "OFF" and disconnect injector connector and ECM connector.

2. Measure resistance between injector control terminal of injector harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification ?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect injector connector and ECM connector.
2. Measure resistance between injector control terminal of injector harness connector and injector control terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check injector

1. IG "OFF" and disconnect injector connector.
2. Measure resistance between power and control terminals of injector connector.(Component side)

Specification : 11.4 ~ 12.6Ω (at 20°C/ 68°F)

3. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good Fuel Pump Relay and check for proper operation. If the problem is corrected, replace Fuel Pump Relay and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-405

P0262 Cylinder 1 Injector Circuit High

Component Location

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

General Description

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

DTC Description

Checking output signals from injectors. Under detecting condition, if an output signal is high, ECM sets P0262. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal High	- Poor connection - Short to battery in harness - Injector - ECM
Enable Conditions	- Engine running state $11V \leq \text{Battery voltage} \leq 16V$ - Above conditions are met $> 0.5\text{sec.}$	
Threshold value	Short to battery	
Diagnosis Time	Continuous (more than 5 sec. failure for every 10 sec. test)	
MIL On Condition	2 Driving Cycles	

Specification

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Diagnostic Circuit Diagram

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Signal Waveform & Data

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Monitor Scantool Data

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Control Circuit Inspection " procedure.

Control Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect injector connector.
- IG "ON".

- Measure voltage between injector control terminal of injector harness connector and chassis ground.

Specification : Approx. 0V

- Is the measured voltage within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Go to "Check short to battery in harness" as follows.

■ Check short to battery in harness

- IG "OFF" and disconnect injector connector and ECM connector.
- Measure resistance between power and control terminals of injector harness connector.

Specification : Infinite

- Is the measured resistance within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check injector

- IG "OFF" and disconnect injector connector.
- Measure resistance between power and control terminals of injector connector.(Component side)

Specification : $11.4 \sim 12.6\Omega$ (at $20^{\circ}\text{C} / 68^{\circ}\text{F}$)

3. Is the measured resistance within specification ?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

 NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Substitute with a known - good Fuel Pump Relay and check for proper operation. If the problem is corrected, replace Fuel Pump Relay and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Engine Control System

FL-407

P0264 Cylinder 2 Injector Circuit Low

Component Location

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

General Description

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

DTC Description

Checking output signals from injectors. under detecting condition, if an output signal is low, ECM sets P0264. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal Low	- Poor connection - Open or short to ground in power harness - Open or short to ground in control harness - Injector - ECM
Enable Conditions	- Engine running state $11V \leq \text{Battery voltage} \leq 16V$ - Above conditions are met $> 0.5\text{sec.}$	
Threshold value	Open or short to ground	
Diagnosis Time	Continuous (more than 5 sec. failure for every 10 sec. test)	
MIL On Condition	2 Driving Cycles	

Specification

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Diagnostic Circuit Diagram

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Signal Waveform & Data

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Monitor Scantool Data

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Power Circuit Inspection " procedure .

Power Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect injector connector.
- IG "ON".

- Measure voltage between power terminal of injector harness connector and chassis ground.

Specification : Approx. B+

- Is the measured voltage within specification ?

YES ▶ Go to "Control Circuit Inspection" procedure.

NO ▶ Check open or connection of the fuse connected to injector power supply.
▶ Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

Control Circuit Inspection

■ Check short to ground in harness

- IG "OFF" and disconnect injector connector and ECM connector.
- Measure resistance between injector control terminal of injector harness connector and chassis ground.

Specification : Infinite

- Is the measured resistance within specification ?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

FL-408

Fuel System

■ Check open in harness

1. IG "OFF" and disconnect injector connector and ECM connector.
2. Measure resistance between injector control terminal of injector harness connector and injector control terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check injector

1. IG "OFF" and disconnect injector connector.
2. Measure resistance between power and control terminals of injector connector.(Component side)

Specification : 11.4 ~ 12.6Ω (at 20°C/ 68°F)

3. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good Fuel Pump Relay and check for proper operation. If the problem is corrected, replace Fuel Pump Relay and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Engine Control System

FL-409

P0265 Cylinder 2 Injector Circuit High

Component Location

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

General Description

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

DTC Description

Checking output signals from injectors. Under detecting condition, if an output signal is high, ECM sets P0265. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal High	- Poor connection - Short to battery in harness - Injector - ECM
Enable Conditions	- Engine running state $11V \leq \text{Battery voltage} \leq 16V$ - Above conditions are met $> 0.5\text{sec.}$	
Threshold value	Short to battery	
Diagnosis Time	Continuous (more than 5 sec. failure for every 10 sec. test)	
MIL On Condition	2 Driving Cycles	

Specification

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Diagnostic Circuit Diagram

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Signal Waveform & Data

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Monitor Scantool Data

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Control Circuit Inspection " procedure.

Control Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect injector connector.
- IG "ON".
- Measure voltage between injector control terminal of injector harness connector and chassis ground.

Specification : Approx. 0V

- Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Go to "Check short to battery in harness" as follows.

■ Check short to battery in harness

- IG "OFF" and disconnect injector connector and ECM connector.
- Measure resistance between power and control terminals of injector harness connector.

Specification : Infinite

- Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

FL-410

Fuel System

Component Inspection

■ Check injector

1. IG "OFF" and disconnect injector connector.
2. Measure resistance between power and control terminals of injector connector.(Component side)

Specification : 11.4 ~ 12.6Ω (at 20°C/ 68°F)

3. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good Fuel Pump Relay and check for proper operation. If the problem is corrected, replace Fuel Pump Relay and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Engine Control System

FL-411

P0267 Cylinder 3 Injector Circuit Low

Component Location

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

General Description

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

DTC Description

Checking output signals from injectors. Under detecting condition, if an output signal is low, ECM sets P0267. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal Low	- Poor connection - Open or short to ground in power harness - Open or short to ground in control harness - Injector - ECM
Enable Conditions	- Engine running state $11V \leq \text{Battery voltage} \leq 16V$ - Above conditions are met $> 0.5\text{sec.}$	
Threshold value	Open or short to ground	
Diagnosis Time	Continuous (more than 5 sec. failure for every 10 sec. test)	
MIL On Condition	2 Driving Cycles	

Specification

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Diagnostic Circuit Diagram

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Signal Waveform & Data

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Monitor Scantool Data

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Power Circuit Inspection " procedure .

Power Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect injector connector.
- IG "ON".

- Measure voltage between power terminal of injector harness connector and chassis ground.

Specification : Approx. B+

- Is the measured voltage within specification ?

YES ▶ Go to "Control Circuit Inspection" procedure.

NO ▶ Check open or connection of the fuse connected to injector power supply.
▶ Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

Control Circuit Inspection

■ Check short to ground in harness

- IG "OFF" and disconnect injector connector and ECM connector.
- Measure resistance between injector control terminal of injector harness connector and chassis ground.

Specification : Infinite

- Is the measured resistance within specification ?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

FL-412

Fuel System

■ Check open in harness

1. IG "OFF" and disconnect injector connector and ECM connector.
2. Measure resistance between injector control terminal of injector harness connector and injector control terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check injector

1. IG "OFF" and disconnect injector connector.
2. Measure resistance between power and control terminals of injector connector.(Component side)

Specification : 11.4 ~ 12.6Ω (at 20°C/ 68°F)

3. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good Fuel Pump Relay and check for proper operation. If the problem is corrected, replace Fuel Pump Relay and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Engine Control System

FL-413

P0268 Cylinder 3 Injector Circuit High

Component Location

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

General Description

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

DTC Description

Checking output signals from injectors. Under detecting condition, if an output signal is high, ECM sets P0268. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal High	- Poor connection - Short to battery in harness - Injector - ECM
Enable Conditions	- Engine running state $11V \leq \text{Battery voltage} \leq 16V$ - Above conditions are met $> 0.5\text{sec.}$	
Threshold value	Short to battery	
Diagnosis Time	Continuous (more than 5 sec. failure for every 10 sec.t-est)	
MIL On Condition	2 Driving Cycles	

Specification

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Diagnostic Circuit Diagram

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Signal Waveform & Data

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Monitor Scantool Data

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Control Circuit Inspection " procedur-e.

Control Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect injector connector.
- IG "ON".
- Measure voltage between injector control terminal of injector harness connector and chassis ground.

Specification : Approx. 0V

- Is the measured voltage within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Go to "Check short to battery in harness" as follows.

■ Check short to battery in harness

- IG "OFF" and disconnect injector connector and ECM connector.
- Measure resistance between power and control terminals of injector harness connector.

Specification : Infinite

- Is the measured resistance within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check injector

1. IG "OFF" and disconnect injector connector.
2. Measure resistance between power and control terminals of injector connector.(Component side)

Specification : 11.4 ~ 12.6Ω (at 20°C/ 68°F)

3. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good Fuel Pump Relay and check for proper operation. If the problem is corrected, replace Fuel Pump Relay and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Engine Control System

FL-415

P0270 Cylinder 4 Injector Circuit Low

Component Location

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

General Description

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

DTC Description

Checking output signals from injectors. Under detecting condition, if an output signal is low, ECM sets P0270. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal Low	- Poor connection - Open or short to ground in power harness - Open or short to ground in control harness - Injector - ECM
Enable Conditions	- Engine running state $11V \leq \text{Battery voltage} \leq 16V$ - Above conditions are met $> 0.5\text{sec.}$	
Threshold value	Open or short to ground	
Diagnosis Time	Continuous (more than 5 sec. failure for every 10 sec. test)	
MIL On Condition	2 Driving Cycles	

Specification

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Diagnostic Circuit Diagram

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Signal Waveform & Data

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Monitor Scantool Data

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Power Circuit Inspection " procedure .

Power Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect injector connector.
- IG "ON".

- Measure voltage between power terminal of injector harness connector and chassis ground.

Specification : Approx. B+

- Is the measured voltage within specification ?

YES ▶ Go to "Control Circuit Inspection" procedure.

NO ▶ Check open or connection of the fuse connected to injector power supply.
▶ Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

Control Circuit Inspection

■ Check short to ground in harness

- IG "OFF" and disconnect injector connector and ECM connector.
- Measure resistance between injector control terminal of injector harness connector and chassis ground.

Specification : Infinite

- Is the measured resistance within specification ?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

FL-416

Fuel System

■ Check open in harness

1. IG "OFF" and disconnect injector connector and ECM connector.
2. Measure resistance between injector control terminal of injector harness connector and injector control terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check injector

1. IG "OFF" and disconnect injector connector.
2. Measure resistance between power and control terminals of injector connector.(Component side)

Specification : 11.4 ~ 12.6Ω (at 20°C/ 68°F)

3. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good Fuel Pump Relay and check for proper operation. If the problem is corrected, replace Fuel Pump Relay and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Engine Control System

FL-417

P0271 Cylinder 4 Injector Circuit High

Component Location

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

General Description

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

DTC Description

Checking output signals from injectors every 10 sec. under detecting condition, if an output signal is high for more than 5 sec., ECM sets P0271. MIL (Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Signal High	• Poor connection • Short to battery in harness • Injector • ECM
Enable Conditions	• Engine running state • $11V \leq \text{Battery voltage} \leq 16V$ • Above conditions are met $> 0.5\text{sec.}$	
Threshold value	• Short to battery	
Diagnosis Time	• Continuous (more than 5 sec. failure for every 10 sec. test)	
MIL On Condition	• 2 Driving Cycles	

Specification

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Diagnostic Circuit Diagram

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Signal Waveform & Data

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Monitor Scantool Data

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Control Circuit Inspection " procedure.

Control Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect injector connector.
2. IG "ON".
3. Measure voltage between injector control terminal of injector harness connector and chassis ground.

Specification : Approx. 0V

4. Is the measured voltage within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Go to "Check short to battery in harness" as follows.

■ Check short to battery in harness

1. IG "OFF" and disconnect injector connector and ECM connector.
2. Measure resistance between power and control terminals of injector harness connector.

Specification : Infinite

3. Is the measured resistance within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

FL-418

Fuel System

Component Inspection

■ Check injector

1. IG "OFF" and disconnect injector connector.
2. Measure resistance between power and control terminals of injector connector.(Component side)

Specification : 11.4 ~ 12.6Ω (at 20°C/ 68°F)

3. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good Fuel Pump Relay and check for proper operation. If the problem is corrected, replace Fuel Pump Relay and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Engine Control System

FL-419

P0273 Cylinder 5 Injector Circuit Low

Component Location

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

General Description

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

DTC Description

Checking output signals from injectors. Under detecting condition, if an output signal is low, ECM sets P0273. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal Low	- Poor connection - Open or short to ground in power harness - Open or short to ground in control harness - Injector - ECM
Enable Conditions	- Engine running state $11V \leq \text{Battery voltage} \leq 16V$ - Above conditions are met $> 0.5\text{sec.}$	
Threshold value	Open or short to ground	
Diagnosis Time	Continuous (more than 5 sec. failure for every 10 sec. test)	
MIL On Condition	2 Driving Cycles	

Specification

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Diagnostic Circuit Diagram

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Signal Waveform & Data

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Monitor Scantool Data

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Power Circuit Inspection " procedure .

Power Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect injector connector.
- IG "ON".

- Measure voltage between power terminal of injector harness connector and chassis ground.

Specification : Approx. B+

- Is the measured voltage within specification ?

YES ▶ Go to "Control Circuit Inspection" procedure.

NO ▶ Check open or connection of the fuse connected to injector power supply.
▶ Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

Control Circuit Inspection

■ Check short to ground in harness

- IG "OFF" and disconnect injector connector and ECM connector.
- Measure resistance between injector control terminal of injector harness connector and chassis ground.

Specification : Infinite

- Is the measured resistance within specification ?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

FL-420

Fuel System

■ Check open in harness

1. IG "OFF" and disconnect injector connector and ECM connector.
2. Measure resistance between injector control terminal of injector harness connector and injector control terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check injector

1. IG "OFF" and disconnect injector connector.
2. Measure resistance between power and control terminals of injector connector.(Component side)

Specification : 11.4 ~ 12.6Ω (at 20°C/ 68°F)

3. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good Fuel Pump Relay and check for proper operation. If the problem is corrected, replace Fuel Pump Relay and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Engine Control System

FL-421

P0274 Cylinder 5 Injector Circuit High

Component Location

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

General Description

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

DTC Description

Checking output signals from injectors. Under detecting condition, if an output signal is high, ECM sets P0274. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal High	- Poor connection - Short to battery in harness - Injector - ECM
Enable Conditions	- Engine running state $11V \leq \text{Battery voltage} \leq 16V$ - Above conditions are met $> 0.5\text{sec.}$	
Threshold value	Short to battery	
Diagnosis Time	Continuous (more than 5 sec. failure for every 10 sec.t-test)	
MIL On Condition	2 Driving Cycles	

Specification

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Diagnostic Circuit Diagram

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Signal Waveform & Data

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Monitor Scantool Data

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Control Circuit Inspection " procedure.

Control Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect injector connector.
- IG "ON".

- Measure voltage between injector control terminal of injector harness connector and chassis ground.

Specification : Approx. 0V

- Is the measured voltage within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Go to "Check short to battery in harness" as follows.

■ Check short to battery in harness

- IG "OFF" and disconnect injector connector and ECM connector.
- Measure resistance between power and control terminals of injector harness connector.

Specification : Infinite

- Is the measured resistance within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check injector

- IG "OFF" and disconnect injector connector.
- Measure resistance between power and control terminals of injector connector.(Component side)

Specification : $11.4 \sim 12.6\Omega$ (at $20^{\circ}\text{C} / 68^{\circ}\text{F}$)

3. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

 NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good Fuel Pump Relay and check for proper operation. If the problem is corrected, replace Fuel Pump Relay and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Engine Control System

FL-423

P0276 Cylinder 6 Injector Circuit Low

Component Location

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

General Description

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

DTC Description

Checking output signals from injectors. Under detecting condition, if an output signal is low, ECM sets P0276. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal Low	- Poor connection - Open or short to ground in power harness - Open or short to ground in control harness - Injector - ECM
Enable Conditions	- Engine running state $11V \leq \text{Battery voltage} \leq 16V$ - Above conditions are met $> 0.5\text{sec.}$	
Threshold value	Open or short to ground	
Diagnosis Time	Continuous (more than 5 sec. failure for every 10 sec. test)	
MIL On Condition	2 Driving Cycles	

Specification

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Diagnostic Circuit Diagram

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Signal Waveform & Data

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Monitor Scantool Data

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Power Circuit Inspection " procedure .

Power Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect injector connector.
- IG "ON".

- Measure voltage between power terminal of injector harness connector and chassis ground.

Specification : Approx. B+

- Is the measured voltage within specification ?

YES ▶ Go to "Control Circuit Inspection" procedure.

NO ▶ Check open or connection of the fuse connected to injector power supply.
▶ Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

Control Circuit Inspection

■ Check short to ground in harness

- IG "OFF" and disconnect injector connector and ECM connector.
- Measure resistance between injector control terminal of injector harness connector and chassis ground.

Specification : Infinite

- Is the measured resistance within specification ?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

FL-424

Fuel System

■ Check open in harness

1. IG "OFF" and disconnect injector connector and ECM connector.
2. Measure resistance between injector control terminal of injector harness connector and injector control terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check injector

1. IG "OFF" and disconnect injector connector.
2. Measure resistance between power and control terminals of injector connector.(Component side)

Specification : 11.4 ~ 12.6Ω (at 20°C/ 68°F)

3. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good Fuel Pump Relay and check for proper operation. If the problem is corrected, replace Fuel Pump Relay and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Engine Control System

FL-425

P0277 Cylinder 6 Injector Circuit High

Component Location

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

General Description

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

DTC Description

Checking output signals from injectors. Under detecting condition, if an output signal is high, ECM sets P0277. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal High	- Poor connection - Short to battery in harness - Injector - ECM
Enable Conditions	- Engine running state $11V \leq \text{Battery voltage} \leq 16V$ - Above conditions are met $> 0.5\text{sec.}$	
Threshold value	Short to battery	
Diagnosis Time	Continuous (more than 5 sec. failure for every 10 sec.t-test)	
MIL On Condition	2 Driving Cycles	

Specification

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Diagnostic Circuit Diagram

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Signal Waveform & Data

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Monitor Scantool Data

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Control Circuit Inspection " procedure.

Control Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect injector connector.
- IG "ON".

- Measure voltage between injector control terminal of injector harness connector and chassis ground.

Specification : Approx. 0V

- Is the measured voltage within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Go to "Check short to battery in harness" as follows.

■ Check short to battery in harness

- IG "OFF" and disconnect injector connector and ECM connector.
- Measure resistance between power and control terminals of injector harness connector.

Specification : Infinite

- Is the measured resistance within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check injector

- IG "OFF" and disconnect injector connector.
- Measure resistance between power and control terminals of injector connector.(Component side)

Specification : $11.4 \sim 12.6\Omega$ (at $20^{\circ}\text{C} / 68^{\circ}\text{F}$)

3. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

 NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good Fuel Pump Relay and check for proper operation. If the problem is corrected, replace Fuel Pump Relay and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0261 : Cylinder 1 Injector Circuit Low

Engine Control System

FL-427

P0300 Random/Multiple Cylinder Misfire Detected

General Description

Misfires can be caused by lack of combustion in a cylinder due to absence of spark, poor fuel metering, poor compression, or many other causes. Even a small number of misfires may result in excessive exhaust emissions due to the unburned mixture. Increased misfire rates cause damage to the catalytic converter. The ECM monitors the crankshaft speed variation to determine if any misfiring generated. The ECM identifies the specific cylinder in which the misfire has occurred and counts individual misfire events by monitoring changes in the crankshaft rotation for each cylinder. A random misfire indicates two or more cylinders are misfiring.

DTC Description

The ECM measures reference event times and calculates the positive and negative acceleration of the crank wheel to determine whether a misfire has occurred.

When the rate of misfire exceeds a threshold where the catalyst reaches a temperature where permanent damage can occur, to the point that tail pipe emissions reach 1.5 times the tailpipe standard or where a cylinder misfire cause a loss of torque produced from that cylinder.

ECM sets this DTC. In case that misfire affects Catalyst damage, MIL (Malfunction Indicator Lamp) will be illuminating and blinking at 1HZ frequency. However, In case of Individual and Emission damaging misfire, MIL will be turned on when the malfunction is detected.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		Determine if a multiple cylinder misfire or a cylinder specific misfire is occurring by monitoring crankshaft acceleration.	- Faulty Spark plugs - Faulty Spark plug cables - Air Leakage - Belt deflection and Air gap of CKPS - Incorrect timing - Faulty injector - Improper fuel pressure - Improper engine compression
Enable Conditions		No disabling faults present / no disabling Active Faults - P0340 / P0341 / P0118 / P0117 / P0115 / P0336 / P0335 / P1295 / P0103 / P0102 / P0108 / P0107 / P0106 / P0501 - Engine speed between 550 and 5800 RPM - System voltage between 9 and 18 volts - The ECT indicates an engine temperature between -6 °C (20 °F) and 120 °C (248 °F)	
Threshold value	Case 1	Individual cylinder misfire detection	
	Case 2	Emissions damaging - 18 times in 600 ignitions (In case that the misfire affects more than 1.5 times than FTP emissions)	
	Case 3	Catalyst damaging - 95 times in 600 ignitions at idle (It is going to be changeable according to the load or the temperature which is not in the range where it does not melt catalyst)	
Diagnosis Time		Continuous	
MIL On Condition		2 Driving Cycles	

FL-428

Fuel System

Signal Waveform & Data

Current Data		
Standard Display	Full List	Graph
Items List	Reset Min.Max.	Record
Stop	VSS	
Sensor Name	Value	Unit
☐ Misfire Cycle Delay Reason	No Delay	-
☒ Cylinder 1 Misfire Counter	0	-
☒ Cylinder 2 Misfire Counter	0	-
☒ Cylinder 3 Misfire Counter	0	-
☒ Cylinder 4 Misfire Counter	0	-
☒ Cylinder 5 Misfire Counter	0	-
☒ Cylinder 6 Misfire Counter	0	-
☒ Total Misfire Counts	0	-

Fig.1

SBHFL9649L

Sensor Name	Value	Unit
☐ Misfire Cycle Delay Reason	No Delay	-
☐ Cylinder 1 Misfire Counter	19	-
☐ Cylinder 2 Misfire Counter	50	-
☐ Cylinder 3 Misfire Counter	2	-
☐ Cylinder 4 Misfire Counter	0	-
☐ Cylinder 5 Misfire Counter	0	-
☐ Cylinder 6 Misfire Counter	0	-

DTC		
Erase All DTC	Freeze Frame	DTC Status
Erase Selective DTC		
	Description	State
P0264	Cylinder 2 Injector Circuit Low	
P0302	Cylinder 2-Misfire detected	

Fig.2

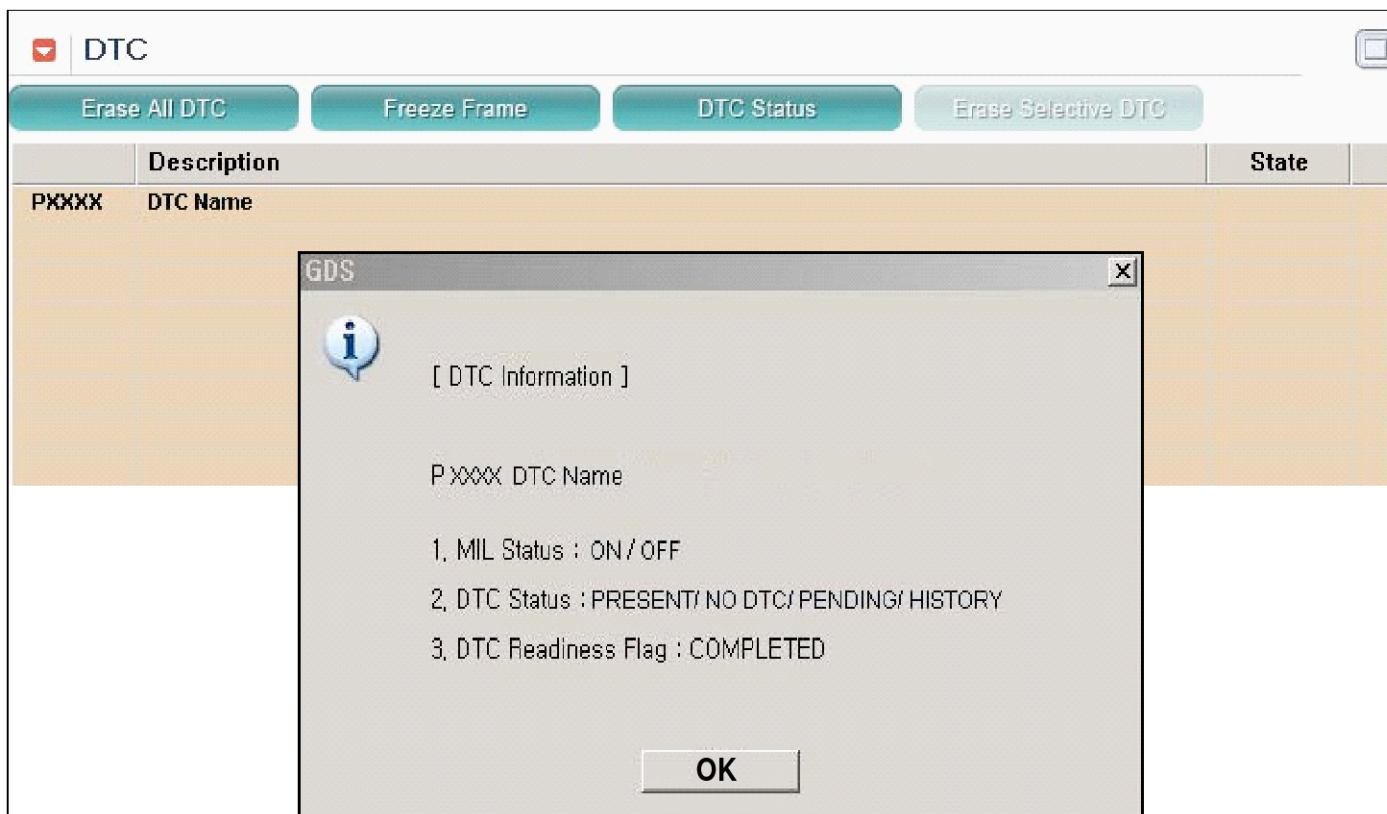
SBHFL9650L

Fig 1) Normal data of misfire counter at idle.

Fig 2) Abnormal data of misfire counter when cylinder 2 injector open.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ▶ Go to "System Inspection" procedure.

NO ▶ Although the misfire does not occur when the vehicle is brought to workshop, misfire can be reproduced when the condition is met. Drive the vehicle according to the freeze frame data in order to satisfy the condition.

System Inspection

■ Check Spark Plug

1. Remove cylinder's spark plugs
2. Visually/physically inspect the following items:
 - ▶ Damaged insulation, Worn electrodes, Oil or fuel fouled, Loose terminals and cracks
 - ▶ Check for plug gap : 1.0 - 1.1 mm (0.039 - 0.043 in.)
 - ▶ Check if the spark plug for the relevant cylinder is lighter in color than the other plugs.

3. Has a problem been found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check Air Leakage " as below.

■ Check Air Leakage

1. Visually/physically inspect the air leakage in intake/exhaust system as following items,
 - ▶ Vacuum hoses for splits, kinks and improper connections.
 - ▶ Throttle body gasket
 - ▶ Gasket between intake manifold and cylinder head
 - ▶ Seals between intake manifold and fuel injectors
 - ▶ Exhaust system between HO2S and Three way catalyst for air leakage
2. Has a problem been found in any of the above areas?
 - YES** ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.
 - NO** ▶ Go to "Check for air leakage in Positive Crankcase Ventilation Valve(PCV).

FL-430

Fuel System

■ Check for air leakage in Positive Crankcase Ventilation Valve(PCV)

1. Remove PCV valve from cylinder head cover by pulling ventilation hose.
2. With engine idling block PCV valve opening.
3. Verify that vacuum is felt.
4. Remove PCV valve.
5. Blow through valve from port "A" and verify that air comes out of port "B".
6. Blow through valve from port "B" and verify that no air comes out of port "A".
7. Has a problem been found in any of the above areas?

YES ► Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Check Compression pressure" as below.

■ Check Compression pressure

1. Warm up the engine to normal operating temperature.
2. Disconnect the spark plug cables and remove the spark plugs.
3. Crank the engine to remove any foreign material in the cylinders.

4. Put compression pressure gauge into spark plug hole.

5. Crank the engine with widely open throttle valve and check compression pressure at each cylinder.

Specification : 1323kPa(13.5 kg/cm²,192 psi)

6. Is compression pressure for each cylinder displayed within specifications ?

YES ► Go to "Check Timing " as below.

NO ► Add a small amount of oil through the spark plug hole, and repeat above steps. If the addition of oil causes the compression to rise, the cause is a worn or damaged piston ring or cylinder inner surface.

► If the compression remains the same, the cause is a burnt or defective valve seat, or pressure is leaking from the gasket. Repair as necessary and go to "Verification of Vehicle Repair" procedure

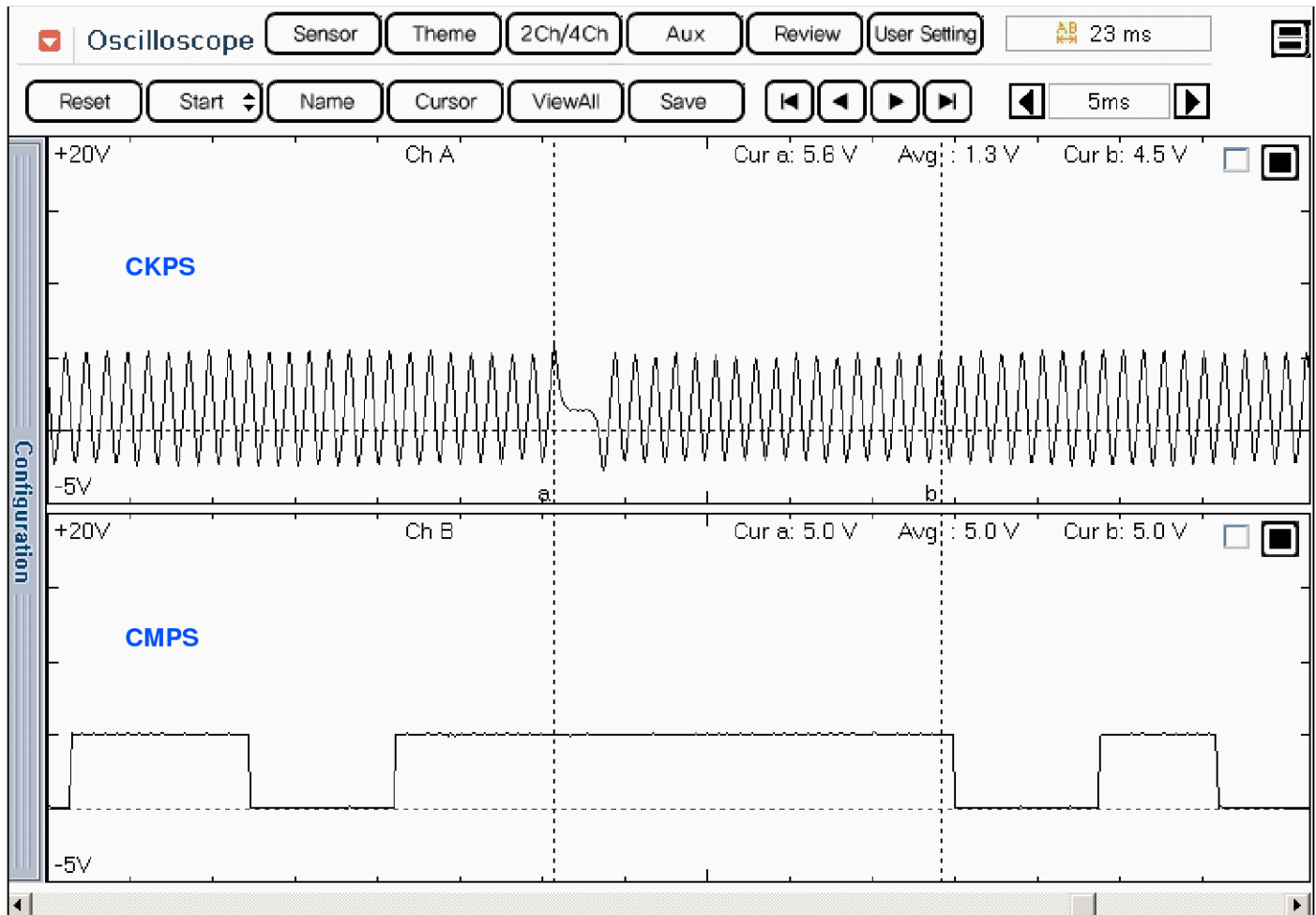
■ Check Timing

1. IG "OFF"
2. Monitor these signal waveforms from CAM and Crank shaft position Sensor are correctly aligned.

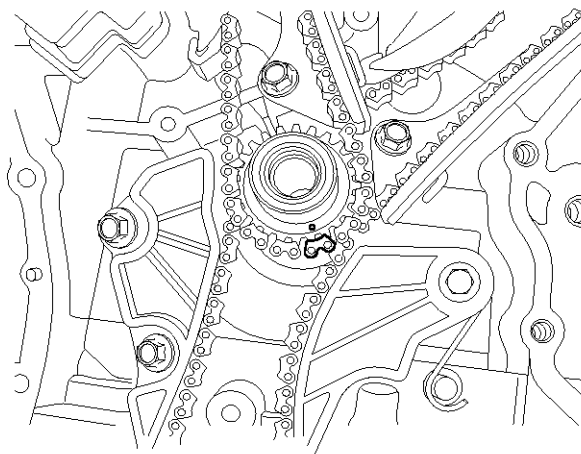
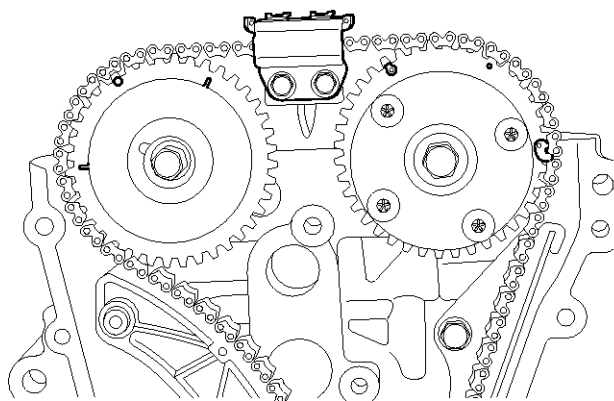
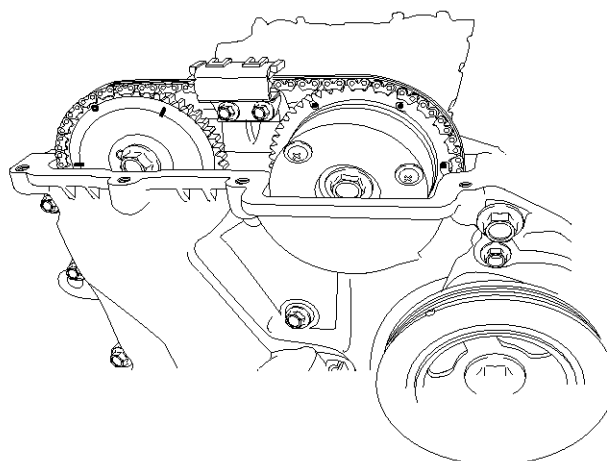
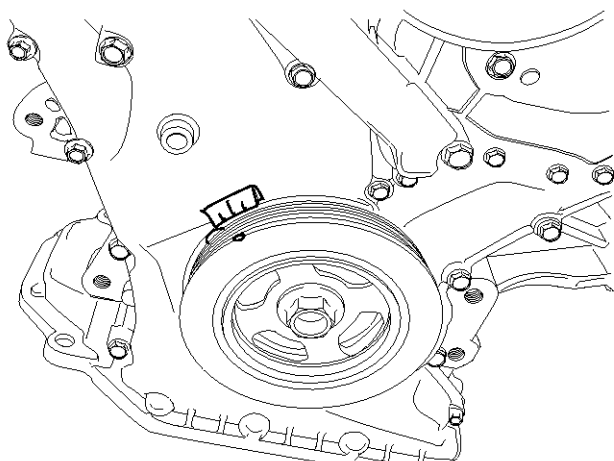
Reference : The 17th of CKP signal from missing tooth is aligned with high of CMP signal.

Engine Control System

FL-431



SBHFL9651L



SBHFL9614L

3. Are all timing marks aligned correctly ?

YES ► Go to "Check Fuel Pressure " as below.

NO ► Check that Cam, Crank and Oil pump sprocket timing marks are correctly aligned. Repair or readjust as necessary and go to "Verification of Vehicle Repair" procedure.

■ Check fuel pressure

📖 NOTICE

1. Be cautious that Fuel is explosive and an empty fuel tank can still contain explosive gases. When working on fuel system make sure to supply adequate ventilation to the work area. Do not smoke, and keep sparks and open flames away.

2. The fuel system remains under pressure when the engine is not running. Release fuel system pressure before disconnecting any fuel line to reduce the chance of personal injury or fire damage to vehicle components.

1. IG "OFF" and disconnect Fuel Pump Relay in Junction Box.
2. Start-up and wait until it stops itself.
3. IG "OFF" and connect Fuel Pump Relay.
4. Install the fuel pressure gauge to the delivery pipe with the fuel pressure gauge adaptor.
5. Activate the fuel pump, and with fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.
6. Measure the fuel pressure at idle.

Specification : 374.6 ~ 384.4 kPa(3.82 ~ 3.92 kg/cm², 54.3 ~ 55.8 psi)

Engine Control System

FL-433

7. Is the measured fuel pressure within specifications ?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Repair or replace according to the below table. And then, go to " Verification of Vehicle Repair" procedure.

Condition	Possible Cause
Fuel Pressure is too low	Fuel filter, fuel pressure regulator, in-tank fuel hose or the fuel pump
Fuel Pressure is too high	Fuel pressure regulator, hose or pipe

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

FL-434

Fuel System

P0301 Cylinder 1-Misfire detected

General Description

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

DTC Description

The ECM measures reference event times and calculates the positive and negative acceleration of the crank wheel to determine whether a misfire has occurred.

When the rate of misfire exceeds a threshold where the catalyst reaches a temperature where permanent damage can occur, to the point that tail pipe emissions reach 1.5 times the tailpipe standard or where a cylinder misfire cause a loss of torque produced from that cylinder.

ECM sets this DTC. In case that misfire affects Catalyst damage, MIL (Malfunction Indicator Lamp) will be illuminating and blinking at 1HZ frequency. However, In case of Individual and Emission damaging misfire, MIL will be turned on when the malfunction is detected.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		Determine if a multiple cylinder misfire or a cylinder specific misfire is occurring by monitoring crankshaft acceleration.	- Faulty Spark plugs - Faulty Spark plug cables - Air Leakage - Belt deflection and Air gap of CKPS - Incorrect timing - Faulty injector - Improper fuel pressure - Improper engine compression
Enable Conditions		No disabling faults present / no disabling Active Faults - P0340 / P0341 / P0118 / P0117 / P0115 / P0336 / P0335 / P1295 / P0103 / P0102 / P0108 / P0107 / P0106 / P0501 - Engine speed between 550 and 5800 RPM - System voltage between 9 and 18 volts - The ECT indicates an engine temperature between -6 °C (20 °F) and 120 °C (248 °F)	
Threshold value	Case 1	Individual cylinder misfire detection	
	Case 2	Emissions damaging - 18 times in 600 ignitions (In case that the misfire affects more than 1.5 times than FTP emissions)	
	Case 3	Catalyst damaging - 95 times in 600 ignitions at idle (It is going to be changeable according to the load or the temperature which is not in the range where it does not melt catalyst)	
Diagnosis Time		Continuous	
MIL On Condition		2 Driving Cycles	

Signal Waveform & Data

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

Monitor Scantool Data

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

Engine Control System

FL-435

System Inspection

■ Check Spark Pulg

1. Remove cylinder's spark plugs
2. Visually/physically inspect the following items:
 - ▶ Damaged insulation, Worn electrodes, Oil or fuel fouled, Loose terminals and cracks
 - ▶ Check for plug gap : 1.0 - 1.1 mm (0.039 - 0.043 in.)
 - ▶ Check if the spark plug for the relevant cylinder is lighter in color than the other plugs.
3. Has a problem been found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check Air Leakage " as below.

■ Check Air Leakage

1. Visually/physically inspect the air leakage in intake/exhaust system as following items,
 - ▶ Vacuum hoses for splits, kinks and improper connections.
 - ▶ Throttle body gasket
 - ▶ Gasket between intake manifold and cylinder head
 - ▶ Seals between intake manifold and fuel injectors
 - ▶ Exhaust system between HO2S and Three way catalyst for air leakage
2. Has a problem been found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check for air leakage in Positive Crankcase Ventilation Valve(PCV).

■ Check for air leakage in Positive Crankcase Ventilation Valve(PCV)

1. Remove PCV valve from cylinder head cover by pulling ventilation hose.
2. With engine idling block PCV valve opening.
3. Verify that vacuum is felt.
4. Remove PCV valve.
5. Blow through valve from port "A" and verify that air comes out of port "B".
6. Blow through valve from port "B" and verify that no air comes out of port "A".

7. Has a problem been found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check Compression pressure" as below.

■ Check Compression pressure

1. Warm up the engine to normal operating temperature.
2. Disconnect the spark plug cables and remove the spark plugs.
3. Crank the engine to remove any foreign material in the cylinders.
4. Put compression pressure gauge into spark plug hole.
5. Crank the engine with widely open throttle valve and check compression pressure at each cylinder.

Specification : 1323kPa(13.5 kg/cm²,192 psi)

6. Is compression pressure for each cylinder displayed within specifications ?

YES ▶ Go to "Check Timing " as below.

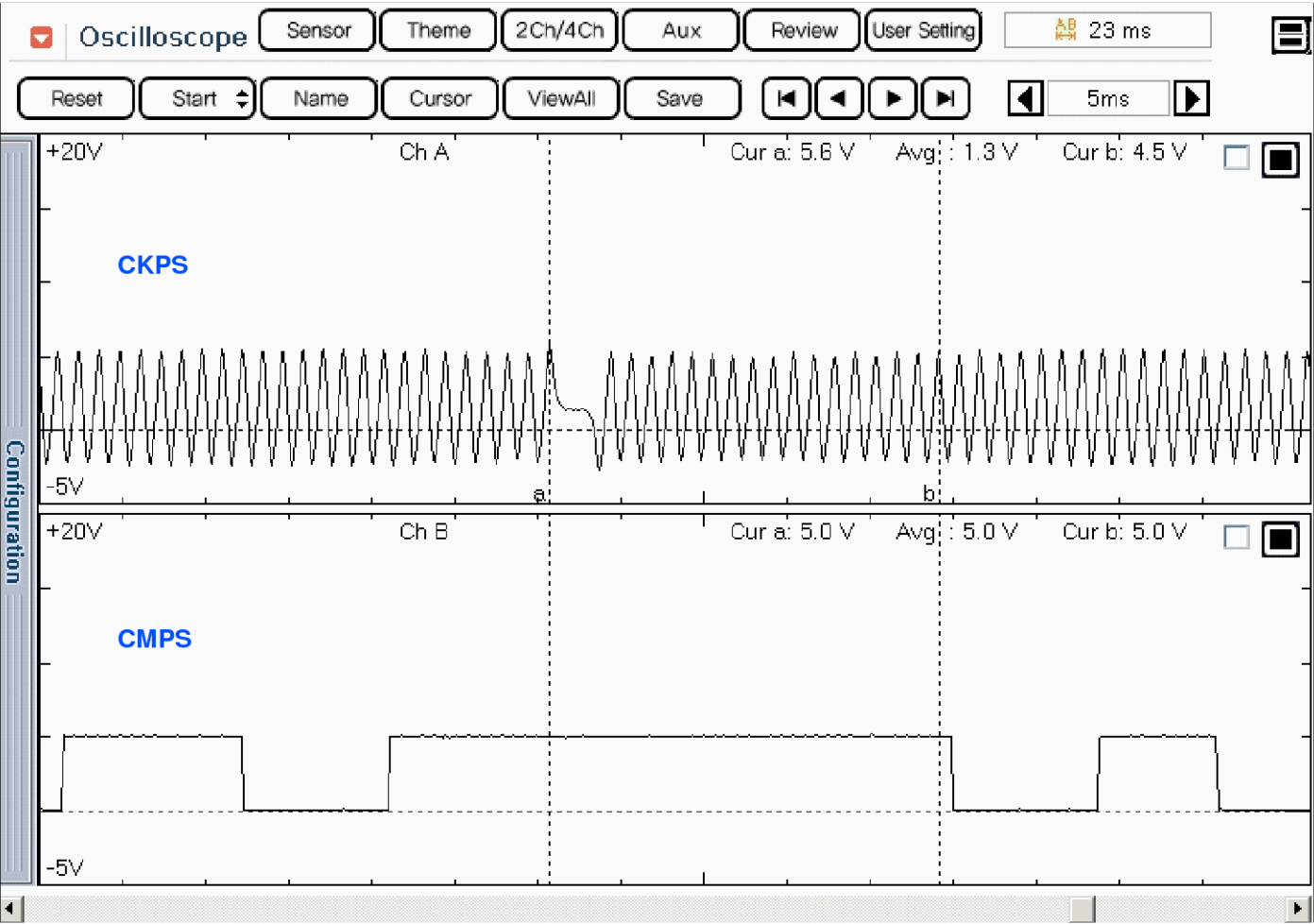
NO ▶ Add a small amount of oil through the spark plug hole, and repeat above steps. If the addition of oil causes the compression to rise, the cause is a worn or damaged piston ring or cylinder inner surface.

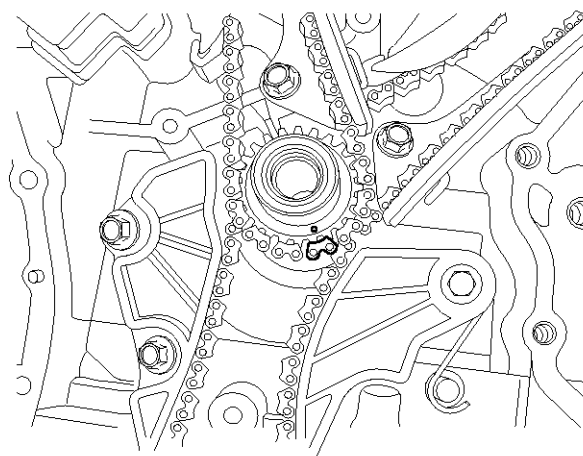
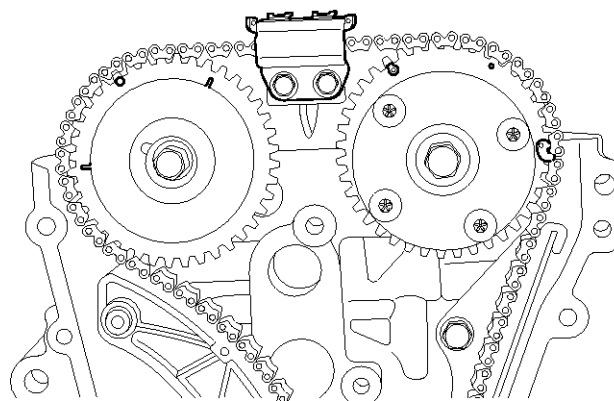
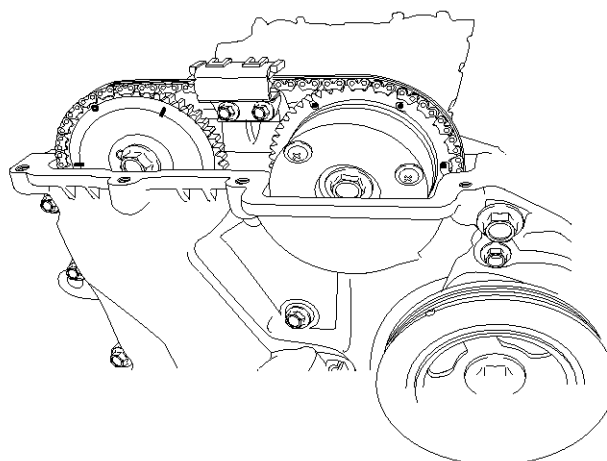
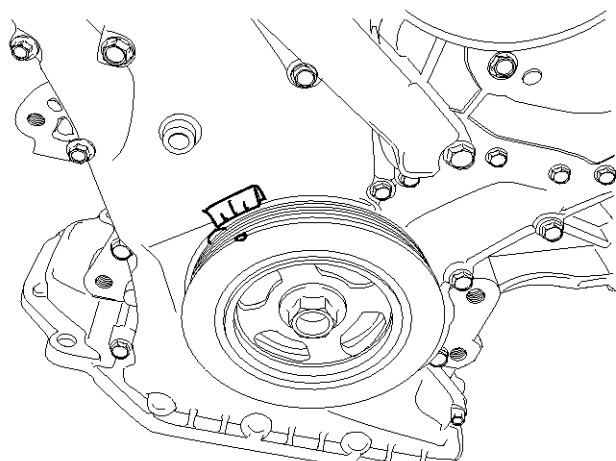
▶ If the compression remains the same, the cause is a burnt or defective valve seat, or pressure is leaking from the gasket. Repair as necessary and go to "Verification of Vehicle Repair" procedure

■ Check Timing

1. IG "OFF"
2. Monitor these signal waveforms from CAM and Crank shaft position Sensor are correctly aligned.

Reference : The 17th of CKP signal from missing tooth is aligned with high of CMP signal.





SBHFL9614L

3. Are all timing marks aligned correctly ?

YES ► Go to "Check Fuel Pressure " as below.

NO ► Check that Cam, Crank and Oil pump sprocket timing marks are correctly aligned. Repair or readjust as necessary and go to "Verification of Vehicle Repair" procedure.

■ Check fuel pressure

NOTICE

1. Be cautious that Fuel is explosive and an empty fuel tank can still contain explosive gases. When working on fuel system make sure to supply adequate ventilation to the work area. Do not smoke, and keep sparks and open flames away.

2. The fuel system remains under pressure when the engine is not running. Release fuel system pressure before disconnecting any fuel line to reduce the chance of personal injury or fire damage to vehicle components.

1. IG "OFF" and disconnect Fuel Pump Relay in Junction Box.
2. Start-up and wait until it stops itself.
3. IG "OFF" and connect Fuel Pump Relay.
4. Install the fuel pressure gauge to the delivery pipe with the fuel pressure gauge adaptor.
5. Activate the fuel pump, and with fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.
6. Measure the fuel pressure at idle.

Specification : 374.6 ~ 384.4 kPa(3.82 ~ 3.92 kg/cm², 54.3 ~ 55.8 psi)

FL-438

Fuel System

7. Is the measured fuel pressure within specifications ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Repair or replace according to the below table. And then, go to " Verification of Vehicle Repair" procedure.

Condition	Possible Cause
Fuel Pressure is too low	Fuel filter, fuel pressure regulator , in-tank fuel hose or the fuel pump
Fuel Pressure is too high	Fuel pressure regulator, hose or pipe

Verification of Vehicle Repair

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

Engine Control System

FL-439

P0302 Cylinder 2-Misfire detected

General Description

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

DTC Description

The ECM measures reference event times and calculates the positive and negative acceleration of the crank wheel to determine whether a misfire has occurred.

When the rate of misfire exceeds a threshold where the catalyst reaches a temperature where permanent damage can occur, to the point that tail pipe emissions reach 1.5 times the tailpipe standard or where a cylinder misfire causes a loss of torque produced from that cylinder.

ECM sets this DTC. In case that misfire affects Catalyst damage, MIL (Malfunction Indicator Lamp) will be illuminating and blinking at 1HZ frequency. However, in case of individual and emission damaging misfire, MIL will be turned on when the malfunction is detected.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		Determine if a multiple cylinder misfire or a cylinder specific misfire is occurring by monitoring crankshaft acceleration.	- Faulty Spark plugs - Faulty Spark plug cables - Air Leakage - Belt deflection and Air gap of CKPS - Incorrect timing - Faulty injector - Improper fuel pressure - Improper engine compression
Enable Conditions		No disabling faults present / no disabling Active Faults - P0340 / P0341 / P0118 / P0117 / P0115 / P0336 / P0335 / P1295 / P0103 / P0102 / P0108 / P0107 / P0106 / P0501 - Engine speed between 550 and 5800 RPM - System voltage between 9 and 18 volts - The ECT indicates an engine temperature between -6 °C (20 °F) and 120 °C (248 °F)	
Threshold value	Case 1	Individual cylinder misfire detection	
	Case 2	Emissions damaging - 18 times in 600 ignitions (In case that the misfire affects more than 1.5 times than FTP emissions)	
	Case 3	Catalyst damaging - 95 times in 600 ignitions at idle (It is going to be changeable according to the load or the temperature which is not in the range where it does not melt catalyst)	
Diagnosis Time		Continuous	
MIL On Condition		2 Driving Cycles	

Signal Waveform & Data

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

Monitor Scantool Data

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

FL-440

Fuel System

System Inspection

■ Check Spark Pulg

1. Remove cylinder's spark plugs
2. Visually/physically inspect the following items:
 - ▶ Damaged insulation, Worn electrodes, Oil or fuel fouled, Loose terminals and cracks
 - ▶ Check for plug gap : 1.0 - 1.1 mm (0.039 - 0.043 in.)
 - ▶ Check if the spark plug for the relevant cylinder is lighter in color than the other plugs.
3. Has a problem been found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check Air Leakage " as below.

■ Check Air Leakage

1. Visually/physically inspect the air leakage in intake/exhaust system as following items,
 - ▶ Vacuum hoses for splits, kinks and improper connections.
 - ▶ Throttle body gasket
 - ▶ Gasket between intake manifold and cylinder head
 - ▶ Seals between intake manifold and fuel injectors
 - ▶ Exhaust system between HO2S and Three way catalyst for air leakage
2. Has a problem been found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check for air leakage in Positive Crankcase Ventilation Valve(PCV).

■ Check for air leakage in Positive Crankcase Ventilation Valve(PCV)

1. Remove PCV valve from cylinder head cover by pulling ventilation hose.
2. With engine idling block PCV valve opening.
3. Verify that vacuum is felt.
4. Remove PCV valve.
5. Blow through valve from port "A" and verify that air comes out of port "B".
6. Blow through valve from port "B" and verify that no air comes out of port "A".

7. Has a problem been found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check Compression pressure" as below.

■ Check Compression pressure

1. Warm up the engine to normal operating temperature.
2. Disconnect the spark plug cables and remove the spark plugs.
3. Crank the engine to remove any foreign material in the cylinders.
4. Put compression pressure gauge into spark plug hole.
5. Crank the engine with widely open throttle valve and check compression pressure at each cylinder.

Specification : 1323kPa(13.5 kg/cm²,192 psi)

6. Is compression pressure for each cylinder displayed within specifications ?

YES ▶ Go to "Check Timing " as below.

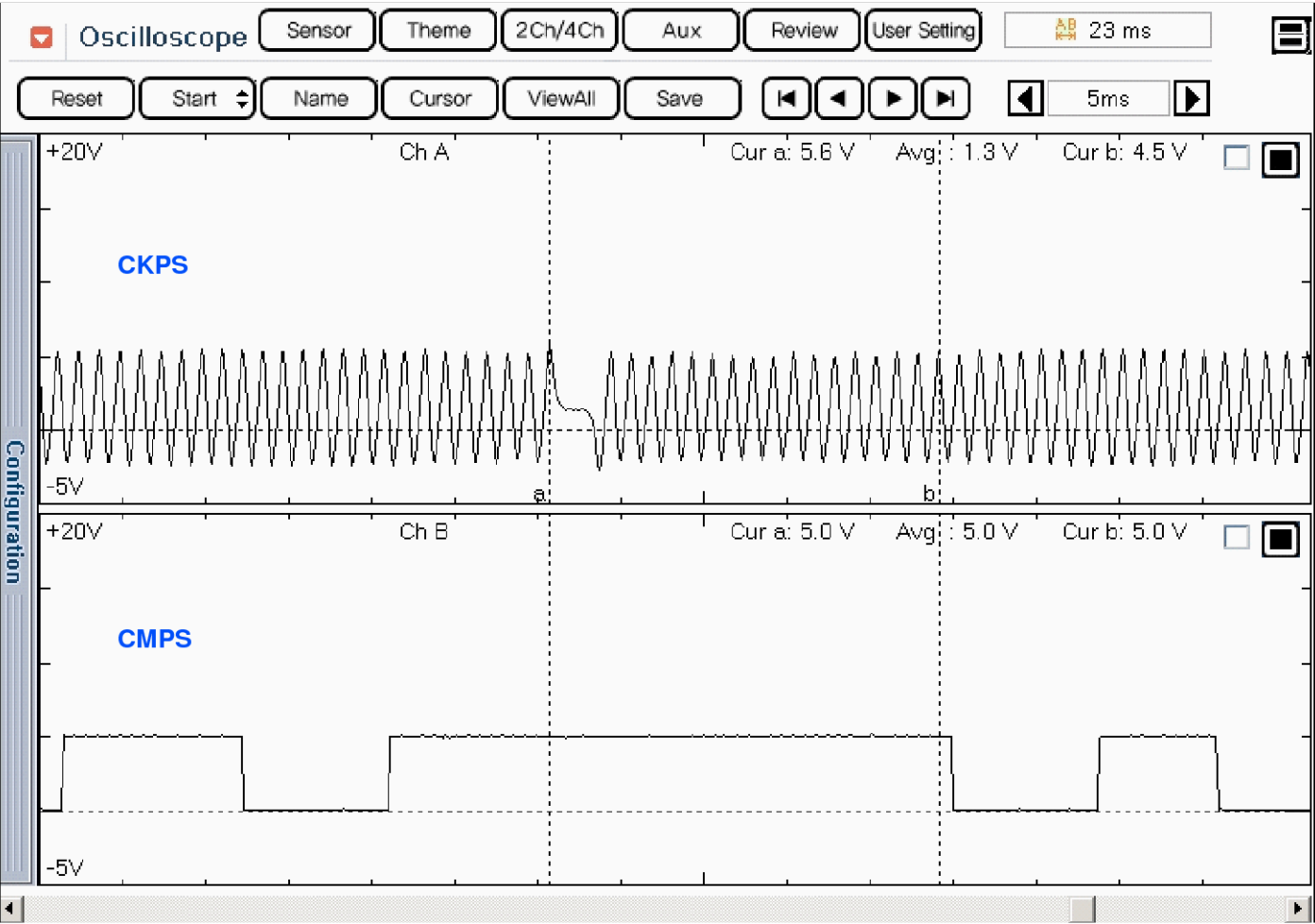
NO ▶ Add a small amount of oil through the spark plug hole, and repeat above steps. If the addition of oil causes the compression to rise, the cause is a worn or damaged piston ring or cylinder inner surface.

▶ If the compression remains the same, the cause is a burnt or defective valve seat, or pressure is leaking from the gasket. Repair as necessary and go to "Verification of Vehicle Repair" procedure

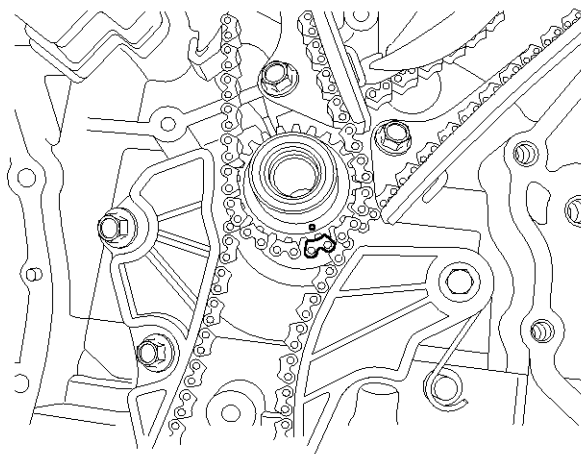
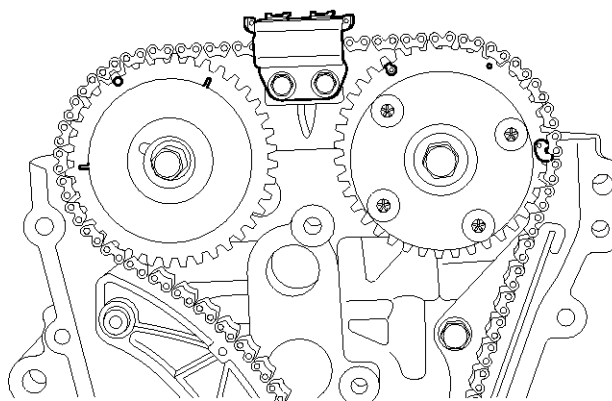
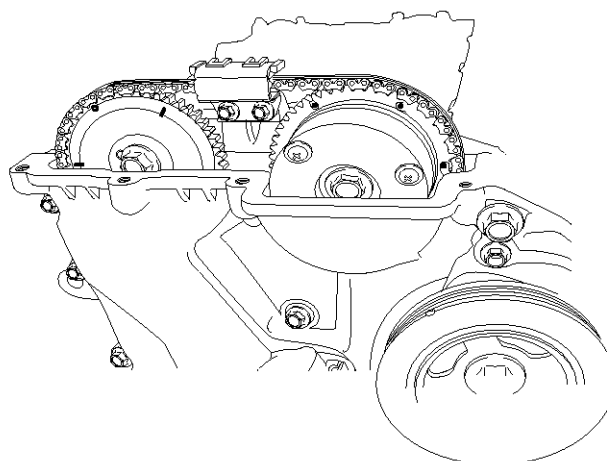
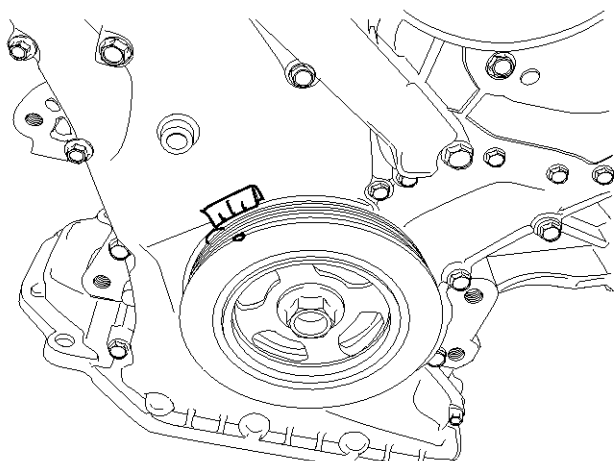
■ Check Timing

1. IG "OFF"
2. Monitor these signal waveforms from CAM and Crank shaft position Sensor are correctly aligned.

Reference : The 17th of CKP signal from missing tooth is aligned with high of CMP signal.



SBHFL9651L



SBHFL9614L

3. Are all timing marks aligned correctly ?

YES ► Go to "Check Fuel Pressure " as below.

NO ► Check that Cam, Crank and Oil pump sprocket timing marks are correctly aligned. Repair or readjust as necessary and go to "Verification of Vehicle Repair" procedure.

■ Check fuel pressure

📖 NOTICE

1. Be cautious that Fuel is explosive and an empty fuel tank can still contain explosive gases. When working on fuel system make sure to supply adequate ventilation to the work area. Do not smoke, and keep sparks and open flames away.

2. The fuel system remains under pressure when the engine is not running. Release fuel system pressure before disconnecting any fuel line to reduce the chance of personal injury or fire damage to vehicle components.

1. IG "OFF" and disconnect Fuel Pump Relay in Junction Box.
2. Start-up and wait until it stops itself.
3. IG "OFF" and connect Fuel Pump Relay.
4. Install the fuel pressure gauge to the delivery pipe with the fuel pressure gauge adaptor.
5. Activate the fuel pump, and with fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.
6. Measure the fuel pressure at idle.

Specification : 374.6 ~ 384.4 kPa(3.82 ~ 3.92 kg/cm², 54.3 ~ 55.8 psi)

Engine Control System

FL-443

7. Is the measured fuel pressure within specifications ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Repair or replace according to the below table. And then, go to " Verification of Vehicle Repair" procedure.

Condition	Possible Cause
Fuel Pressure is too low	Fuel filter, fuel pressure regulator , in-tank fuel hose or the fuel pump
Fuel Pressure is too high	Fuel pressure regulator, hose or pipe

Verification of Vehicle Repair

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

FL-444

Fuel System

P0303 Cylinder 3-Misfire detected

General Description

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

DTC Description

The ECM measures reference event times and calculates the positive and negative acceleration of the crank wheel to determine whether a misfire has occurred.

When the rate of misfire exceeds a threshold where the catalyst reaches a temperature where permanent damage can occur, to the point that tail pipe emissions reach 1.5 times the tailpipe standard or where a cylinder misfire cause a loss of torque produced from that cylinder.

ECM sets this DTC. In case that misfire affects Catalyst damage, MIL (Malfunction Indicator Lamp) will be illuminating and blinking at 1HZ frequency. However, In case of Individual and Emission damaging misfire, MIL will be turned on when the malfunction is detected.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		Determine if a multiple cylinder misfire or a cylinder specific misfire is occurring by monitoring crankshaft acceleration.	- Faulty Spark plugs - Faulty Spark plug cables - Air Leakage - Belt deflection and Air gap of CKPS - Incorrect timing - Faulty injector - Improper fuel pressure - Improper engine compression
Enable Conditions		No disabling faults present / no disabling Active Faults - P0340 / P0341 / P0118 / P0117 / P0115 / P0336 / P0335 / P1295 / P0103 / P0102 / P0108 / P0107 / P0106 / P0501 - Engine speed between 550 and 5800 RPM - System voltage between 9 and 18 volts - The ECT indicates an engine temperature between -6 °C (20 °F) and 120 °C (248 °F)	
Threshold value	Case 1	Individual cylinder misfire detection	
	Case 2	Emissions damaging - 18 times in 600 ignitions (In case that the misfire affects more than 1.5 times than FTP emissions)	
	Case 3	Catalyst damaging - 95 times in 600 ignitions at idle (It is going to be changeable according to the load or the temperature which is not in the range where it does not melt catalyst)	
Diagnosis Time		Continuous	
MIL On Condition		2 Driving Cycles	

Signal Waveform & Data

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

Monitor Scantool Data

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

Engine Control System

FL-445

System Inspection

■ Check Spark Pulg

1. Remove cylinder's spark plugs
2. Visually/physically inspect the following items:
 - ▶ Damaged insulation, Worn electrodes, Oil or fuel fouled, Loose terminals and cracks
 - ▶ Check for plug gap : 1.0 - 1.1 mm (0.039 - 0.043 in.)
 - ▶ Check if the spark plug for the relevant cylinder is lighter in color than the other plugs.
3. Has a problem been found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check Air Leakage " as below.

■ Check Air Leakage

1. Visually/physically inspect the air leakage in intake/exhaust system as following items,
 - ▶ Vacuum hoses for splits, kinks and improper connections.
 - ▶ Throttle body gasket
 - ▶ Gasket between intake manifold and cylinder head
 - ▶ Seals between intake manifold and fuel injectors
 - ▶ Exhaust system between HO2S and Three way catalyst for air leakage
2. Has a problem been found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check for air leakage in Positive Crankcase Ventilation Valve(PCV).

■ Check for air leakage in Positive Crankcase Ventilation Valve(PCV)

1. Remove PCV valve from cylinder head cover by pulling ventilation hose.
2. With engine idling block PCV valve opening.
3. Verify that vacuum is felt.
4. Remove PCV valve.
5. Blow through valve from port "A" and verify that air comes out of port "B".
6. Blow through valve from port "B" and verify that no air comes out of port "A".

7. Has a problem been found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check Compression pressure" as below.

■ Check Compression pressure

1. Warm up the engine to normal operating temperature.
2. Disconnect the spark plug cables and remove the spark plugs.
3. Crank the engine to remove any foreign material in the cylinders.
4. Put compression pressure gauge into spark plug hole.
5. Crank the engine with widely open throttle valve and check compression pressure at each cylinder.

Specification : 1323kPa(13.5 kg/cm²,192 psi)

6. Is compression pressure for each cylinder displayed within specifications ?

YES ▶ Go to "Check Timing " as below.

NO ▶ Add a small amount of oil through the spark plug hole, and repeat above steps. If the addition of oil causes the compression to rise, the cause is a worn or damaged piston ring or cylinder inner surface.

▶ If the compression remains the same, the cause is a burnt or defective valve seat, or pressure is leaking from the gasket. Repair as necessary and go to "Verification of Vehicle Repair" procedure

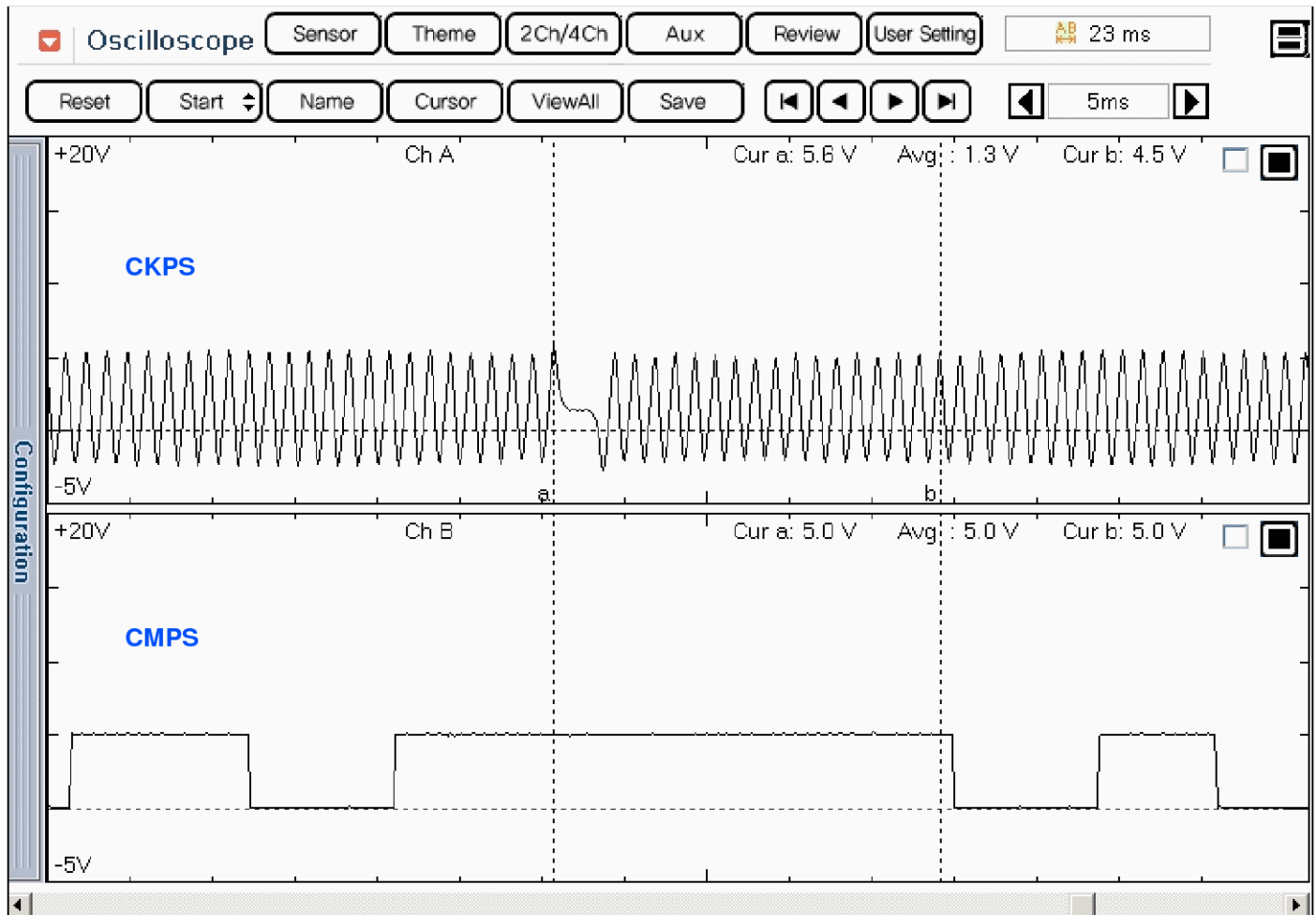
■ Check Timing

1. IG "OFF"
2. Monitor these signal waveforms from CAM and Crank shaft position Sensor are correctly aligned.

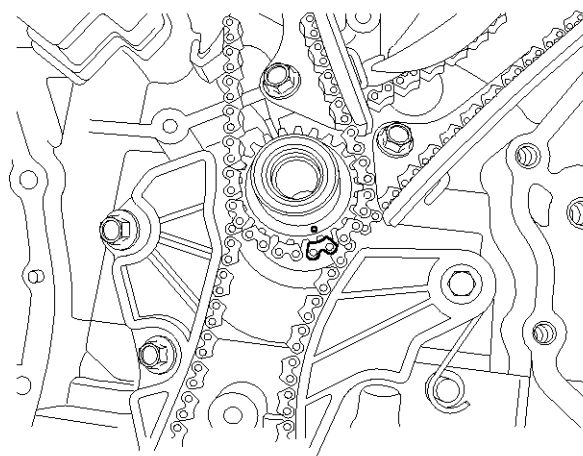
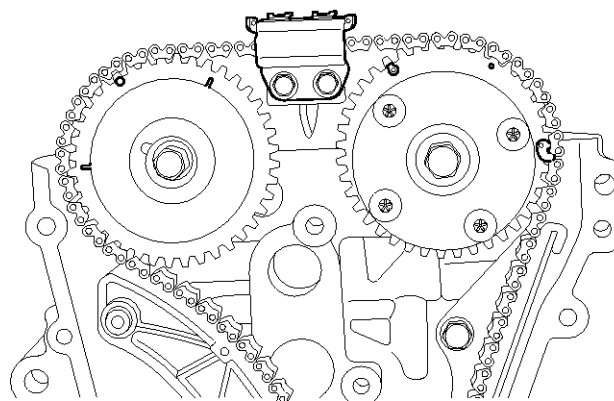
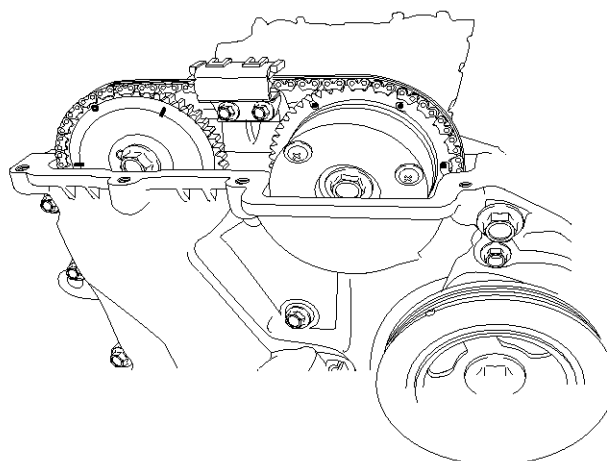
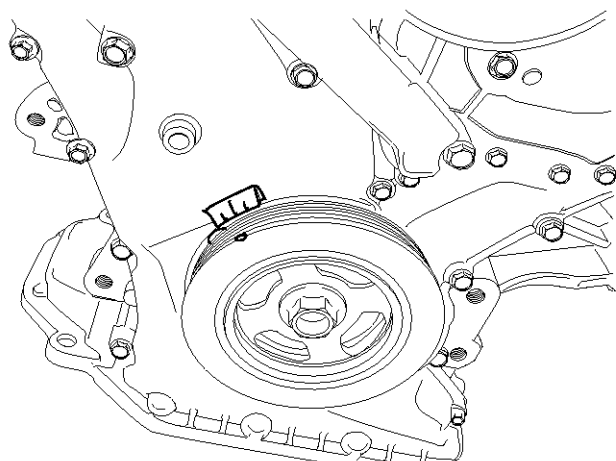
Reference : The 17th of CKP signal from missing tooth is aligned with high of CMP signal.

FL-446

Fuel System



SBHFL9651L



SBHFL9614L

3. Are all timing marks aligned correctly ?

YES ► Go to "Check Fuel Pressure " as below.

NO ► Check that Cam, Crank and Oil pump sprocket timing marks are correctly aligned. Repair or readjust as necessary and go to "Verification of Vehicle Repair" procedure.

■ Check fuel pressure

NOTICE

1. Be cautious that Fuel is explosive and an empty fuel tank can still contain explosive gases. When working on fuel system make sure to supply adequate ventilation to the work area. Do not smoke, and keep sparks and open flames away.

2. The fuel system remains under pressure when the engine is not running. Release fuel system pressure before disconnecting any fuel line to reduce the chance of personal injury or fire damage to vehicle components.

1. IG "OFF" and disconnect Fuel Pump Relay in Junction Box.
2. Start-up and wait until it stops itself.
3. IG "OFF" and connect Fuel Pump Relay.
4. Install the fuel pressure gauge to the delivery pipe with the fuel pressure gauge adaptor.
5. Activate the fuel pump, and with fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.
6. Measure the fuel pressure at idle.

Specification : 374.6 ~ 384.4 kPa(3.82 ~ 3.92 kg/cm², 54.3 ~ 55.8 psi)

FL-448

Fuel System

7. Is the measured fuel pressure within specifications ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Repair or replace according to the below table. And then, go to " Verification of Vehicle Repair" procedure.

Condition	Possible Cause
Fuel Pressure is too low	Fuel filter, fuel pressure regulator , in-tank fuel hose or the fuel pump
Fuel Pressure is too high	Fuel pressure regulator, hose or pipe

Verification of Vehicle Repair

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

Engine Control System

FL-449

P0304 Cylinder 4-Misfire detected

General Description

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

DTC Description

The ECM measures reference event times and calculates the positive and negative acceleration of the crank wheel to determine whether a misfire has occurred.

When the rate of misfire exceeds a threshold where the catalyst reaches a temperature where permanent damage can occur, to the point that tail pipe emissions reach 1.5 times the tailpipe standard or where a cylinder misfire cause a loss of torque produced from that cylinder.

ECM sets this DTC. In case that misfire affects Catalyst damage, MIL (Malfunction Indicator Lamp) will be illuminating and blinking at 1HZ frequency. However, In case of Individual and Emission damaging misfire, MIL will be turned on when the malfunction is detected.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		Determine if a multiple cylinder misfire or a cylinder specific misfire is occurring by monitoring crankshaft acceleration.	- Faulty Spark plugs - Faulty Spark plug cables - Air Leakage - Belt deflection and Air gap of CKPS - Incorrect timing - Faulty injector - Improper fuel pressure - Improper engine compression
Enable Conditions		No disabling faults present / no disabling Active Faults - P0340 / P0341 / P0118 / P0117 / P0115 / P0336 / P0335 / P1295 / P0103 / P0102 / P0108 / P0107 / P0106 / P0501 - Engine speed between 550 and 5800 RPM - System voltage between 9 and 18 volts - The ECT indicates an engine temperature between -6 °C (20 °F) and 120 °C (248 °F)	
Threshold value	Case 1	Individual cylinder misfire detection	
	Case 2	Emissions damaging - 18 times in 600 ignitions (In case that the misfire affects more than 1.5 times than FTP emissions)	
	Case 3	Catalyst damaging - 95 times in 600 ignitions at idle (It is going to be changeable according to the load or the temperature which is not in the range where it does not melt catalyst)	
Diagnosis Time		Continuous	
MIL On Condition		2 Driving Cycles	

Signal Waveform & Data

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

Monitor Scantool Data

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

FL-450

Fuel System

System Inspection

■ Check Spark Pulg

1. Remove cylinder's spark plugs
2. Visually/physically inspect the following items:
 - ▶ Damaged insulation, Worn electrodes, Oil or fuel fouled, Loose terminals and cracks
 - ▶ Check for plug gap : 1.0 - 1.1 mm (0.039 - 0.043 in.)
 - ▶ Check if the spark plug for the relevant cylinder is lighter in color than the other plugs.
3. Has a problem been found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check Air Leakage " as below.

■ Check Air Leakage

1. Visually/physically inspect the air leakage in intake/exhaust system as following items,
 - ▶ Vacuum hoses for splits, kinks and improper connections.
 - ▶ Throttle body gasket
 - ▶ Gasket between intake manifold and cylinder head
 - ▶ Seals between intake manifold and fuel injectors
 - ▶ Exhaust system between HO2S and Three way catalyst for air leakage
2. Has a problem been found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check for air leakage in Positive Crankcase Ventilation Valve(PCV).

■ Check for air leakage in Positive Crankcase Ventilation Valve(PCV)

1. Remove PCV valve from cylinder head cover by pulling ventilation hose.
2. With engine idling block PCV valve opening.
3. Verify that vacuum is felt.
4. Remove PCV valve.
5. Blow through valve from port "A" and verify that air comes out of port "B".
6. Blow through valve from port "B" and verify that no air comes out of port "A".

7. Has a problem been found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check Compression pressure" as below.

■ Check Compression pressure

1. Warm up the engine to normal operating temperature.
2. Disconnect the spark plug cables and remove the spark plugs.
3. Crank the engine to remove any foreign material in the cylinders.
4. Put compression pressure gauge into spark plug hole.
5. Crank the engine with widely open throttle valve and check compression pressure at each cylinder.

Specification : 1323kPa(13.5 kg/cm²,192 psi)

6. Is compression pressure for each cylinder displayed within specifications ?

YES ▶ Go to "Check Timing " as below.

NO ▶ Add a small amount of oil through the spark plug hole, and repeat above steps. If the addition of oil causes the compression to rise, the cause is a worn or damaged piston ring or cylinder inner surface.

▶ If the compression remains the same, the cause is a burnt or defective valve seat, or pressure is leaking from the gasket. Repair as necessary and go to "Verification of Vehicle Repair" procedure

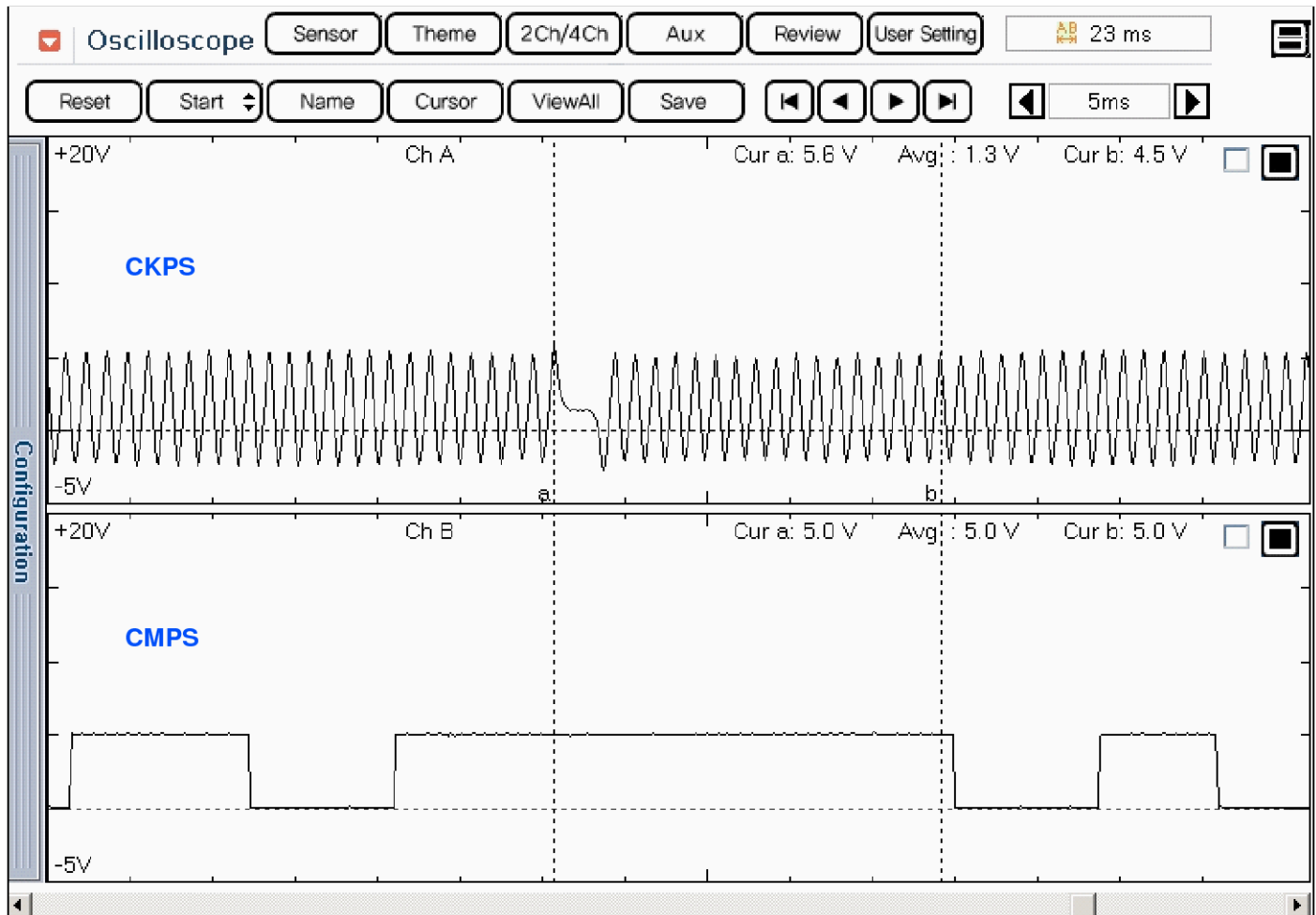
■ Check Timing

1. IG "OFF"
2. Monitor these signal waveforms from CAM and Crank shaft position Sensor are correctly aligned.

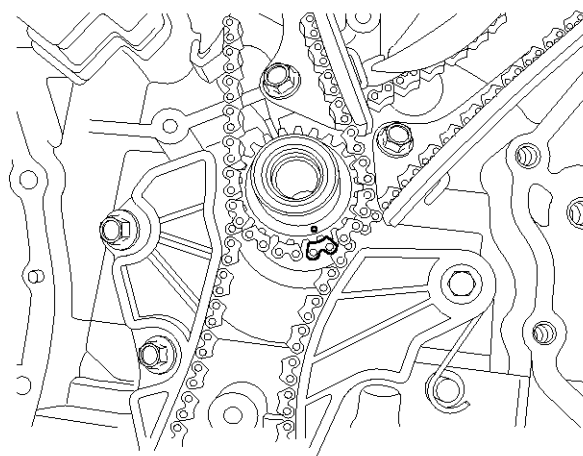
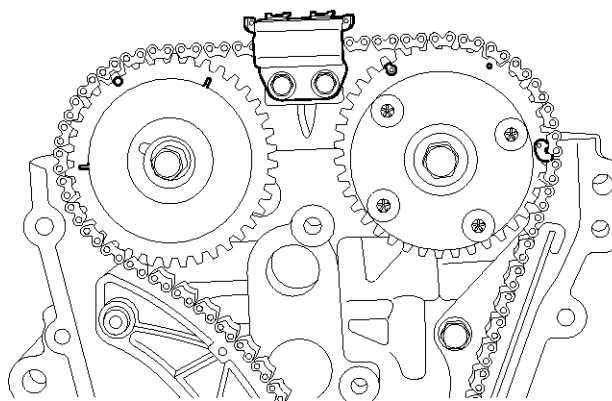
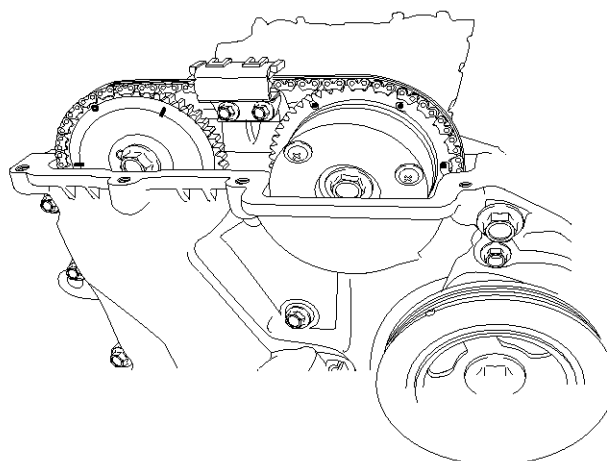
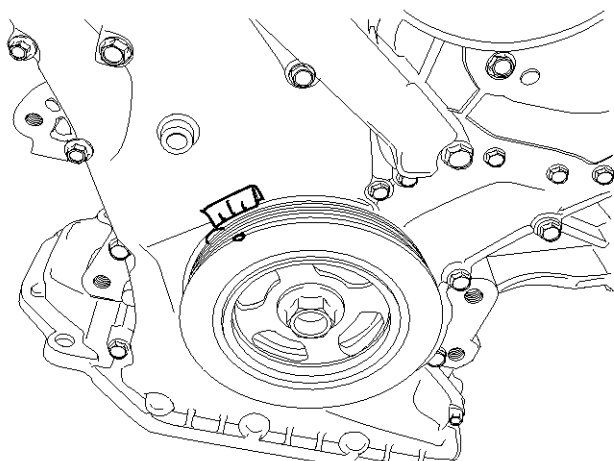
Reference : The 17th of CKP signal from missing tooth is aligned with high of CMP signal.

Engine Control System

FL-451



SBHFL9651L



SBHFL9614L

3. Are all timing marks aligned correctly ?

YES ► Go to "Check Fuel Pressure " as below.

NO ► Check that Cam, Crank and Oil pump sprocket timing marks are correctly aligned. Repair or readjust as necessary and go to "Verification of Vehicle Repair" procedure.

■ Check fuel pressure

📌 NOTICE

1. Be cautious that Fuel is explosive and an empty fuel tank can still contain explosive gases. When working on fuel system make sure to supply adequate ventilation to the work area. Do not smoke, and keep sparks and open flames away.

2. The fuel system remains under pressure when the engine is not running. Release fuel system pressure before disconnecting any fuel line to reduce the chance of personal injury or fire damage to vehicle components.

1. IG "OFF" and disconnect Fuel Pump Relay in Junction Box.
2. Start-up and wait until it stops itself.
3. IG "OFF" and connect Fuel Pump Relay.
4. Install the fuel pressure gauge to the delivery pipe with the fuel pressure gauge adaptor.
5. Activate the fuel pump, and with fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.
6. Measure the fuel pressure at idle.

Specification : 374.6 ~ 384.4 kPa(3.82 ~ 3.92 kg/cm², 54.3 ~ 55.8 psi)

Engine Control System

FL-453

7. Is the measured fuel pressure within specifications ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Repair or replace according to the below table. And then, go to " Verification of Vehicle Repair" procedure.

Condition	Possible Cause
Fuel Pressure is too low	Fuel filter, fuel pressure regulator , in-tank fuel hose or the fuel pump
Fuel Pressure is too high	Fuel pressure regulator, hose or pipe

Verification of Vehicle Repair

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

FL-454

Fuel System

P0305 Cylinder 5-Misfire detected

General Description

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

DTC Description

The ECM measures reference event times and calculates the positive and negative acceleration of the crank wheel to determine whether a misfire has occurred.

When the rate of misfire exceeds a threshold where the catalyst reaches a temperature where permanent damage can occur, to the point that tail pipe emissions reach 1.5 times the tailpipe standard or where a cylinder misfire causes a loss of torque produced from that cylinder.

ECM sets this DTC. In case that misfire affects Catalyst damage, MIL (Malfunction Indicator Lamp) will be illuminating and blinking at 1HZ frequency. However, in case of individual and emission damaging misfire, MIL will be turned on when the malfunction is detected.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		Determine if a multiple cylinder misfire or a cylinder specific misfire is occurring by monitoring crankshaft acceleration.	- Faulty Spark plugs - Faulty Spark plug cables - Air Leakage - Belt deflection and Air gap of CKPS - Incorrect timing - Faulty injector - Improper fuel pressure - Improper engine compression
Enable Conditions		No disabling faults present / no disabling Active Faults - P0340 / P0341 / P0118 / P0117 / P0115 / P0336 / P0335 / P1295 / P0103 / P0102 / P0108 / P0107 / P0106 / P0501 - Engine speed between 550 and 5800 RPM - System voltage between 9 and 18 volts - The ECT indicates an engine temperature between -6 °C (20 °F) and 120 °C (248 °F)	
Threshold value	Case 1	Individual cylinder misfire detection	
	Case 2	Emissions damaging - 18 times in 600 ignitions (In case that the misfire affects more than 1.5 times than FTP emissions)	
	Case 3	Catalyst damaging - 95 times in 600 ignitions at idle (It is going to be changeable according to the load or the temperature which is not in the range where it does not melt catalyst)	
Diagnosis Time		Continuous	
MIL On Condition		2 Driving Cycles	

Signal Waveform & Data

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

Monitor Scantool Data

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

Engine Control System

FL-455

System Inspection

■ Check Spark Pulg

1. Remove cylinder's spark plugs
2. Visually/physically inspect the following items:
 - ▶ Damaged insulation, Worn electrodes, Oil or fuel fouled, Loose terminals and cracks
 - ▶ Check for plug gap : 1.0 - 1.1 mm (0.039 - 0.043 in.)
 - ▶ Check if the spark plug for the relevant cylinder is lighter in color than the other plugs.
3. Has a problem been found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check Air Leakage " as below.

■ Check Air Leakage

1. Visually/physically inspect the air leakage in intake/exhaust system as following items,
 - ▶ Vacuum hoses for splits, kinks and improper connections.
 - ▶ Throttle body gasket
 - ▶ Gasket between intake manifold and cylinder head
 - ▶ Seals between intake manifold and fuel injectors
 - ▶ Exhaust system between HO2S and Three way catalyst for air leakage
2. Has a problem been found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check for air leakage in Positive Crankcase Ventilation Valve(PCV).

■ Check for air leakage in Positive Crankcase Ventilation Valve(PCV)

1. Remove PCV valve from cylinder head cover by pulling ventilation hose.
2. With engine idling block PCV valve opening.
3. Verify that vacuum is felt.
4. Remove PCV valve.
5. Blow through valve from port "A" and verify that air comes out of port "B".
6. Blow through valve from port "B" and verify that no air comes out of port "A".

7. Has a problem been found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check Compression pressure" as below.

■ Check Compression pressure

1. Warm up the engine to normal operating temperature.
2. Disconnect the spark plug cables and remove the spark plugs.
3. Crank the engine to remove any foreign material in the cylinders.
4. Put compression pressure gauge into spark plug hole.
5. Crank the engine with widely open throttle valve and check compression pressure at each cylinder.

Specification : 1323kPa(13.5 kg/cm²,192 psi)

6. Is compression pressure for each cylinder displayed within specifications ?

YES ▶ Go to "Check Timing " as below.

NO ▶ Add a small amount of oil through the spark plug hole, and repeat above steps. If the addition of oil causes the compression to rise, the cause is a worn or damaged piston ring or cylinder inner surface.

▶ If the compression remains the same, the cause is a burnt or defective valve seat, or pressure is leaking from the gasket. Repair as necessary and go to "Verification of Vehicle Repair" procedure

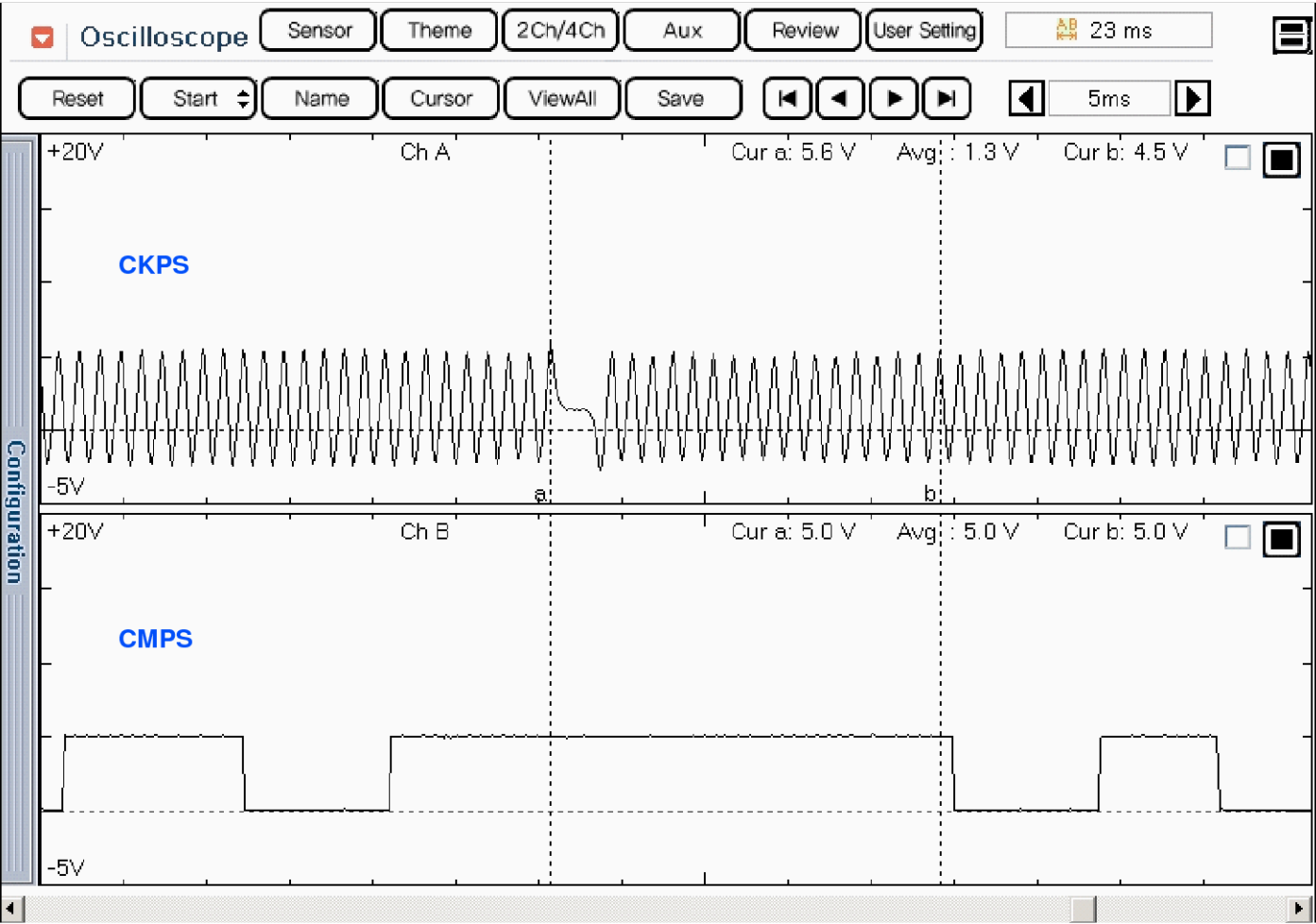
■ Check Timing

1. IG "OFF"
2. Monitor these signal waveforms from CAM and Crank shaft position Sensor are correctly aligned.

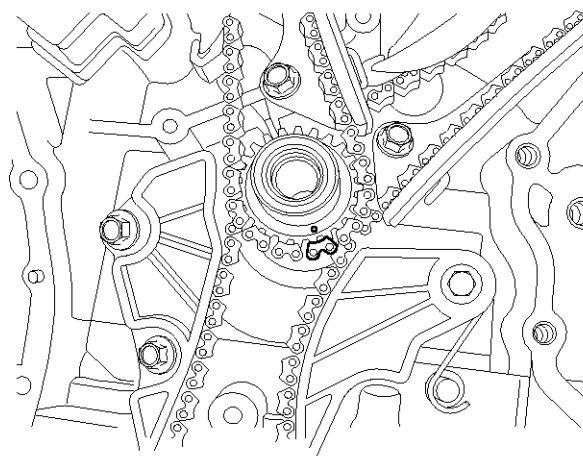
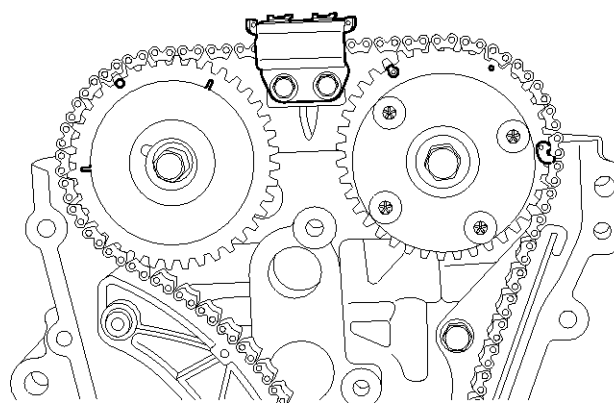
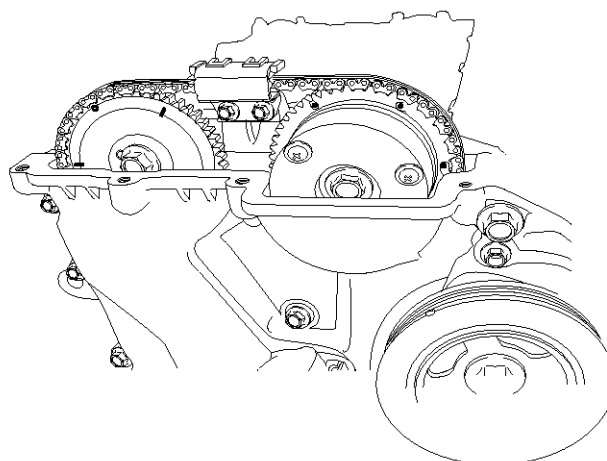
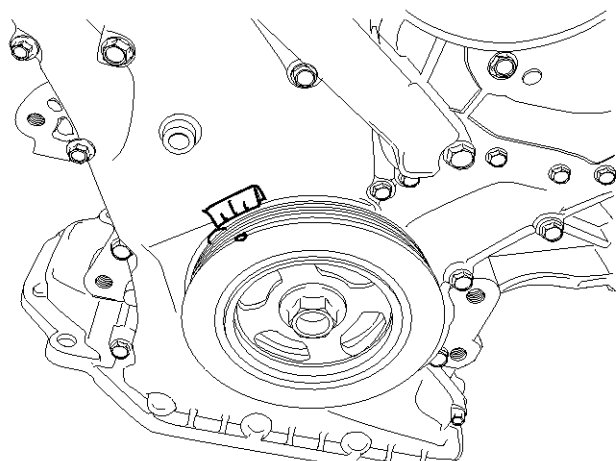
Reference : The 17th of CKP signal from missing tooth is aligned with high of CMP signal.

FL-456

Fuel System



SBHFL9651L



SBHFL9614L

3. Are all timing marks aligned correctly ?

YES ► Go to "Check Fuel Pressure " as below.

NO ► Check that Cam, Crank and Oil pump sprocket timing marks are correctly aligned. Repair or readjust as necessary and go to "Verification of Vehicle Repair" procedure.

■ Check fuel pressure

NOTICE

1. Be cautious that Fuel is explosive and an empty fuel tank can still contain explosive gases. When working on fuel system make sure to supply adequate ventilation to the work area. Do not smoke, and keep sparks and open flames away.

2. The fuel system remains under pressure when the engine is not running. Release fuel system pressure before disconnecting any fuel line to reduce the chance of personal injury or fire damage to vehicle components.

1. IG "OFF" and disconnect Fuel Pump Relay in Junction Box.
2. Start-up and wait until it stops itself.
3. IG "OFF" and connect Fuel Pump Relay.
4. Install the fuel pressure gauge to the delivery pipe with the fuel pressure gauge adaptor.
5. Activate the fuel pump, and with fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.
6. Measure the fuel pressure at idle.

Specification : 374.6 ~ 384.4 kPa(3.82 ~ 3.92 kg/cm², 54.3 ~ 55.8 psi)

FL-458

Fuel System

7. Is the measured fuel pressure within specifications ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Repair or replace according to the below table. And then, go to " Verification of Vehicle Repair" procedure.

Condition	Possible Cause
Fuel Pressure is too low	Fuel filter, fuel pressure regulator , in-tank fuel hose or the fuel pump
Fuel Pressure is too high	Fuel pressure regulator, hose or pipe

Verification of Vehicle Repair

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

Engine Control System

FL-459

P0306 Cylinder 6-Misfire detected

General Description

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

DTC Description

The ECM measures reference event times and calculates the positive and negative acceleration of the crank wheel to determine whether a misfire has occurred.

When the rate of misfire exceeds a threshold where the catalyst reaches a temperature where permanent damage can occur, to the point that tail pipe emissions reach 1.5 times the tailpipe standard or where a cylinder misfire cause a loss of torque produced from that cylinder.

ECM sets this DTC. In case that misfire affects Catalyst damage, MIL (Malfunction Indicator Lamp) will be illuminating and blinking at 1HZ frequency. However, In case of Individual and Emission damaging misfire, MIL will be turned on when the malfunction is detected.

DTC Detecting Condition

Item		Detecting Condition	Possible Cause
DTC Strategy		Determine if a multiple cylinder misfire or a cylinder specific misfire is occurring by monitoring crankshaft acceleration.	- Faulty Spark plugs - Faulty Spark plug cables - Air Leakage - Belt deflection and Air gap of CKPS - Incorrect timing - Faulty injector - Improper fuel pressure - Improper engine compression
Enable Conditions		No disabling faults present / no disabling Active Faults - P0340 / P0341 / P0118 / P0117 / P0115 / P0336 / P0335 / P1295 / P0103 / P0102 / P0108 / P0107 / P0106 / P0501 - Engine speed between 550 and 5800 RPM - System voltage between 9 and 18 volts - The ECT indicates an engine temperature between -6 °C (20 °F) and 120 °C (248 °F)	
Threshold value	Case 1	Individual cylinder misfire detection	
	Case 2	Emissions damaging - 18 times in 600 ignitions (In case that the misfire affects more than 1.5 times than FTP emissions)	
	Case 3	Catalyst damaging - 95 times in 600 ignitions at idle (It is going to be changeable according to the load or the temperature which is not in the range where it does not melt catalyst)	
Diagnosis Time		Continuous	
MIL On Condition		2 Driving Cycles	

Signal Waveform & Data

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

Monitor Scantool Data

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

FL-460

Fuel System

System Inspection

■ Check Spark Pulg

1. Remove cylinder's spark plugs
2. Visually/physically inspect the following items:
 - ▶ Damaged insulation, Worn electrodes, Oil or fuel fouled, Loose terminals and cracks
 - ▶ Check for plug gap : 1.0 - 1.1 mm (0.039 - 0.043 in.)
 - ▶ Check if the spark plug for the relevant cylinder is lighter in color than the other plugs.
3. Has a problem been found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check Air Leakage " as below.

■ Check Air Leakage

1. Visually/physically inspect the air leakage in intake/exhaust system as following items,
 - ▶ Vacuum hoses for splits, kinks and improper connections.
 - ▶ Throttle body gasket
 - ▶ Gasket between intake manifold and cylinder head
 - ▶ Seals between intake manifold and fuel injectors
 - ▶ Exhaust system between HO2S and Three way catalyst for air leakage
2. Has a problem been found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check for air leakage in Positive Crankcase Ventilation Valve(PCV).

■ Check for air leakage in Positive Crankcase Ventilation Valve(PCV)

1. Remove PCV valve from cylinder head cover by pulling ventilation hose.
2. With engine idling block PCV valve opening.
3. Verify that vacuum is felt.
4. Remove PCV valve.
5. Blow through valve from port "A" and verify that air comes out of port "B".
6. Blow through valve from port "B" and verify that no air comes out of port "A".

7. Has a problem been found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check Compression pressure" as below.

■ Check Compression pressure

1. Warm up the engine to normal operating temperature.
2. Disconnect the spark plug cables and remove the spark plugs.
3. Crank the engine to remove any foreign material in the cylinders.
4. Put compression pressure gauge into spark plug hole.
5. Crank the engine with widely open throttle valve and check compression pressure at each cylinder.

Specification : 1323kPa(13.5 kg/cm²,192 psi)

6. Is compression pressure for each cylinder displayed within specifications ?

YES ▶ Go to "Check Timing " as below.

NO ▶ Add a small amount of oil through the spark plug hole, and repeat above steps. If the addition of oil causes the compression to rise, the cause is a worn or damaged piston ring or cylinder inner surface.

▶ If the compression remains the same, the cause is a burnt or defective valve seat, or pressure is leaking from the gasket. Repair as necessary and go to "Verification of Vehicle Repair" procedure

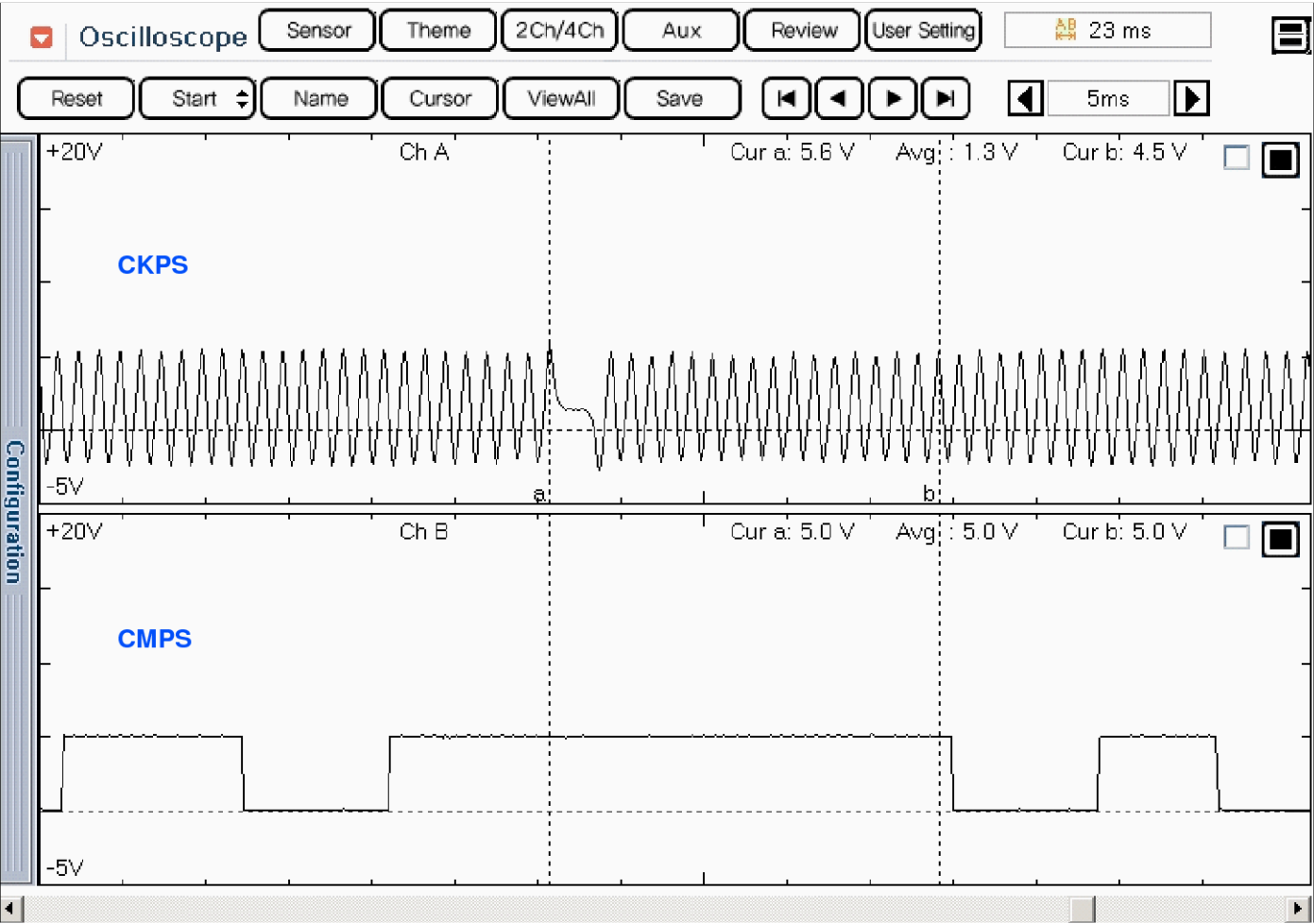
■ Check Timing

1. IG "OFF"
2. Monitor these signal waveforms from CAM and Crank shaft position Sensor are correctly aligned.

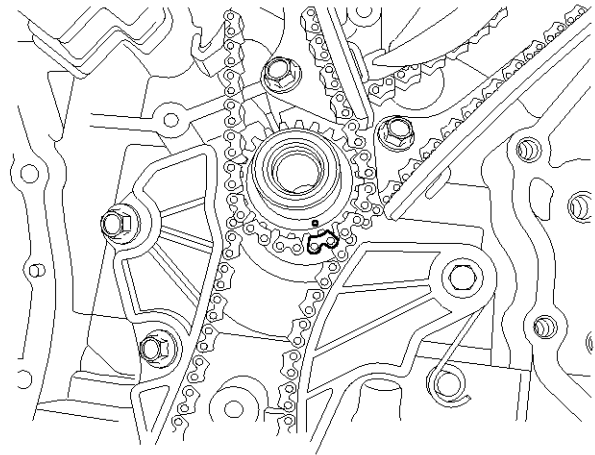
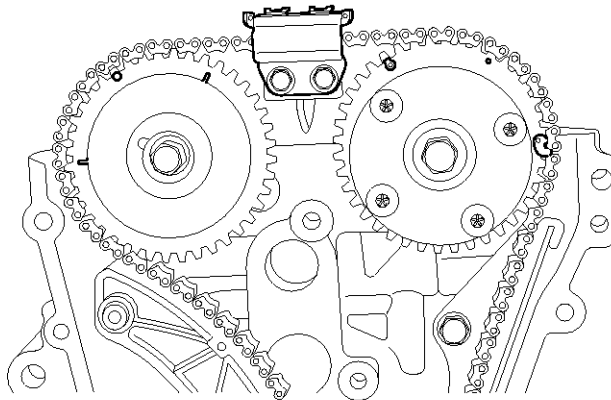
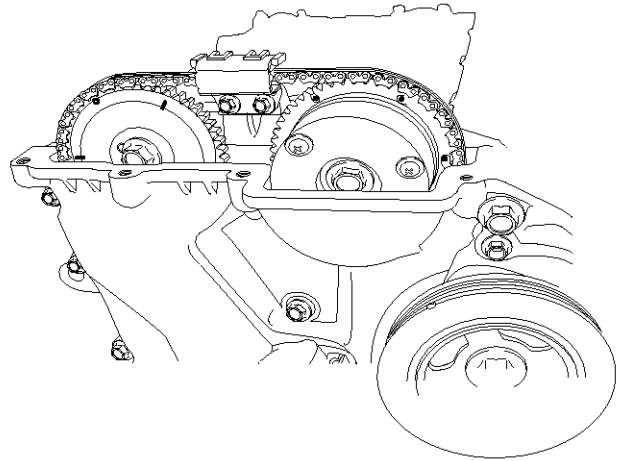
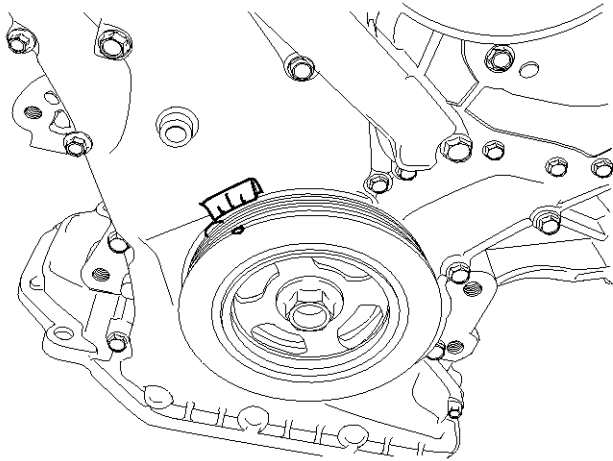
Reference : The 17th of CKP signal from missing tooth is aligned with high of CMP signal.

Engine Control System

FL-461



SBHFL9651L



SBHFL9614L

3. Are all timing marks aligned correctly ?

YES ► Go to "Check Fuel Pressure " as below.

NO ► Check that Cam, Crank and Oil pump sprocket timing marks are correctly aligned. Repair or readjust as necessary and go to "Verification of Vehicle Repair" procedure.

■ Check fuel pressure

📌 NOTICE

1. Be cautious that Fuel is explosive and an empty fuel tank can still contain explosive gases. When working on fuel system make sure to supply adequate ventilation to the work area. Do not smoke, and keep sparks and open flames away.

2. The fuel system remains under pressure when the engine is not running. Release fuel system pressure before disconnecting any fuel line to reduce the chance of personal injury or fire damage to vehicle components.

1. IG "OFF" and disconnect Fuel Pump Relay in Junction Box.
2. Start-up and wait until it stops itself.
3. IG "OFF" and connect Fuel Pump Relay.
4. Install the fuel pressure gauge to the delivery pipe with the fuel pressure gauge adaptor.
5. Activate the fuel pump, and with fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.
6. Measure the fuel pressure at idle.

Specification : 374.6 ~ 384.4 kPa(3.82 ~ 3.92 kg/cm², 54.3 ~ 55.8 psi)

Engine Control System

FL-463

7. Is the measured fuel pressure within specifications ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Repair or replace according to the below table. And then, go to " Verification of Vehicle Repair" procedure.

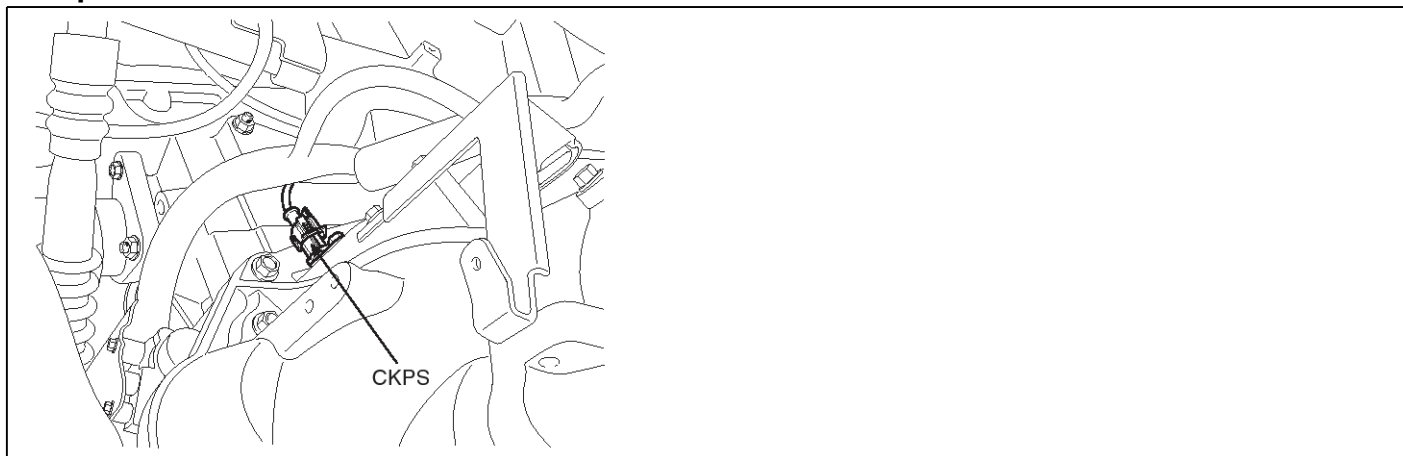
Condition	Possible Cause
Fuel Pressure is too low	Fuel filter, fuel pressure regulator , in-tank fuel hose or the fuel pump
Fuel Pressure is too high	Fuel pressure regulator, hose or pipe

Verification of Vehicle Repair

Refer to DTC P0300 : Random/Multiple Cylinder Misfire Detected

P0315 Crankshaft Position (CKP) Sensor Error

Component Location



SBHFL9304L

General Description

The Crankshaft Position Sensor (CKPS) is a magnetic field sensitive type sensor that generates voltage using a sensor and a target wheel mounted on the crankshaft; there are 58 slots in the target wheel where one is longer than the others. When the slot in the wheel aligns with the sensor, the sensor voltage outputs low. When the metal (tooth) in the wheel aligns with the sensor, the sensor voltage outputs high. During one crankshaft rotation there are 58 rectangular signals and one longer signal. The ECM calculates engine RPM by using the sensor's signal and controls the injection duration and the ignition timing. Using the signal differences caused by the longer slot, the ECM identifies which cylinder is at top dead center.

DTC Description

Checking tooth error correction under detecting condition, if the TEC(Tooth Error Correction) is out of Threshold value, ECM sets P0315.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	This DTC indicates that crankwheel tooth error has not been learned.	- loosened CKPS - Target wheel - ECM
Enable Conditions	$10\% \leq \text{Engine load} < 90\%$ $2000 \text{ rpm} \leq \text{engine speed} \leq 4000 \text{ rpm}$ - TEC(Tooth Error Correction) RPM stability timer $> 10\text{s-ec}$ $0^{\circ}\text{C}(32^{\circ}\text{F}) < \text{coolant temperature} < 110^{\circ}\text{C}(230^{\circ}\text{F})$ - Not active disabling faults	
Threshold value	- Distance driven without learning(during fuel cut off) tooth error $\geq 4000\text{km}$ - Actual Value is higher or lower than calibrated value	
Diagnosis Time	-	
MIL On Condition	NO MIL ON(DTC only)	

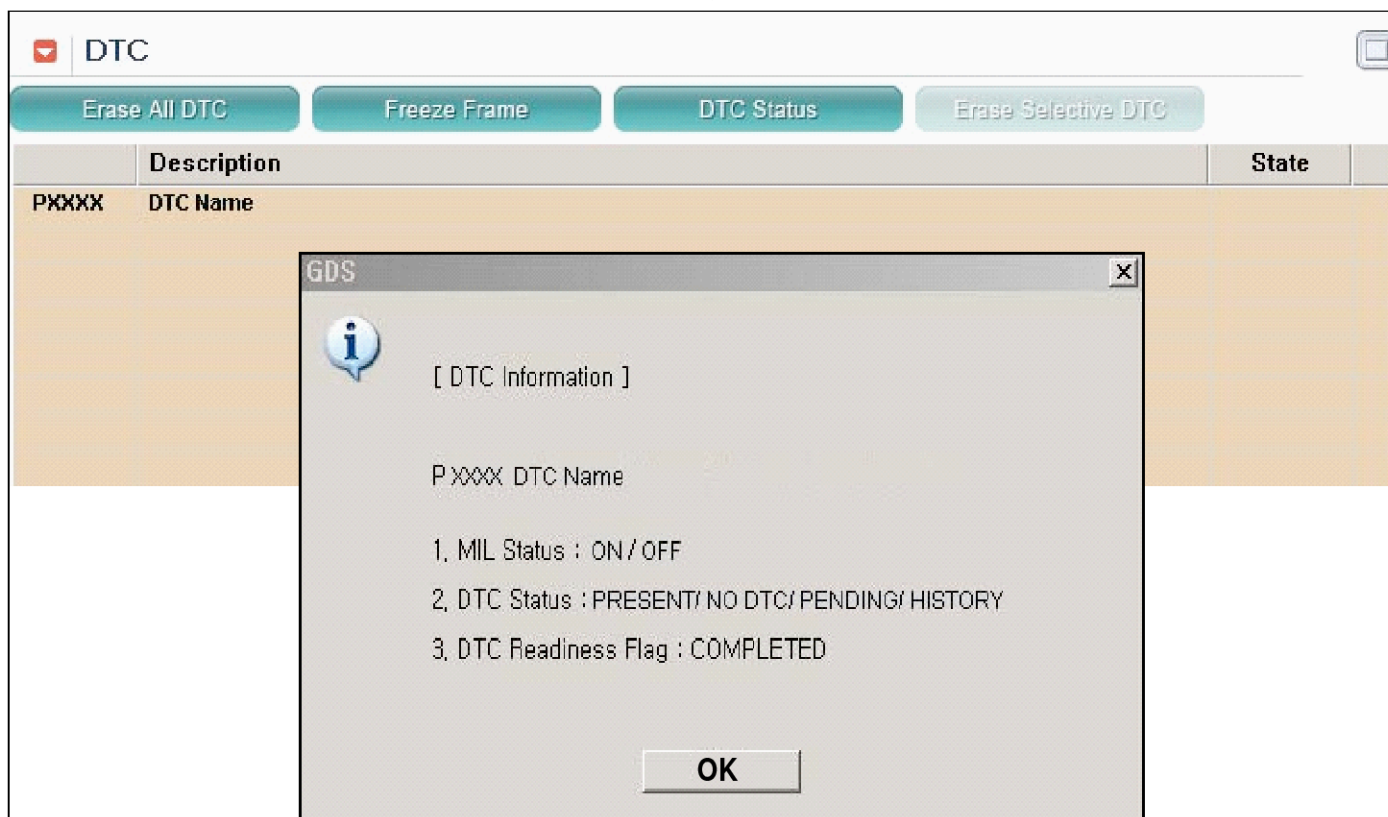
Engine Control System

FL-465

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Component Inspection" procedure.

NO ► Fault is intermittent caused by ECM memory was not cleared after repair. Erase DTC and drive the vehicle to satisfy the enable condition then, go to "Component Inspection" procedure.

Component Inspection

■ Visually check CKPS and target wheel

1. IG "OFF"
2. Visually check CKPS is loosened or target wheel is deformed or damaged.

3. Is the above items normal ?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

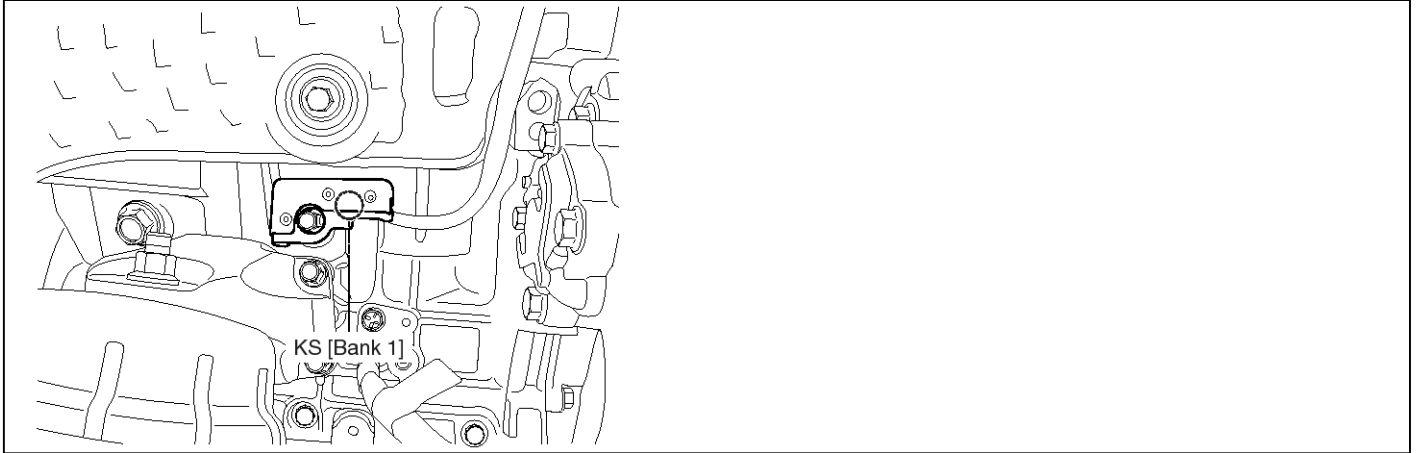
NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-467

P0325 Knock Sensor 1 Circuit (Bank 1 or Single Sensor)

Component Location



SBHFL9309L

General Description

The knock sensor is attached to the cylinder block and senses engine knocking. The sensor contains a piezoelectric element that converts vibration (or noise) into voltage signal and sends this signal to ECM. With input signals from camshaft position and crankshaft position sensor, ECM can identify which cylinder is knocking. ECM filters vibrations and determines if the vibrations are knocking signal. The Engine Control Module (ECM) uses this signal to suppress knocking by retarding ignition timing. The ECM will set a code (Malfunction Indicator Lamp will Not turn on) if during two driving cycles the Knock sensor's output voltage falls below minimum threshold. This code indicates an unexpected vibration is being read by the Knock sensor or ECM under normal engine operation.

DTC Description

Checking the range of input signal with a knock sensor under detecting condition, ECM senses open in knock sensor circuit or malfunction of sensor. If a knock signal or noise level is inputted without the specified value during standard duration, ECM sets P0325.

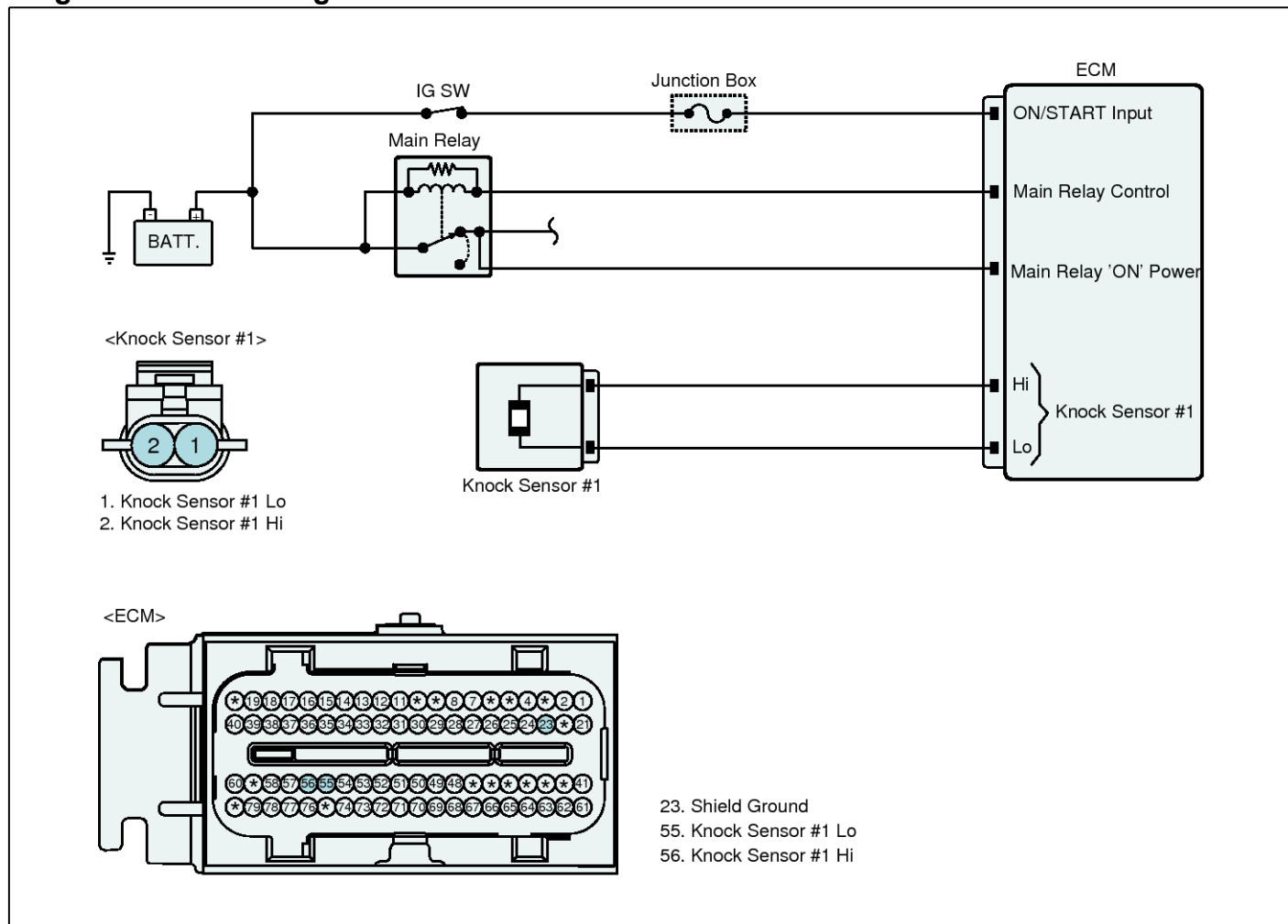
DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal short	- Poor connection - Open in harness - Knock sensor - ECM
Enable Conditions	- Pressure in intake manifold is normal - Engine speed ≥ 2200rpm	
Threshold value	Knock Filtered Value < 1.0	
Diagnosis Time	Continuous	
MIL On Condition	NO MIL ON(DTC only)	

FL-468

Fuel System

Diagnostic Circuit Diagram



SBHFL9520L

Signal Waveform & Data

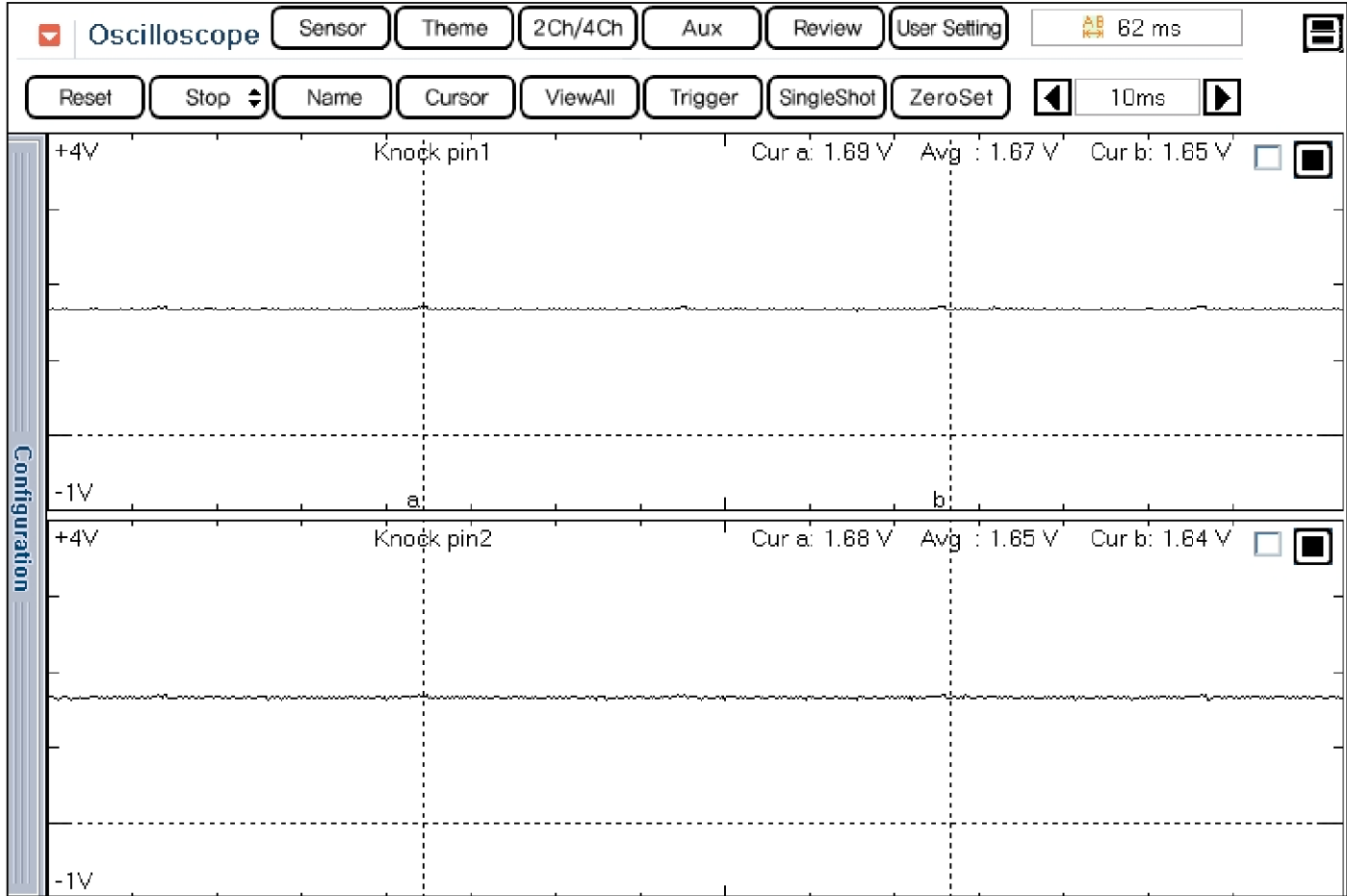


Fig.1

SBHFL9652L

Sensor Name	Value	Unit
☐ Knock Adaption-Cylinder 1	0.0	DEG
☐ Knock Adaption-Cylinder 2	0.0	DEG
☐ Knock Adaption-Cylinder 3	0.0	DEG
☐ Knock Adaption-Cylinder 4	0.0	DEG
☐ Knock Adaption-Cylinder 5	0.0	DEG
☐ Knock Adaption-Cylinder 6	0.0	DEG

Fig.2

SBHFL9653L

Fig 1) Normal waveform of knock sensor at ig on.

Fig 2) Normal data of knock sensor at ig on.

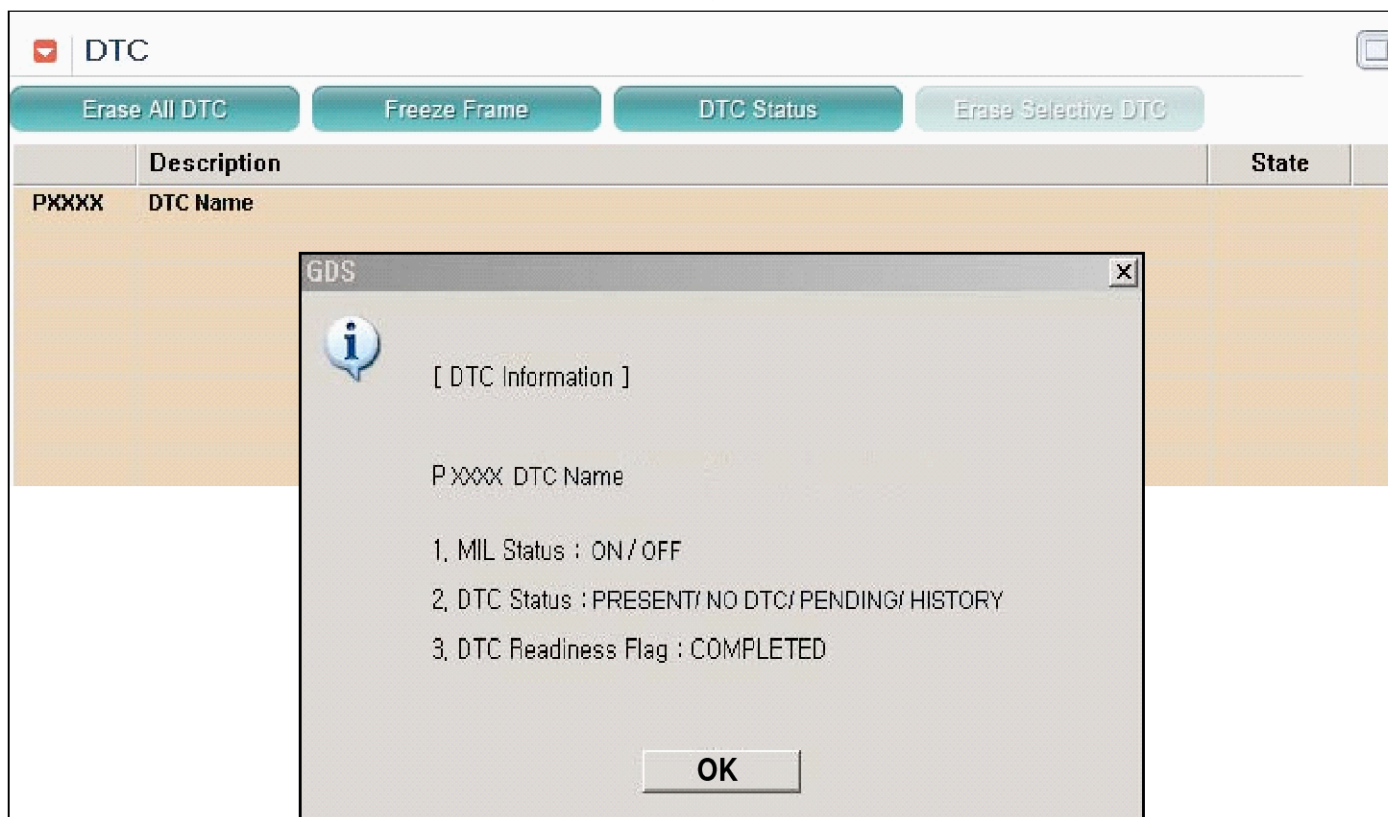
FL-470

Fuel System

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Signal Circuit Inspection " procedure .

Signal Circuit Inspection

■ Check open in harness

1. IG "OFF" and disconnect knock sensor connector and ECM connector.
2. Measure resistance between low signal terminal of knock sensor harness connector and knock sensor low signal terminal of ECM harness connector.
3. Measure resistance between high signal terminal of knock sensor harness connector and knock sensor high signal terminal of ECM harness connector.

Specification : Below 1Ω

Engine Control System

FL-471

4. Is the measured resistance within specification ?

YES ► If the problem is corrected after substituting with a known - good knock sensor, replace it. If the problem is pending, check for proper operating after substituting with a known - good ECM. and then if the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.



NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

FL-472

Fuel System

P0326 Knock Sensor 1 Circuit Range/Performance (Bank 1 or Single Sensor)

Component Location

Refer to DTC P0325 : Knock Sensor 1 Circuit (Bank 1 or Single Sensor)

General Description

Refer to DTC P0325 : Knock Sensor 1 Circuit (Bank 1 or Single Sensor)

DTC Description

Checking the range of input signal with a knock sensor under detecting condition, ECM senses short in knock sensor circuit or malfunction of sensor. If the average value of the knock signal is out of the threshold value during standard duration, ECM sets P0326.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal short	- Poor connection - Short in harness - Knock sensor - ECM
Enable Conditions	- Pressure in intake manifold is normal - Engine speed ≥ 2200rpm	
Threshold value	Knock Filtered Value < 5 or > 65	
Diagnosis Time	Continuous	
MIL On Condition	NO MIL ON(DTC only)	

Diagnostic Circuit Diagram

Refer to DTC P0325 : Knock Sensor 1 Circuit (Bank 1 or Single Sensor)

Signal Waveform & Data

Refer to DTC P0325 : Knock Sensor 1 Circuit (Bank 1 or Single Sensor)

Monitor Scantool Data

Refer to DTC P0325 : Knock Sensor 1 Circuit (Bank 1 or Single Sensor)

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Signal Circuit Inspection " procedure .

Signal Circuit Inspection

■ Check short to battery in harness

- IG "OFF" and disconnect knock sensor connector.
- IG "ON".
- Measure voltage between low signal terminal of knock sensor harness connector and chassis ground.
- Measure voltage between high signal terminal of knock sensor harness connector and chassis ground.

Specification : Approx. 1.5V

- Is the measured voltage within specification ?

YES ► Go to "Check short to ground in harness" as follows.

NO ► Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check short to ground in harness

- IG "OFF" and disconnect knock sensor connector and ECM connector.
- Measure resistance between low signal terminal of knock sensor harness connector and chassis ground.
- Measure resistance between high signal terminal of knock sensor harness connector and chassis ground.

Specification : Infinite

Engine Control System

FL-473

4. Is the measured resistance within specification ?

YES ► If the problem is corrected after substituting with a known - good knock sensor, replace it. If the problem is pending, check for proper operating after substituting with a known - good ECM. and then if the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

 NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

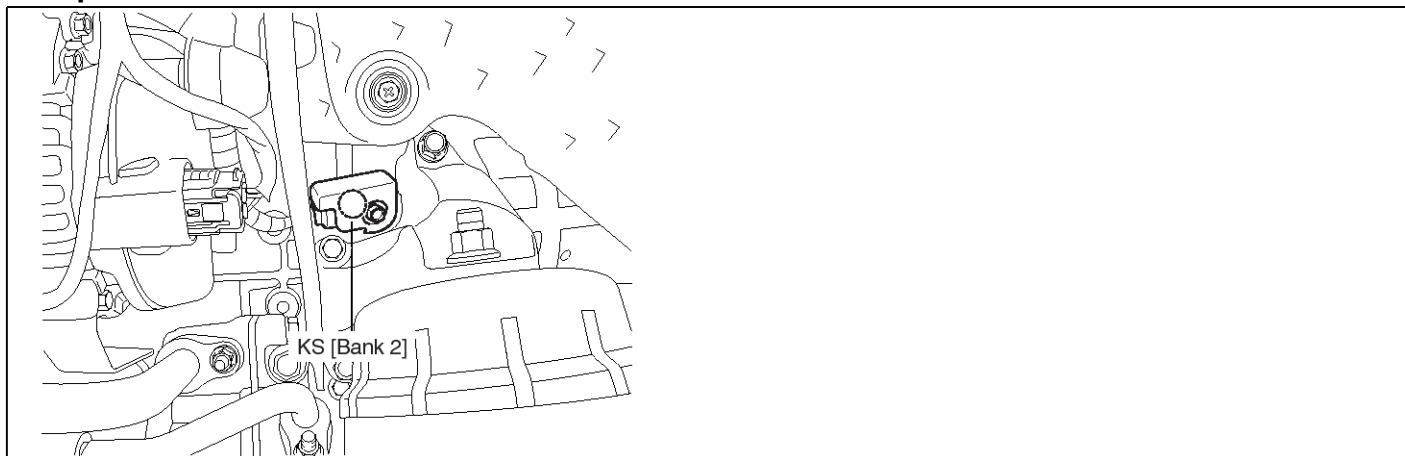
Refer to DTC P0325 : Knock Sensor 1 Circuit (Bank 1 or Single Sensor)

FL-474

Fuel System

P0330 Knock Sensor 2 Circuit (Bank 2)

Component Location



SBHFL9310L

General Description

The knock sensor is attached to the cylinder block and senses engine knocking. The sensor contains a piezoelectric element that converts vibration (or noise) into voltage signal and sends this signal to ECM. With input signals from camshaft position and crankshaft position sensor, ECM can identify which cylinder is knocking. ECM filters vibrations and determines if the vibrations are knocking signal. The Engine Control Module (ECM) uses this signal to suppress knocking by retarding ignition timing. The ECM will set a code (Malfunction Indicator Lamp will Not turn on) if during two driving cycles the Knock sensor's output voltage falls below minimum threshold. This code indicates an unexpected vibration is being read by the Knock sensor or ECM under normal engine operation.

DTC Description

Checking the range of input signal with a knock sensor under detecting condition, ECM senses open in knock sensor circuit or malfunction of sensor. If a knock signal or noise level is inputted without the specified value during standard duration, ECM sets P0330.

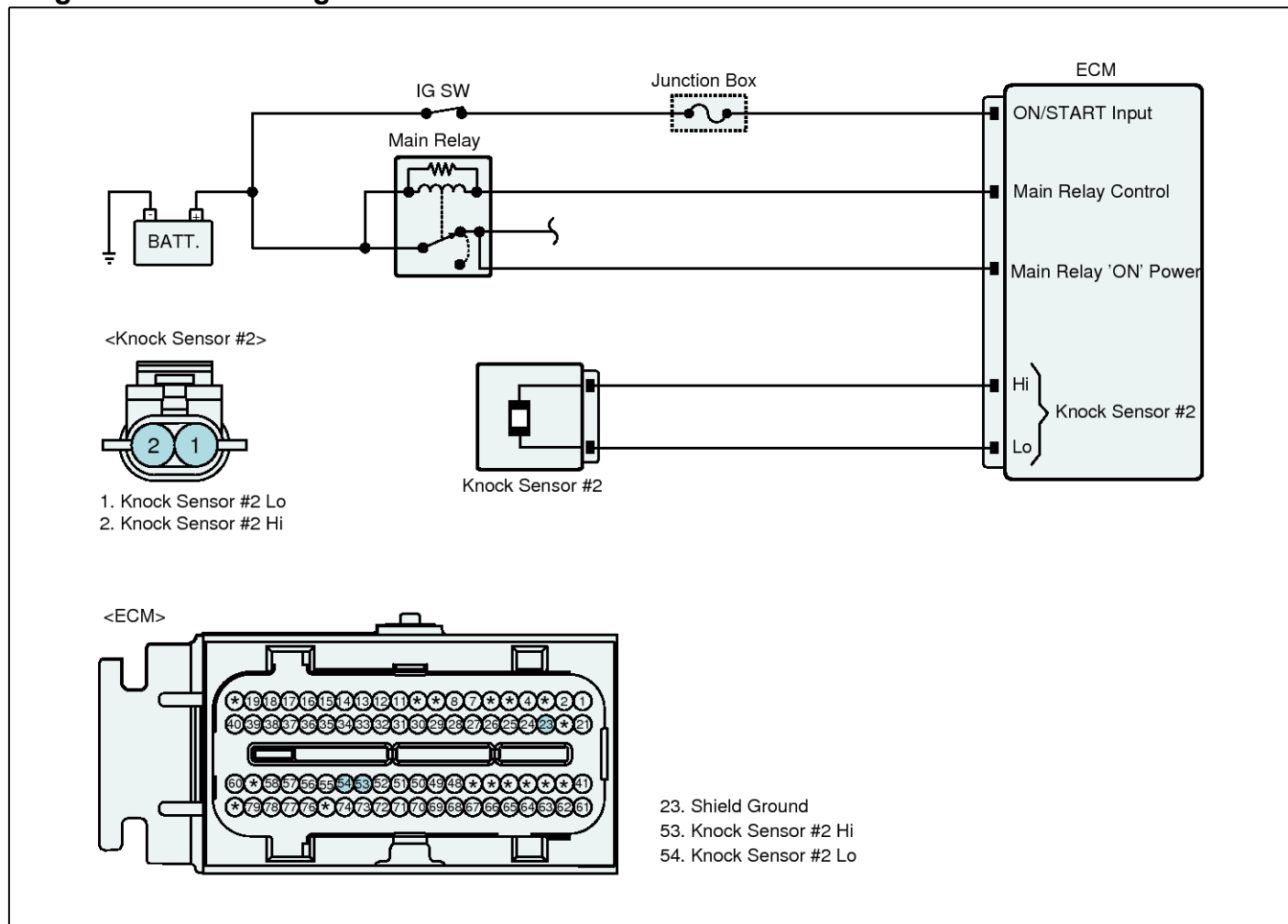
DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Signal short	- Poor connection - Open in harness - Knock sensor - ECM
Enable Conditions	- Pressure in intake manifold is normal - Engine speed ≥ 2200rpm	
Threshold value	Knock Filtered Value < 1.0	
Diagnosis Time	Continuous	
MIL On Condition	NO MIL ON(DTC only)	

Engine Control System

FL-475

Diagnostic Circuit Diagram



SBHFL9521L

Signal Waveform & Data

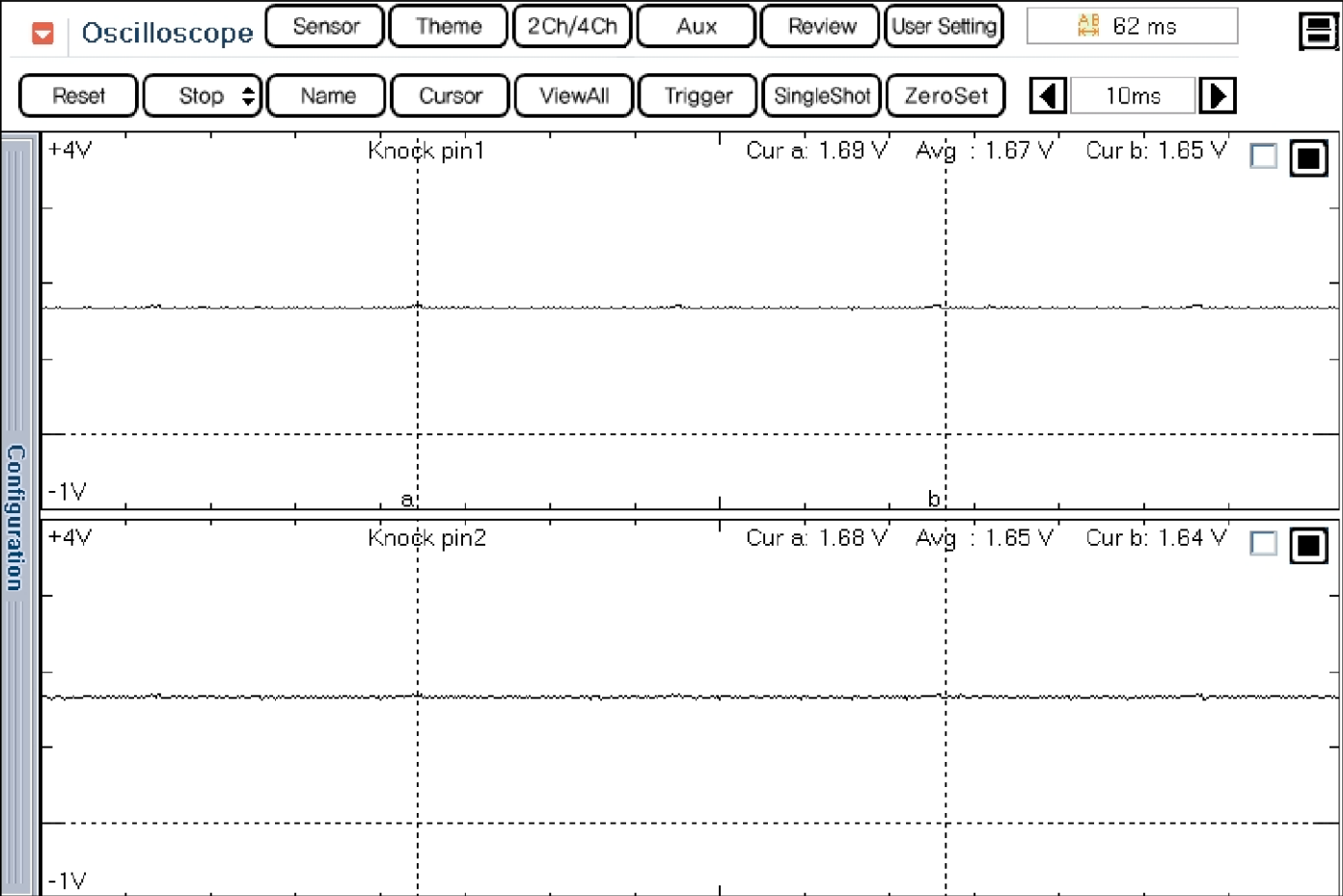


Fig.1

SBHFL9652L

Sensor Name	Value	Unit
☐ Knock Adaption-Cylinder 1	0.0	DEG
☐ Knock Adaption-Cylinder 2	0.0	DEG
☐ Knock Adaption-Cylinder 3	0.0	DEG
☐ Knock Adaption-Cylinder 4	0.0	DEG
☐ Knock Adaption-Cylinder 5	0.0	DEG
☐ Knock Adaption-Cylinder 6	0.0	DEG

Fig.2

SBHFL9653L

Fig 1) Normal waveform of knock sensor at ig on.

Fig 2) Normal data of knock sensor at ig on.

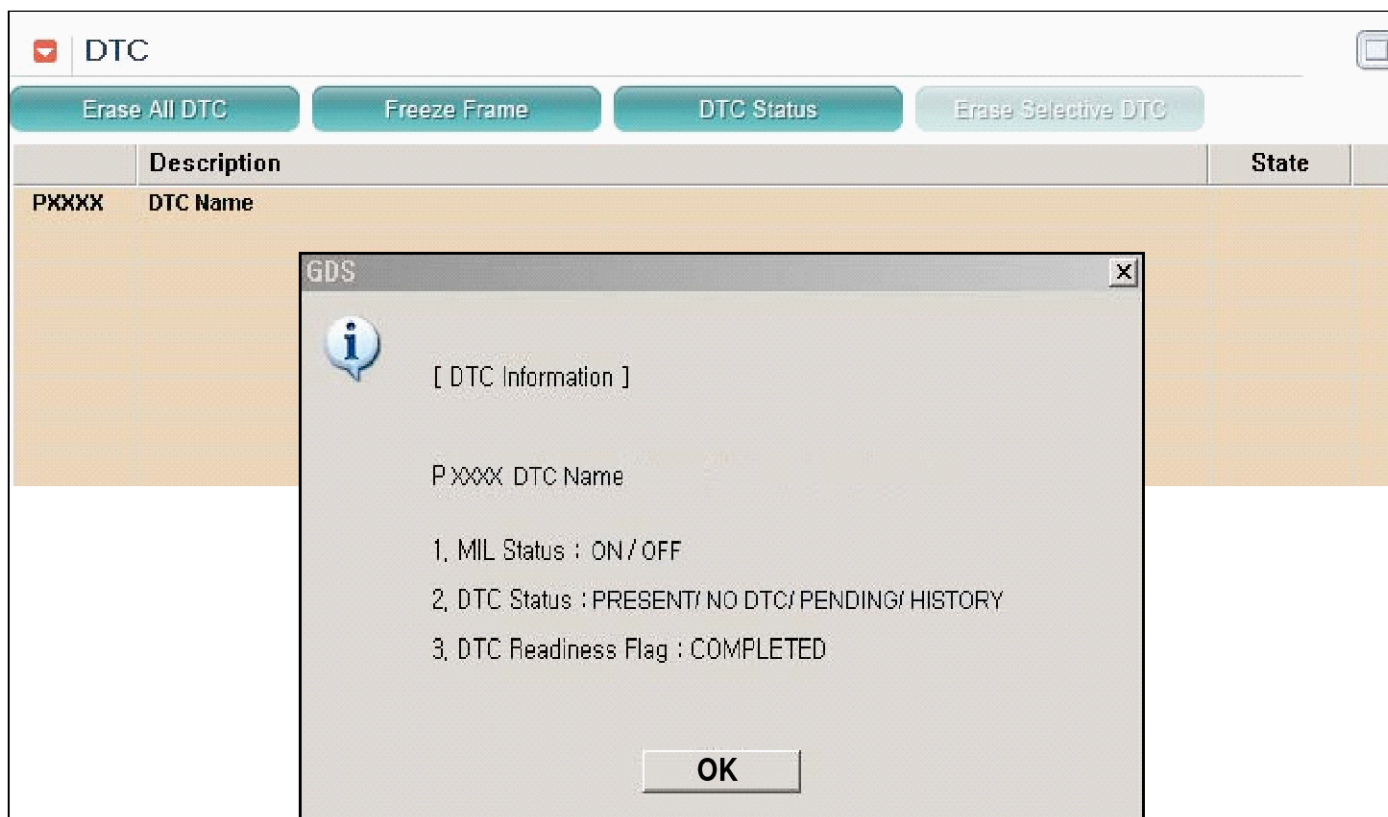
Engine Control System

FL-477

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Signal Circuit Inspection " procedure .

Signal Circuit Inspection

■ Check open in harness

1. IG "OFF" and disconnect knock sensor connector and ECM connector.
2. Measure resistance between low signal terminal of knock sensor harness connector and knock sensor low signal terminal of ECM harness connector.
3. Measure resistance between high signal terminal of knock sensor harness connector and knock sensor high signal terminal of ECM harness connector.

Specification : Below 1Ω

4. Is the measured resistance within specification ?

YES ► If the problem is corrected after substituting with a known - good knock sensor, replace it. If the problem is pending, check for proper operating after substituting with a known - good ECM. and then if the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

 NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-479

P0331 Knock Sensor 2 Circuit Range/Performance (Bank 2)

Component Location

Refer to DTC P0330 : Knock Sensor 2 Circuit (Bank 2)

General Description

Refer to DTC P0330 : Knock Sensor 2 Circuit (Bank 2)

DTC Description

Checking the range of input signal with a knock sensor under detecting condition, ECM senses short in knock sensor circuit or malfunction of sensor. If the average value of the knock signals is out of the threshold value during standard duration, ECM sets P0331.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Signal short	• Poor connection • Short in harness • Knock sensor • ECM
Enable Conditions	• Pressure in intake manifold is normal • Engine speed ≥ 2200 rpm	
Threshold value	• Knock Filtered Value < 5 or > 65	
Diagnosis Time	• Continuous	
MIL On Condition	• NO MIL ON(DTC only)	

Diagnostic Circuit Diagram

Refer to DTC P0330 : Knock Sensor 2 Circuit (Bank 2)

Signal Waveform & Data

Refer to DTC P0330 : Knock Sensor 2 Circuit (Bank 2)

Monitor Scantool Data

Refer to DTC P0330 : Knock Sensor 2 Circuit (Bank 2)

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Signal Circuit Inspection " procedure .

Signal Circuit Inspection

■ Check short to battery in harness

- IG "OFF" and disconnect knock sensor connector.
- IG "ON".
- Measure voltage between low signal terminal of knock sensor harness connector and chassis ground.

- Measure voltage between high signal terminal of knock sensor harness connector and chassis ground.

Specification : Approx. 1.5V

- Is the measured voltage within specification ?

YES ► Go to "Check short to ground in harness" as follows.

NO ► Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check short to ground in harness

- IG "OFF" and disconnect knock sensor connector and ECM connector.
- Measure resistance between low signal terminal of knock sensor harness connector and chassis ground.
- Measure resistance between high signal terminal of knock sensor harness connector and chassis ground.

Specification : Infinite

FL-480

Fuel System

4. Is the measured resistance within specification ?

YES ► If the problem is corrected after substituting with a known - good knock sensor, replace it. If the problem is pending, check for proper operating after substituting with a known - good ECM. and then if the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

 NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

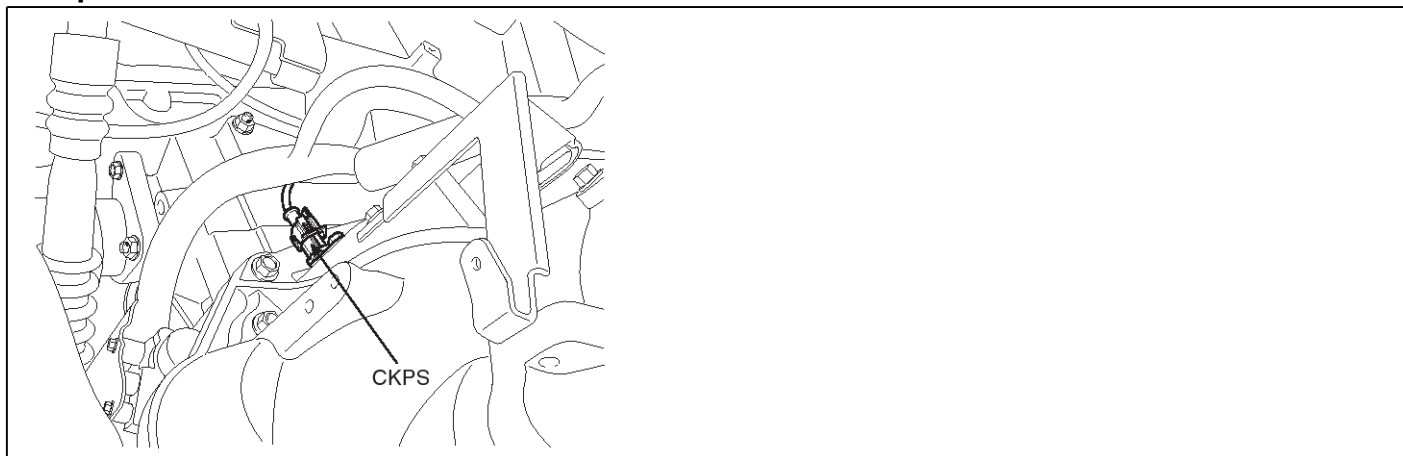
Refer to DTC P0330 : Knock Sensor 2 Circuit (Bank 2)

Engine Control System

FL-481

P0335 Crankshaft Position Sensor "A" Circuit

Component Location



SBHFL9304L

General Description

The Crankshaft Position Sensor (CKPS) is a magnetic field sensitive type sensor that generates voltage using a sensor and a target wheel mounted on the crankshaft; there are 58 slots in the target wheel where one is longer than the others. During one crankshaft rotation there are 58 rectangular signals and one longer signal. The ECM calculates engine RPM by using the sensor's signal and controls the injection duration and the ignition timing. Using the signal differences caused by the longer slot, the ECM identifies which cylinder is at top dead center.

DTC Description

Checking reference signals from CKPS under detecting condition, if any signal is detected for more than 0.15 sec., ECM sets P0335.

MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

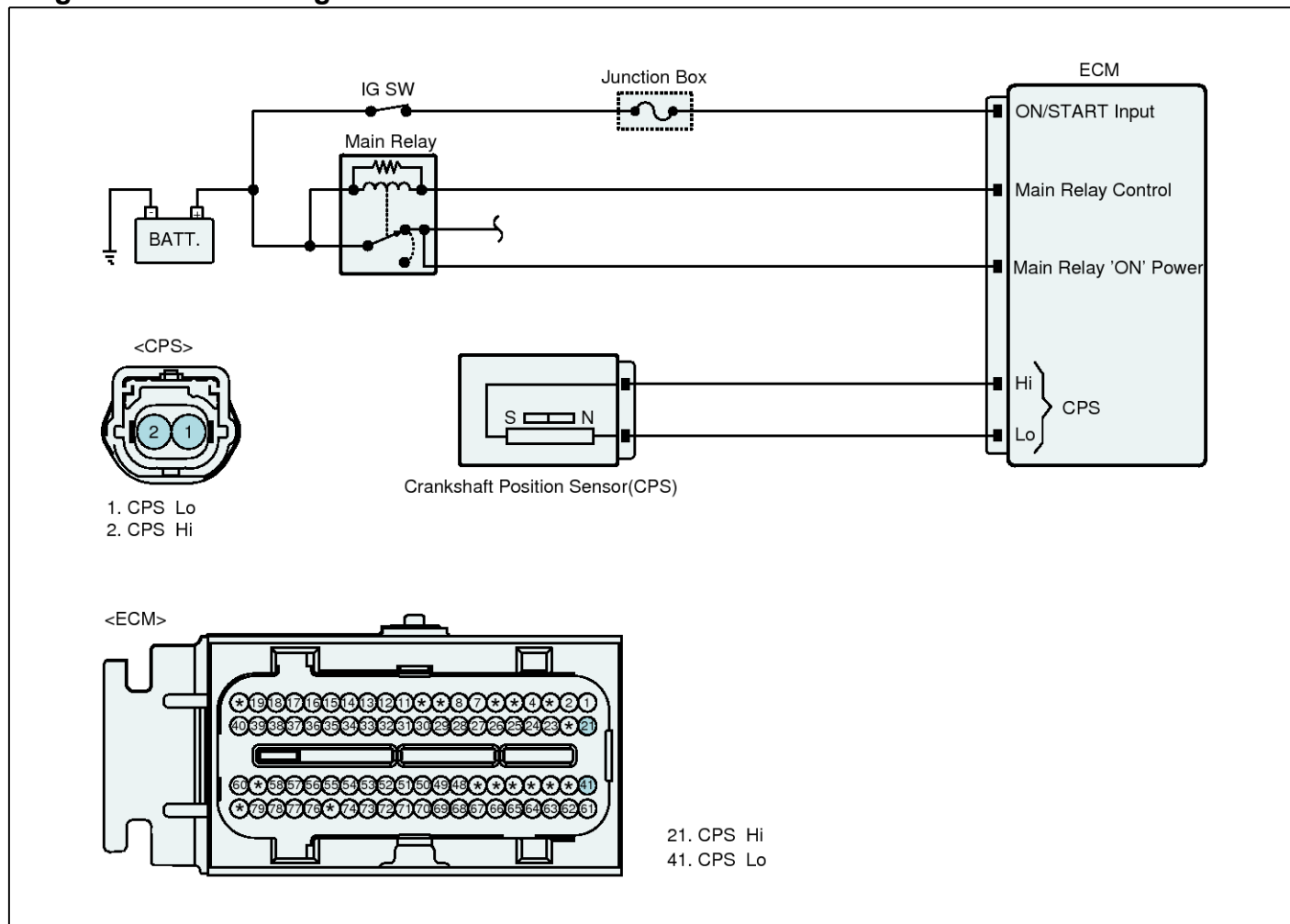
DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	Check reference wave during cranking	- Poor connection - Open in harness - CKP sensor - ECM
Enable Conditions	- IG "ON", Cranking or engine-off during driving - No DTC related to CAM - Camshaft position sensor state change	
Threshold value	No reference signal over 0.15 sec.	
Diagnosis Time	0.15 sec.	
MIL On Condition	2 Driving Cycles	

Specification

Item	Specification
Coil Resistance (Ω)	630 ~ 770 Ω (20 $^{\circ}$ C)
Airgap (mm)	0.5 ~ 1.5 mm

Diagnostic Circuit Diagram



SBHFL9522L

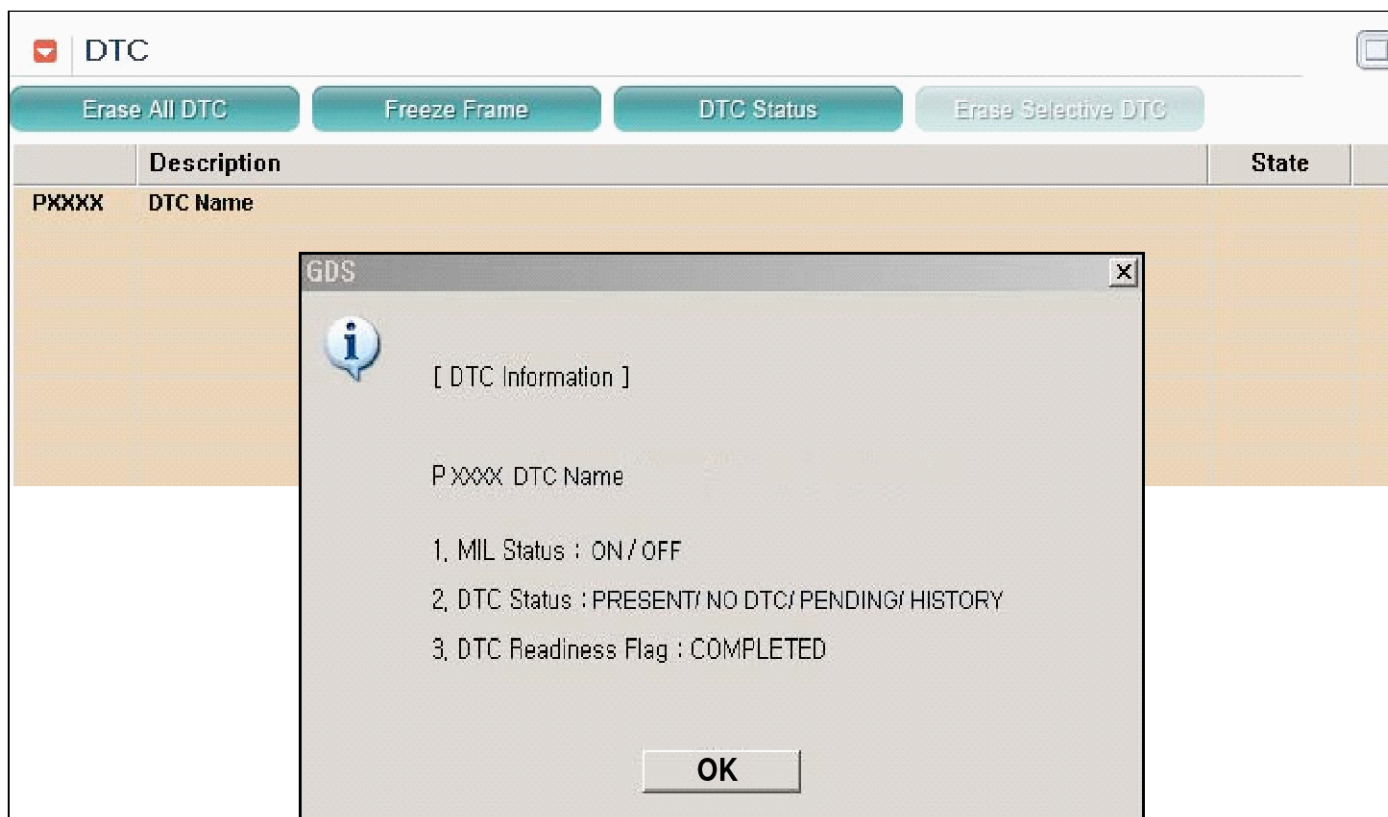
FL-484

Fuel System

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Signal Circuit Inspection " procedure .

Signal Circuit Inspection

■ Check voltages

1. IG "OFF" and disconnect CKPS connector.
2. IG "ON".
3. Measure voltage between low signal terminal of CKPS harness connector and chassis ground.
4. Measure voltage between high signal terminal of CKPS harness connector and chassis ground.

Specification : Approx. 1.4V

5. Is the measured voltage within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Go to "Check open in harness" as follows.

Engine Control System

FL-485

■ Check open in harness

1. IG "OFF" and disconnect CKPS connector and ECM connector.
2. Measure resistance between low signal terminal of CKPS harness connector and CKPS low signal terminal of ECM harness connector.
3. Measure resistance between high signal terminal of CKPS harness connector and CKPS high signal terminal of ECM harness connector.

Specification : Below 1Ω

4. Is the measured resistance within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check CKPS

1. IG "OFF" and disconnect CKPS connector.
2. Measure resistance between low signal and high signal terminals of CKPS connector.(Component side)

Specification : $700 \pm 70\Omega$ (at 20°C / 68°F)

3. Is the measured resistance within specification ?

YES ► Go to "Check signal waveform of CKPS" as follows.

NO ► Substitute with a known - good CKPS and check for proper operation. If the problem is corrected, replace CKPS and go to "Verification of Vehicle Repair" procedure.

■ Check signal waveform of CKPS

1. IG "OFF" and connect scantool.
2. NG "ON" and Measure signal waveform at signal terminal of CKPS.

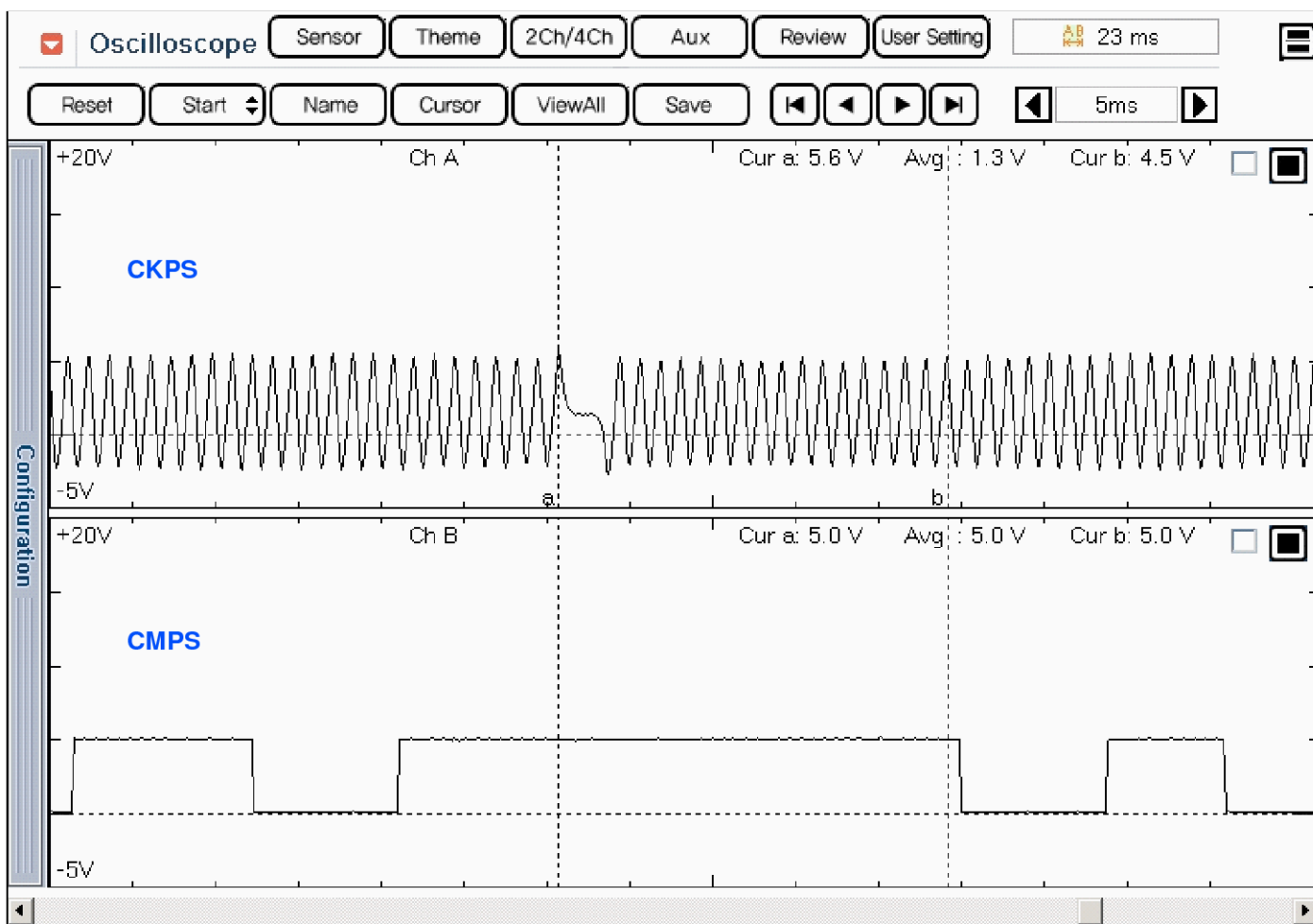


Fig.1

SBHFL9613L

Fig 1) Normal waveforms of CKPS & CMPS

3. Is the measured signal waveform normal?

YES ► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary, and go to "Verification of Vehicle Repair" procedure.

NO ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-487

P0336 Crankshaft Position Sensor "A" Circuit Range/Performance

Component Location

Refer to DTC P0335 : Crankshaft Position Sensor "A" Circuit

General Description

Refer to DTC P0335 : Crankshaft Position Sensor "A" Circuit

DTC Description

Checking output signals from CKPS every 7.8 sec. under detecting condition, if an output signal is missing or redundant for more than 1.56 sec., ECM sets P0336. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Detecting extra/missing pulses between consecutive 58 X reference pulses	• Poor connection • Noise • Short in harness • Target wheel • ECM
Enable Conditions	• Engine running state	
Threshold value	• Extra / missing pulses > 2 pulses	
Diagnosis Time	• Continuous (More than 1.56 sec.failure for every 7.8 sec.test)	
MIL On Condition	• 2 Driving Cycles	

Specification

Refer to DTC P0335 : Crankshaft Position Sensor "A" Circuit

Diagnostic Circuit Diagram

Refer to DTC P0335 : Crankshaft Position Sensor "A" Circuit

Signal Waveform & Data

Refer to DTC P0335 : Crankshaft Position Sensor "A" Circuit

Monitor Scantool Data

Refer to DTC P0335 : Crankshaft Position Sensor "A" Circuit

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Signal Circuit Inspection " procedure

Signal Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect CKPS connector.
2. IG "ON".
3. Measure voltage between low signal terminal of CKPS harness connector and chassis ground.
4. Measure voltage between high signal terminal of CKPS harness connector and chassis ground.

Specification : Approx. 1.4V

5. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Go to "Check short in harness" as follows.

■ Check short in harness

1. IG "OFF" and disconnect CKPS connector and ECM connector.
2. Measure resistance between low(high) signal terminal of CKPS harness connector and chassis ground.(Measurement "A")
3. Measure resistance between low signal and high signal terminals of CKPS harness connector.(Measurement "B")

Specification : Infinite

FL-488

Fuel System

4. Is the measured resistance within specification?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Visually check CKPS and target wheel

1. IG "OFF"
2. Check CKPS and target wheel for deformation or damage visually
3. Is the above items normal ?

YES ▶ Go to "Check CKPS resistance" as follows.

NO ▶ Repair or replace it, and go to "Verification of Vehicle Repair" procedure.

■ Check CKPS

1. IG "OFF" and disconnect CKPS connector.
2. Measure resistance between low signal and high signal terminals of CKPS connector.(Component side)

Specification : $700 \pm 70\Omega$ (at 20°C/ 68°F)

3. Is the measured signal waveform normal?

YES ▶ Go to "Check signal waveform of CKPS" as follows.

NO ▶ Substitute with a known - good CKPS and check for proper operation. If the problem is corrected, replace CKPS and go to "Verification of Vehicle Repair" procedure.

Engine Control System

FL-489

■ Check signal waveform of CKPS

1. IG "OFF" and connect scantool.
2. ENG "ON" and Measure signal waveform at signal terminal of CKPS.

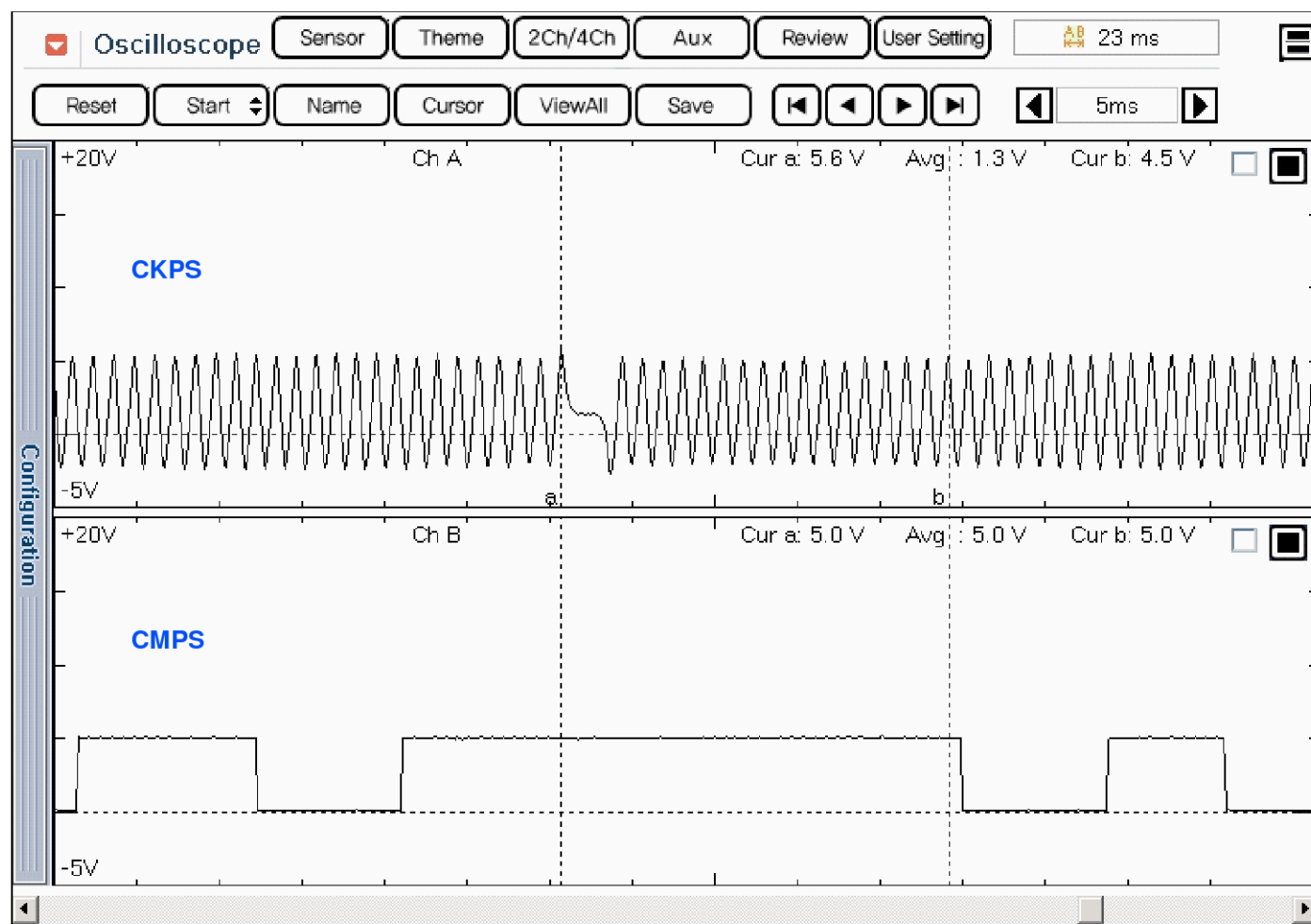


Fig.1

Fig 1) Normal waveforms of CKPS & CMPS

3. Is the measured signal waveform normal?

YES ► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary, and go to "Verification of Vehicle Repair" procedure.

NO ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

Verification of Vehicle Repair

Refer to DTC P0335 : Crankshaft Position Sensor "A" Circuit

SBHFL9613L

FL-490

Fuel System

P0340 Camshaft Position Sensor "A" Circuit (Single Sensor)

Component Location



SBHFL9305L

General Description

The Camshaft Position Sensor (CMPS) is a sensor that detects the compression TDC of the NO. 1 cylinder. The CMPS consists of a hall type sensor and a target on the end of the intake camshaft. When the target triggers the sensor, the sensor voltage is 5V. If not, the sensor voltage is 0V. These CMPS signal is sent to the ECM and the ECM uses the CMPS signal for synchronizing the firing of sequential fuel injectors.

DTC Description

If ECM detects that cam event signal count is over 3 under detecting condition, ECM sets P0340. And MIL(Malfunction Indication Lamp) turns on.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Check if CAM sensor is synchronized correctly	• Poor connection • Open in harness • CMPS(B1-Intake) • ECM
Enable Conditions	• Engine running state	
Threshold value	• CAM event signal count ≥ 3	
Diagnosis Time	• Continuous	
MIL On Condition	• 1 Driving Cycles	

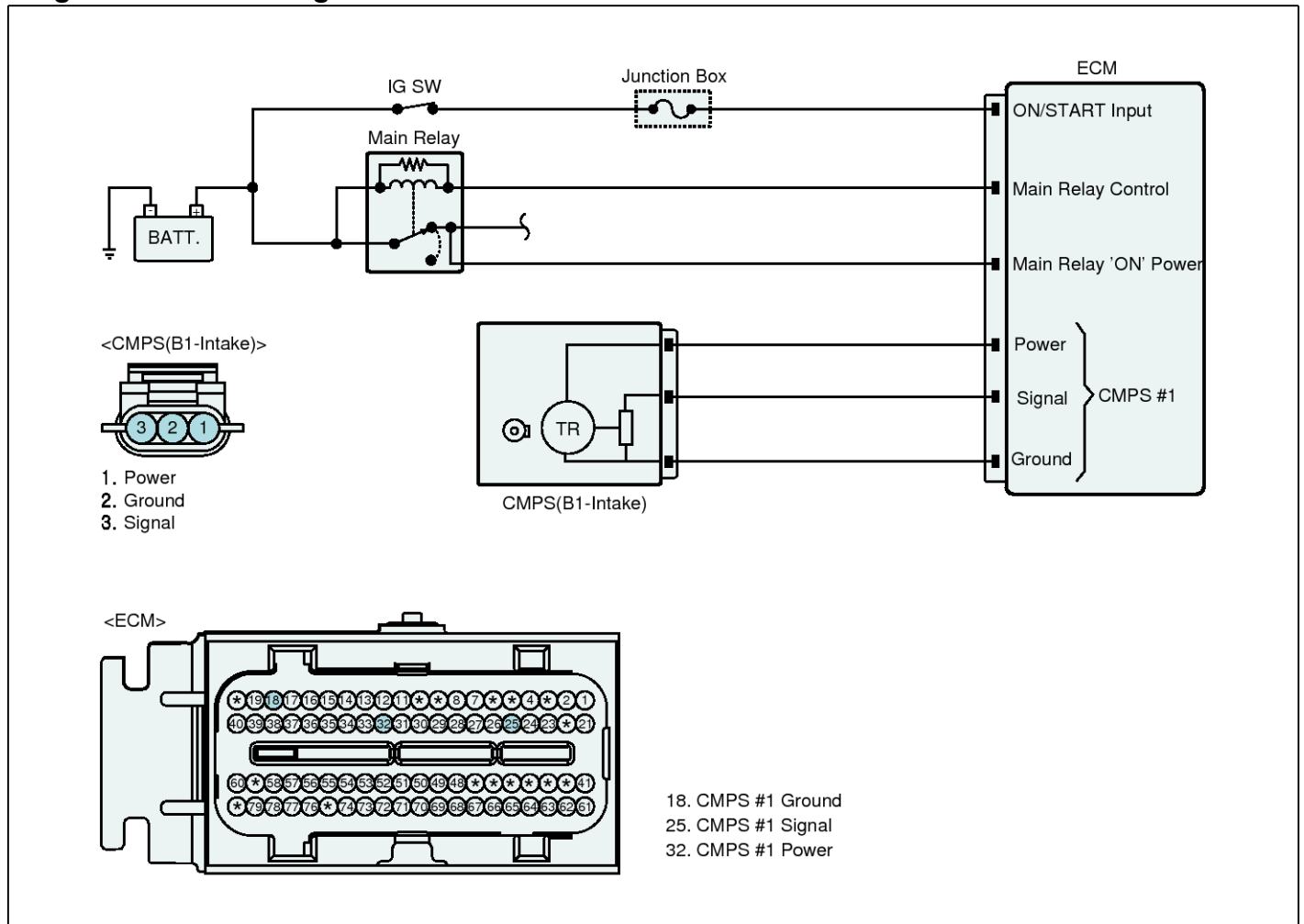
Specification

Item	Specification	
Output Voltage(V)	Hi : 5.0V	Low : 0.7V
Airgap(mm)	0.5 ~ 1.5	

Engine Control System

FL-491

Diagnostic Circuit Diagram



SBHFL9523L

Signal Waveform & Data

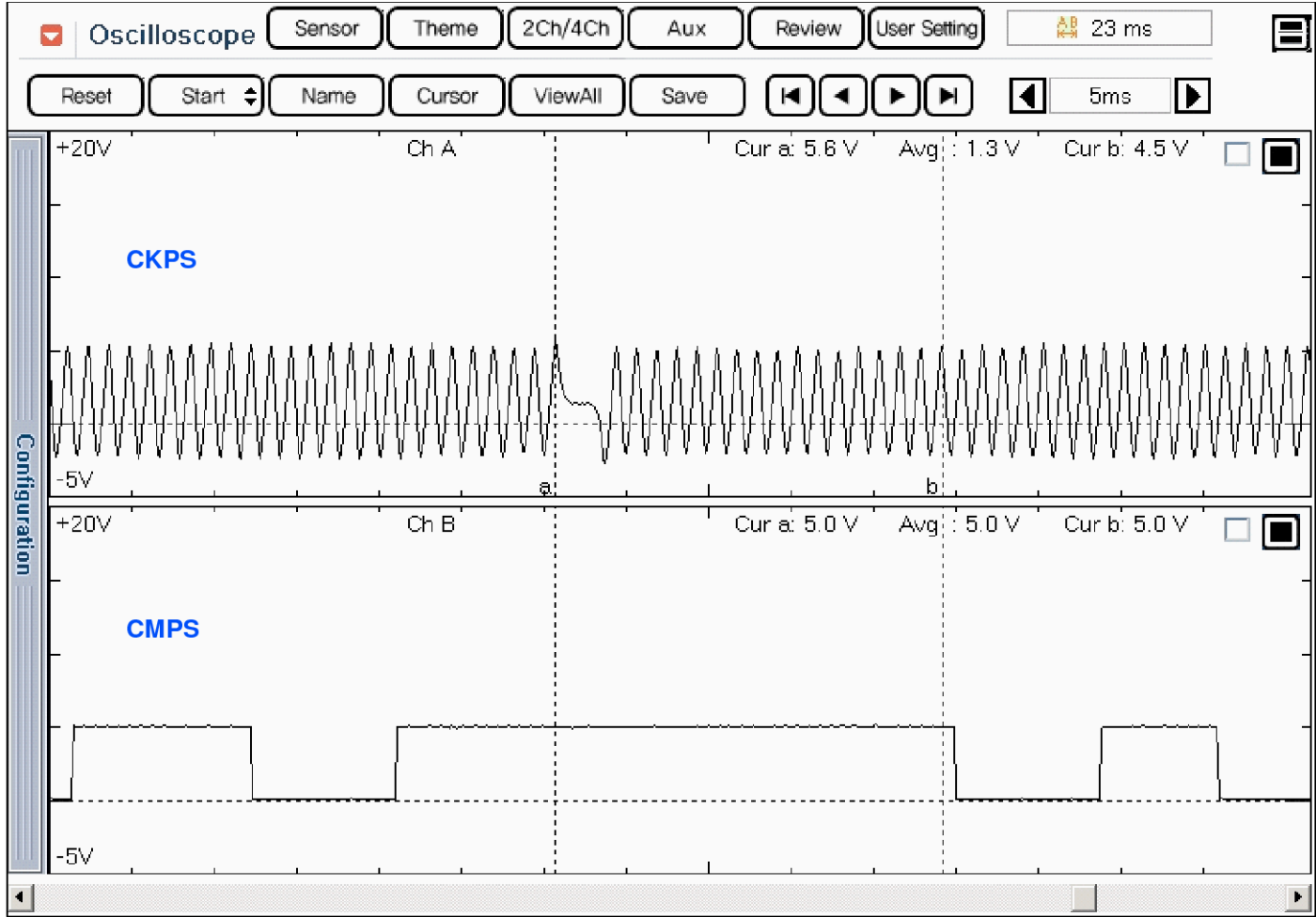


Fig.1

SBHFL9613L

Fig 1) Normal waveforms of CKPS & CMPS

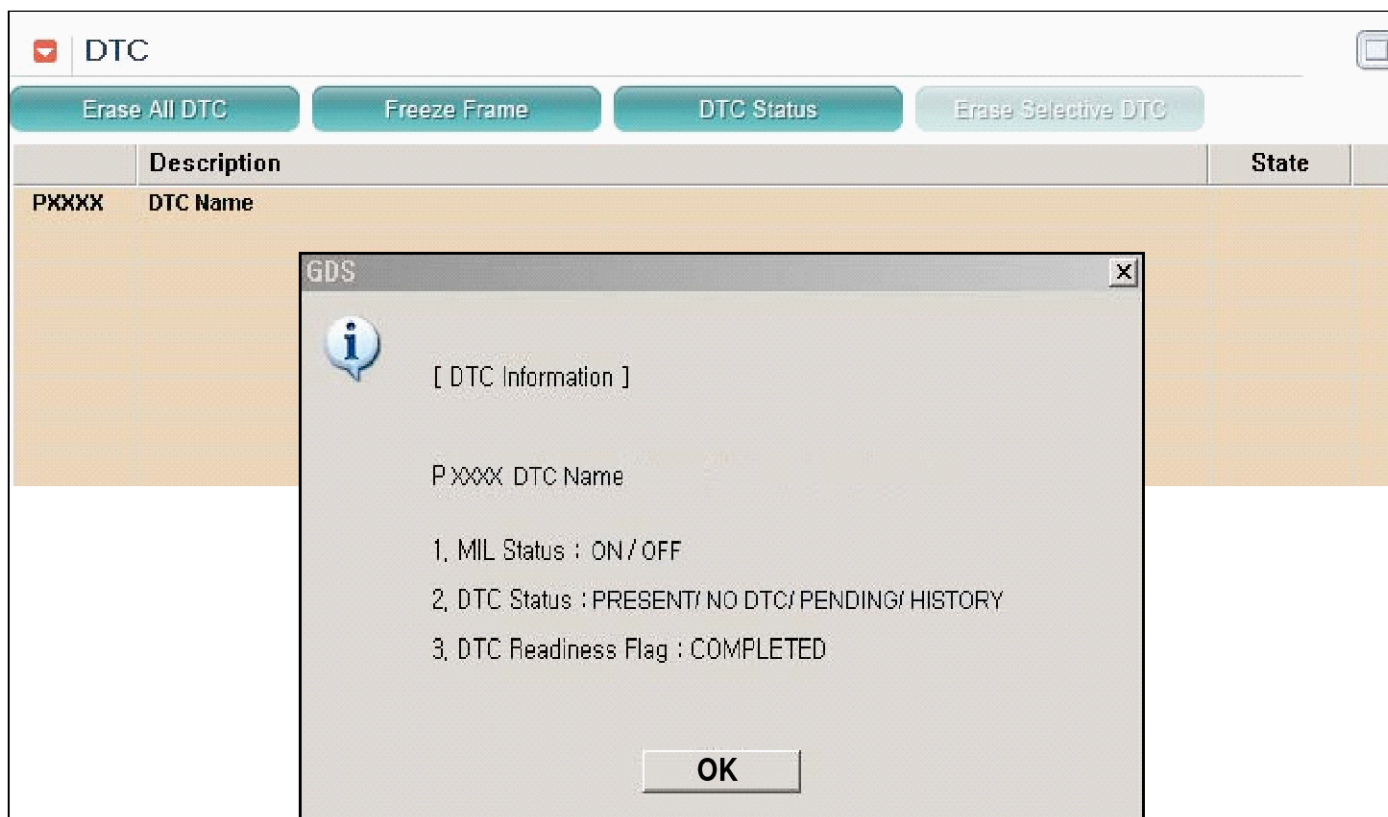
Engine Control System

FL-493

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Power Circuit Inspection " procedure .

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect CMPS(B1-Intake) connector.
2. IG "ON".
3. Measure voltage between power terminal of CMPS(B1-Intake) harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ► Go to "Signal Circuit Inspection" procedure.

NO ► Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Signal Circuit Inspection

■ Check short to battery in harness

1. IG "OFF" and disconnect CMPS(B1-Intake) connector.
2. IG "ON".
3. Measure voltage between signal terminal of CMPS(B1-Intake) harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Go to "Check open in harness" as follows.

■ Check open in harness

1. IG "OFF" and disconnect CMPS(B1-Intake) connector and ECM connector.
2. Measure resistance between signal terminal of CMPS(B1-Intake) harness connector and CMPS(B1-Intake) signal terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Ground Circuit Inspection

■ Check open in harness

1. IG "OFF" and disconnect CMPS(B1-Intake) connector and then IG "ON".
2. Measure voltage between signal terminal of CMPS(B1-Intake) harness connector and chassis ground.(Measurement "A")
3. Measure voltage between signal and ground terminals of CMPS(B1-Intake) harness connector.(Measurement "B")

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair contact resistance or open in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check CMPS

1. IG "OFF" and connect scantool.
2. ENG "ON" and Measure signal waveform at signal terminal of CMPS.

Reference signal waveform :

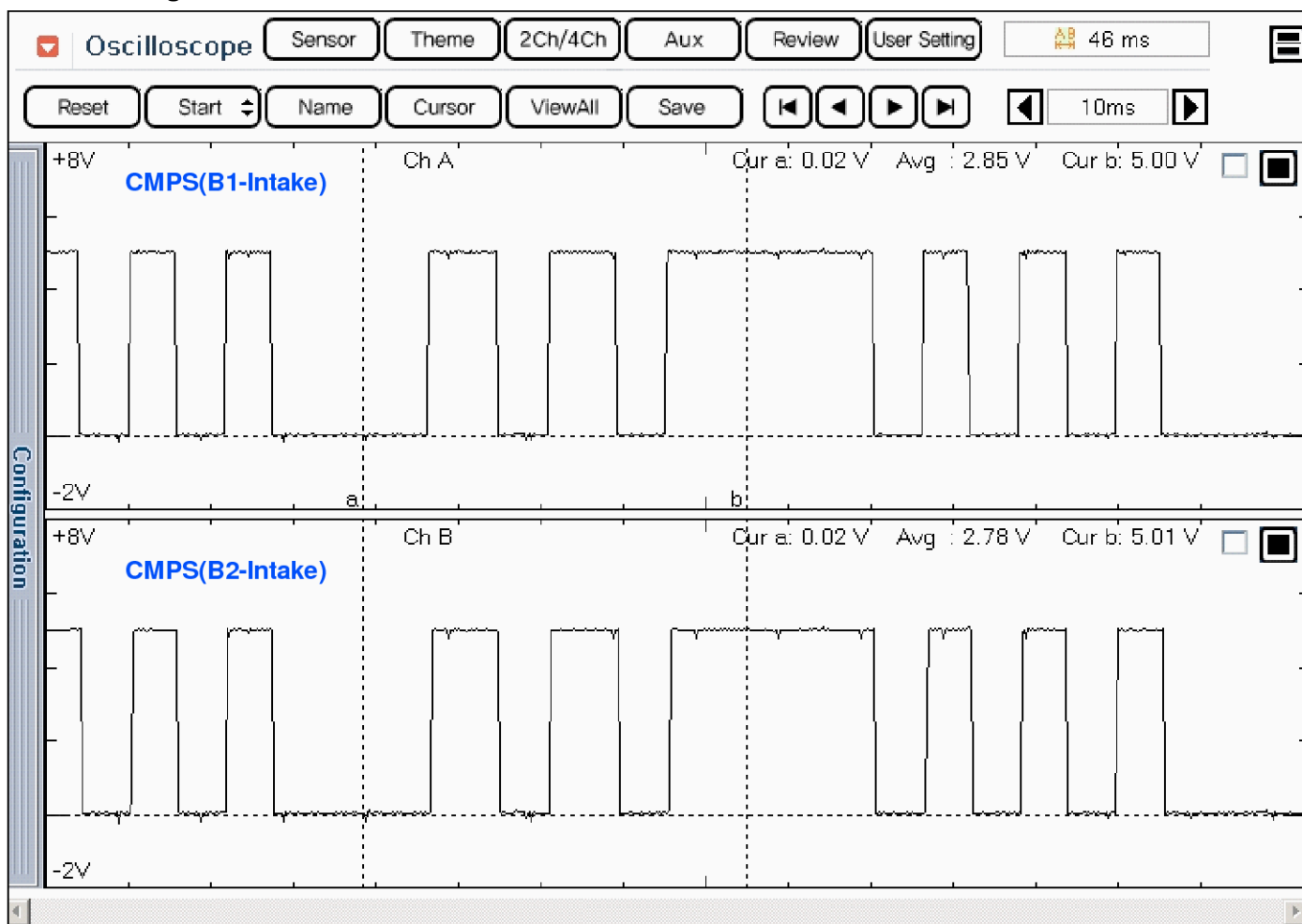


Fig.1

SBHFL9654L

Fig 1) Normal waveform of CMPS1 & 2 at idle.

3. Is the measured signal waveform normal?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good CMPS and check for proper operation. If the problem is corrected, replace CMPS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

FL-496

Fuel System

P0341 Camshaft Position Sensor A Circuit Range/Performance (Bank 1)

Component Location

Refer to DTC P0340 : Camshaft Position Sensor "A" Circuit (Single Sensor)

General Description

Refer to DTC P0340 : Camshaft Position Sensor "A" Circuit (Single Sensor)

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Check if CAM sensor is synchronized correctly	• Poor connection • Short in harness • Electrical noise • Target wheel • CMPS(B1-Intake) • ECM
Enable Conditions	• Engine running state	
Threshold value	• Cam tooth count $\neq$ 6	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

Specification

Refer to DTC P0340 : Camshaft Position Sensor "A" Circuit (Single Sensor)

Diagnostic Circuit Diagram

Refer to DTC P0340 : Camshaft Position Sensor "A" Circuit (Single Sensor)

Signal Waveform & Data

Refer to DTC P0340 : Camshaft Position Sensor "A" Circuit (Single Sensor)

Monitor Scantool Data

Refer to DTC P0340 : Camshaft Position Sensor "A" Circuit (Single Sensor)

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Power Circuit Inspection " procedure

DTC Description

Checking output signals from CMP during engine running, if the expected number of cam tooth count is not observed, ECM sets P0341.

MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

Power Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect CMPS(B1-Intake) connector.
- IG "ON".
- Measure voltage between power terminal of CMPS(B1-Intake) harness connector and chassis ground.

Specification : Approx. 5V

- Is the measured voltage within specification ?

YES ▶ Go to "Signal Circuit Inspection" procedure.

NO ▶ Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

Signal Circuit Inspection

■ Check short in harness

- IG "OFF" and disconnect CMPS(B1-Intake) connector.
- Measure resistance between signal and power terminals of CMPS(B1-Intake) harness connector.

Specification : Infinite

- Is the measured resistance within specification?

YES ▶ Go to "Check short to ground in harness" as follows.

NO ▶ Repair short in harness, and go to "Verification of Vehicle Repair" procedure.

Engine Control System

FL-497

■ Check short to ground in harness

1. IG "OFF" and disconnect CMPS(B1-Intake) connector and ECM connector.
2. Measure resistance between signal terminal of CMPS(B1-Intake) harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check CMPS

1. IG "OFF" and connect scantool.
2. ENG "ON" and Measure signal waveform at signal terminal of CMPS.

Reference signal waveform :

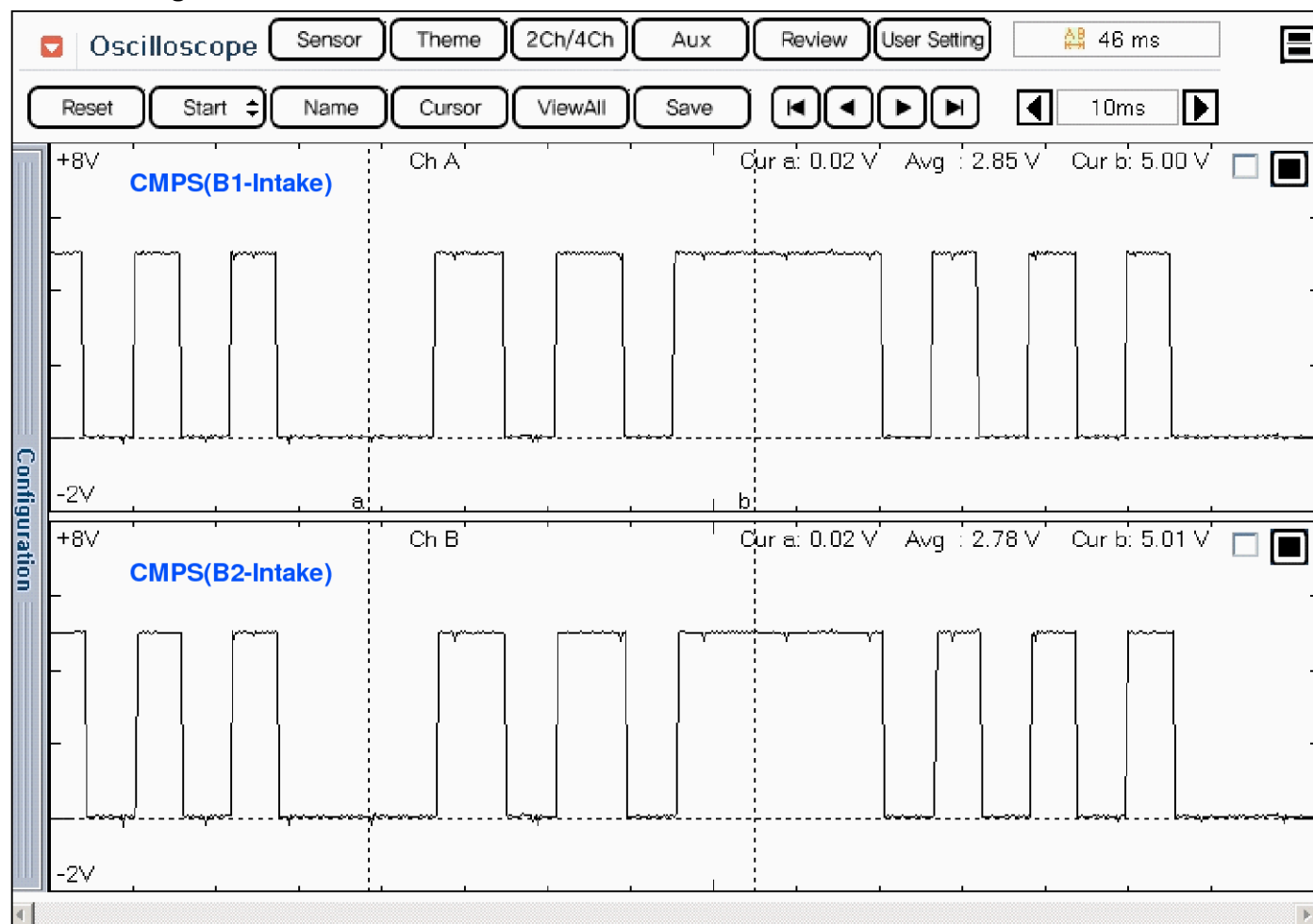


Fig.1

SBHFL9654L

Fig 1) Normal waveform of CMPS1 & 2 at idle.

3. Is the measured signal waveform normal?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

 NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good CMPS and check for proper operation. If the problem is corrected, replace CMPS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

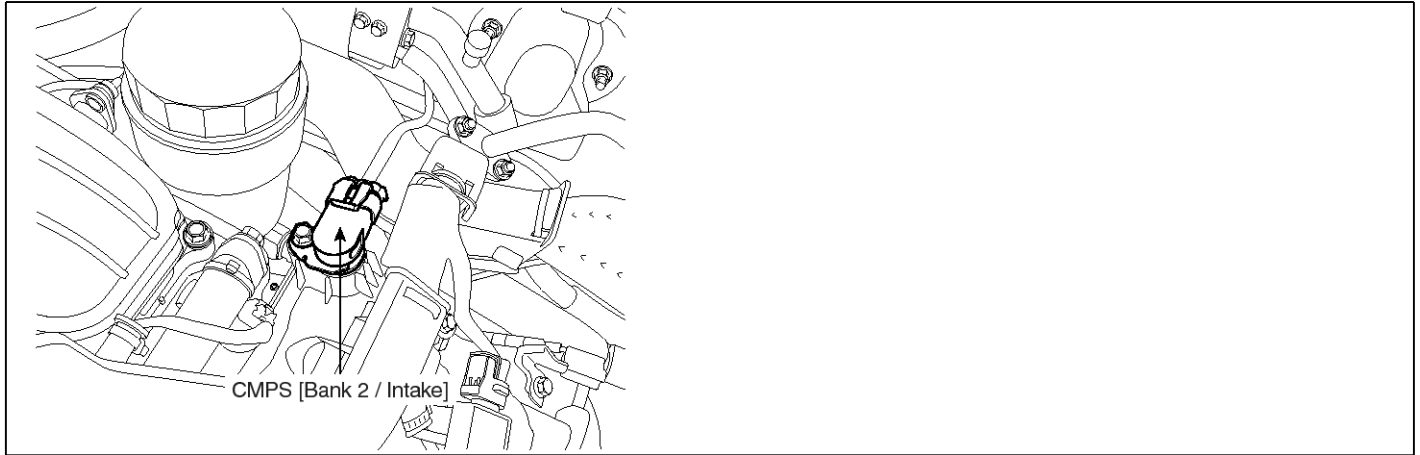
Refer to DTC P0340 : Camshaft Position Sensor "A" Circuit (Single Sensor)

Engine Control System

FL-499

P0346 Camshaft Position Sensor A Circuit Range/Performance (Bank 2)

Component Location



SBHFL9307L

General Description

The Camshaft Position Sensor (CMPS) is a sensor that detects the compression TDC of the NO. 1 cylinder. The CMPS consists of a hall type sensor and a target on the end of the intake camshaft. When the target triggers the sensor, the sensor voltage is 5V. If not, the sensor voltage is 0V. These CMPS signal is sent to the ECM and the ECM uses the CMPS signal for synchronizing the firing of sequential fuel injectors.

DTC Description

Checking oputput signals from CMP during engine running, if the expected number of cam tooth count is not observed, ECM sets P0346.

MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

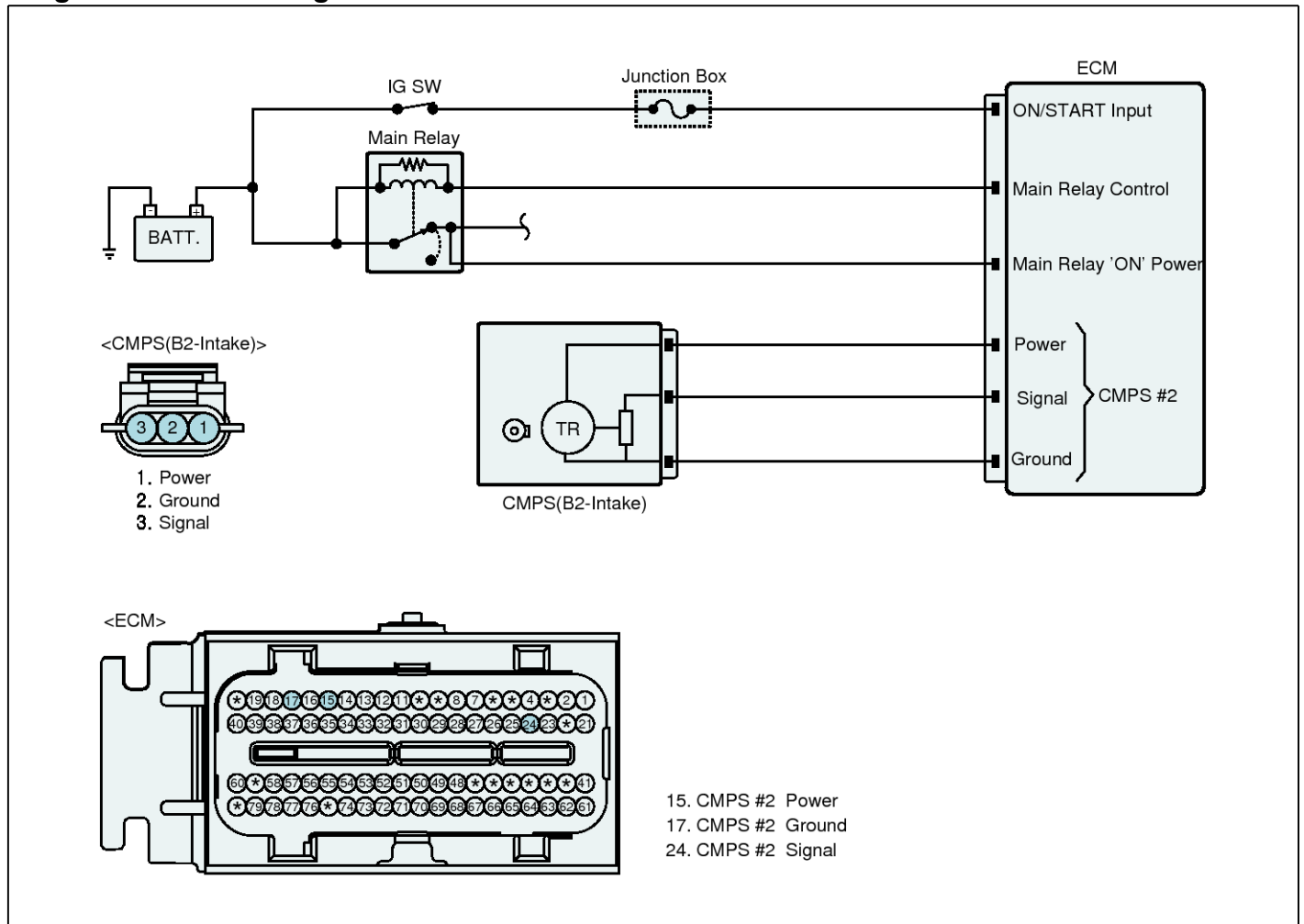
DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Check if CAM sensor is synchronized correctly	• Poor connection • Open or short in harness • Electrical noise • Target wheel • CMPS(B2-Intake) • ECM
Enable Conditions	• Engine running state	
Threshold value	• Cam tooth count $\neq$ 6	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

Specification

Item	Specification	
Output Voltage(V)	Hi : 5.0V	Low : 0.7V
Airgap(mm)	0.5 ~ 1.5	

Diagnostic Circuit Diagram



SBHFL9524L

Signal Waveform & Data

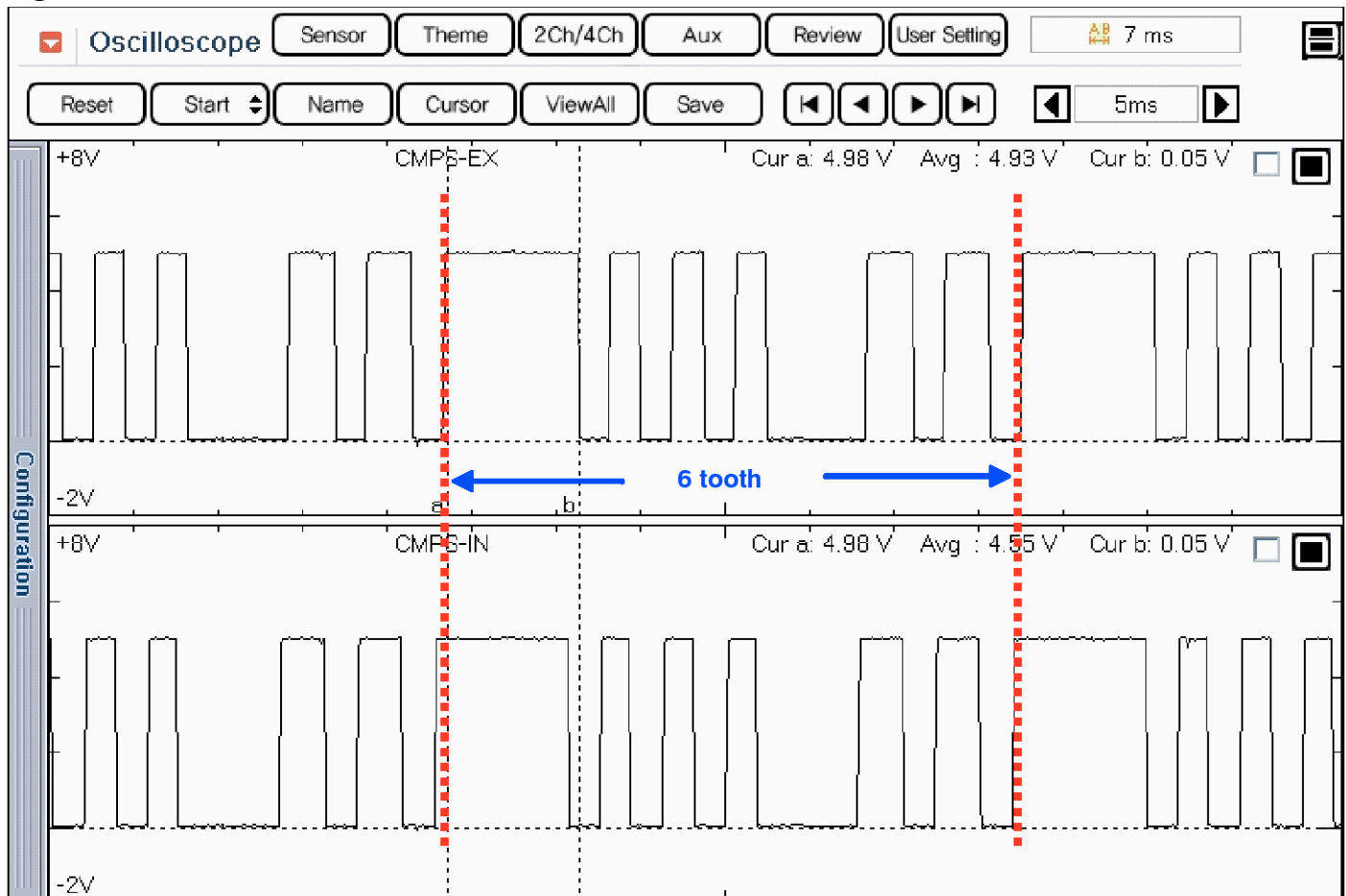


Fig.1

SBHFL9655L

Fig 1) Normal waveforms of CMPS

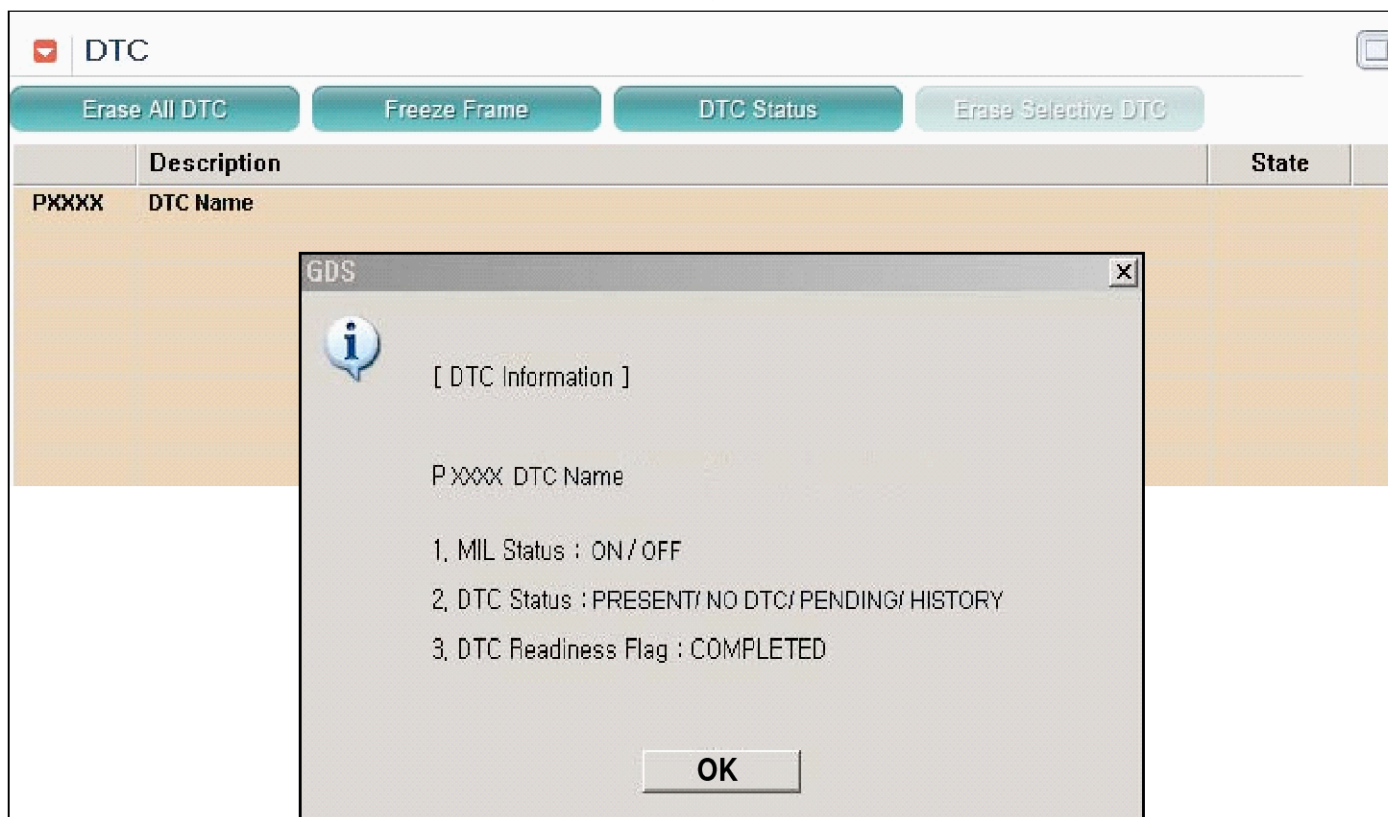
FL-502

Fuel System

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Power Circuit Inspection " procedure .

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect CMPS(B2-Intake) connector.
2. IG "ON".
3. Measure voltage between power terminal of CMPS(B2-Intake) harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ► Go to "Signal Circuit Inspection" procedure.

Engine Control System

FL-503

- NO** ▶ Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

Signal Circuit Inspection

■ Check short to battery in harness

1. IG "OFF" and disconnect CMPS(B2-Intake) connector.
2. IG "ON".
3. Measure voltage between signal terminal of CMPS(B2-Intake) harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ▶ Go to "Check short in harness" as follows.

NO ▶ Go to "Check open in harness" as follows.

■ Check short in harness

1. IG "OFF" and disconnect CMPS(B2-Intake) connector and ECM connector.
2. Measure resistance between signal and power terminals of CMPS(B2-Intake) harness connector.

Specification : Infinite

3. Is the measured resistance within specification?

YES ▶ Go to "Check short to ground in harness" as follows.

NO ▶ Repair short in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check short to ground in harness

1. IG "OFF" and disconnect CMPS(B2-Intake) connector and ECM connector.
2. Measure resistance between signal terminal of CMPS(B2-Intake) harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect CMPS(B2-Intake) connector and ECM connector.
2. Measure resistance between signal terminal of CMPS(B2-Intake) harness connector and CMPS(B2-Intake) signal terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Ground Circuit Inspection

■ Check open in harness

1. IG "OFF" and disconnect CMPS(B2-Intake) connector and then IG "ON".
2. Measure voltage between signal terminal of CMPS(B2-Intake) harness connector and chassis ground. (Measurement "A")
3. Measure voltage between signal and ground terminals of CMPS(B2-Intake) harness connector. (Measurement "B")

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair contact resistance or open in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check CMPS

1. IG "OFF" and connect scantool.
2. ENG "ON" and Measure signal waveform at signal terminal of CMPS.

Reference signal waveform :

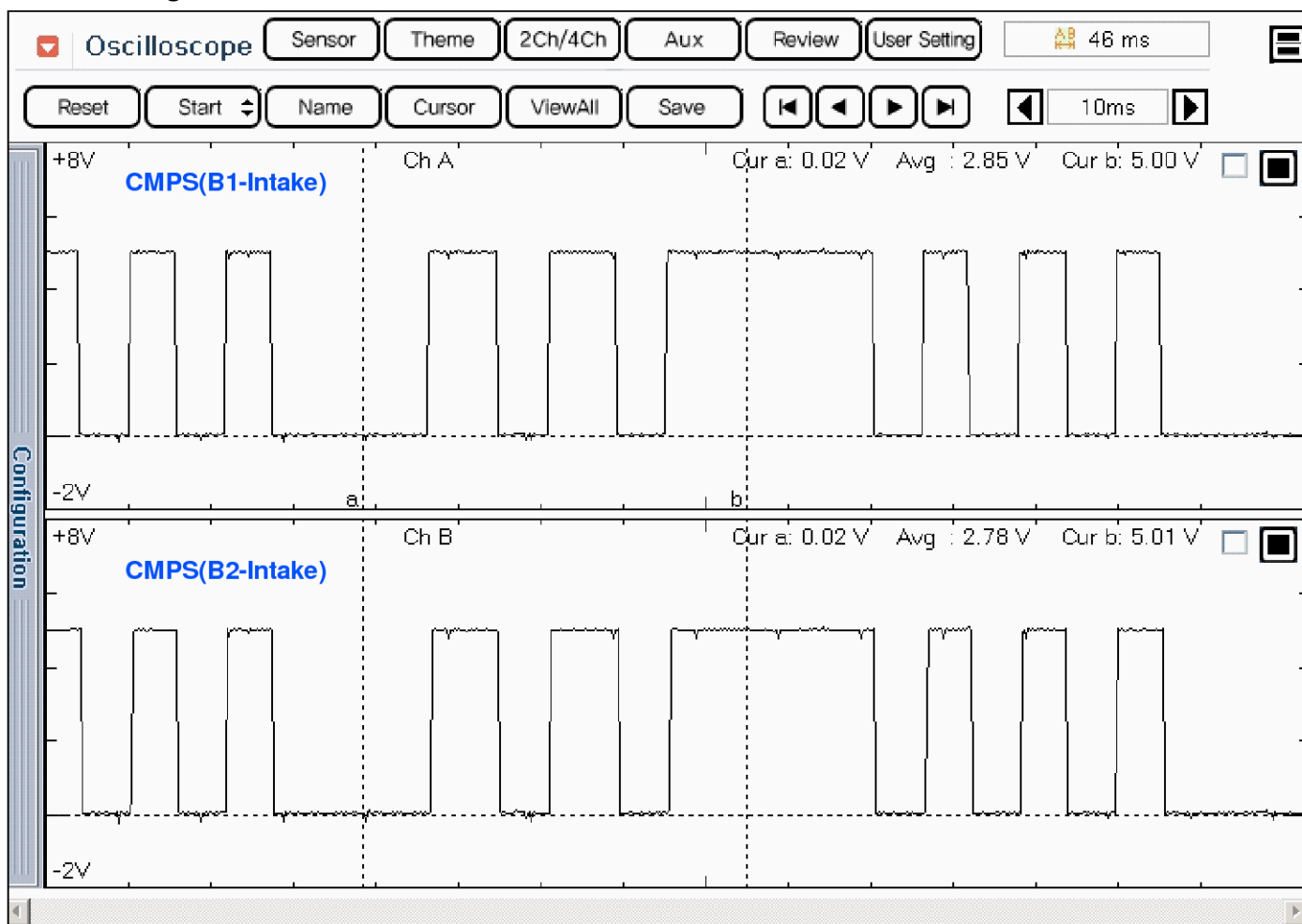


Fig.1

SBHFL9654L

Fig 1) Normal waveform of CMPS1 & 2 at idle.

3. Is the measured signal waveform normal?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good CMPS and check for proper operation. If the problem is corrected, replace CMPS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

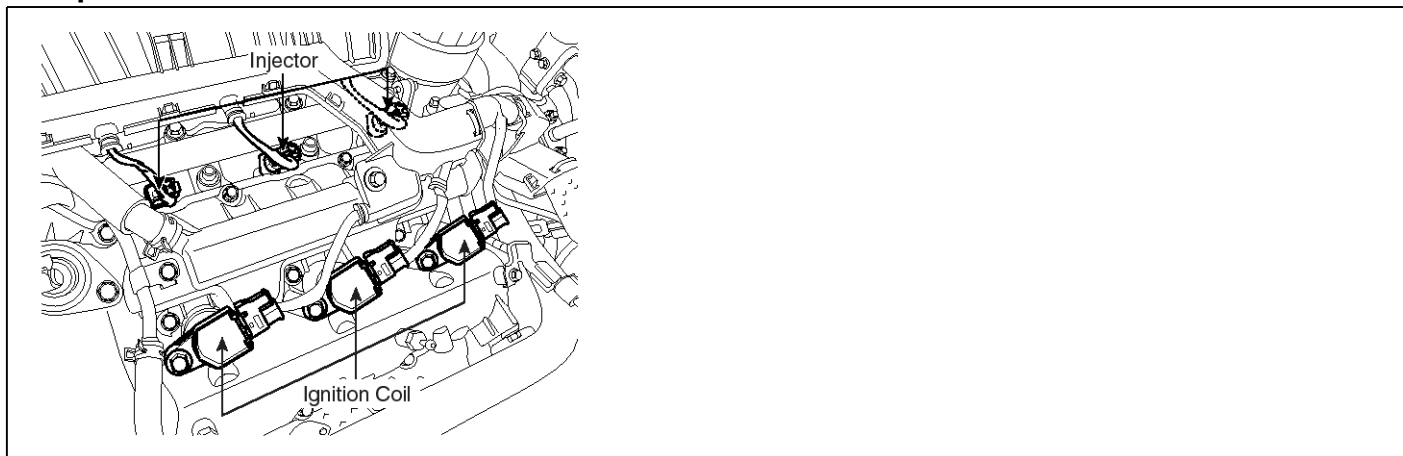
NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-505

P0351 Ignition Coil 'A' Primary / Secondary Circuit

Component Location



SBHFL9318L

General Description

With the ignition switch in the ON or START position, voltage is applied to the ignition coil. Each ignition coil consists of two coils. High tension leads go to each cylinder from the ignition coils. The ignition coils fire two spark plugs on every power stroke (the cylinder under compression and the cylinder on the exhaust stroke). The Engine Control Module (ECM) provides a switching circuit to ground for energizing the primary ignition coils. The ECM uses the crankshaft position sensor and camshaft position sensor signal to time the energizing of the coil. When a primary ignition coil is energized and de-energized, the secondary coil produces a high voltage spike to the attached spark plugs.

DTC Description

Checking output signals from ignition coils every 10 sec. under detecting condition, if the signals indicating open or short in the circuit are detected for more than 5 sec., ECM sets this DTC. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Detects a short to ground, to battery or open circuit	• Poor connection • Open or short in harness • Ignition Coil • ECM
Enable Conditions	• NO DTC related to this item • Engine running state • $11V \leq \text{Battery voltage} \leq 16V$ • The above conditions are met > 0.5 sec.	
Threshold value	• Open or short	
Diagnosis Time	• Continuous (More than 5 sec.failure for every 10 sec.test)	
MIL On Condition	• 2 driving cycles	

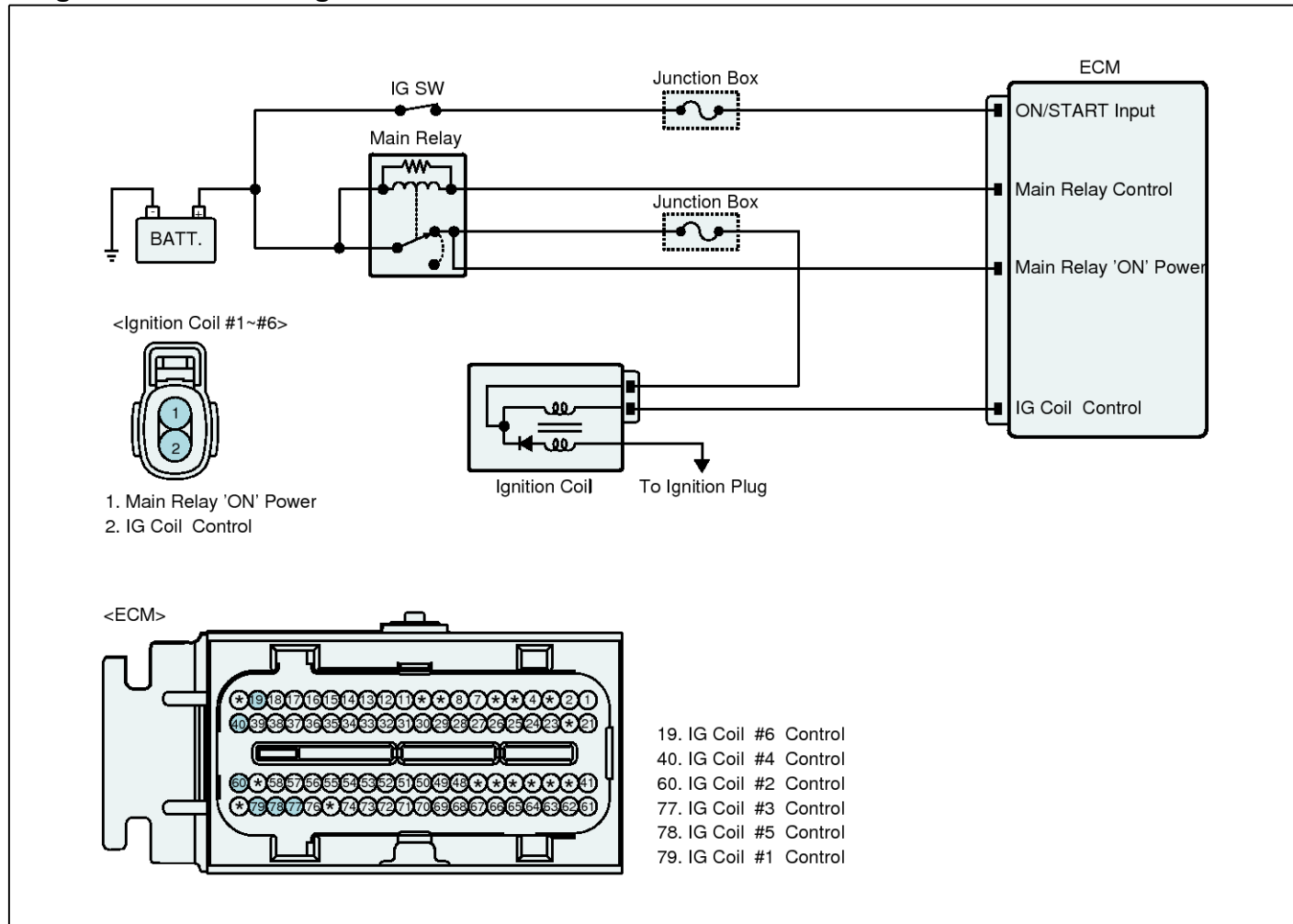
FL-506

Fuel System

Specification

Resistance(Ω)	Primary Coil	Secondary Coil
	$0.62 \pm 10\% (20^{\circ}\text{C})$	$7.0\text{k} \pm 15\% (20^{\circ}\text{C})$

Diagnostic Circuit Diagram



SBHFL9525L

Signal Waveform & Data

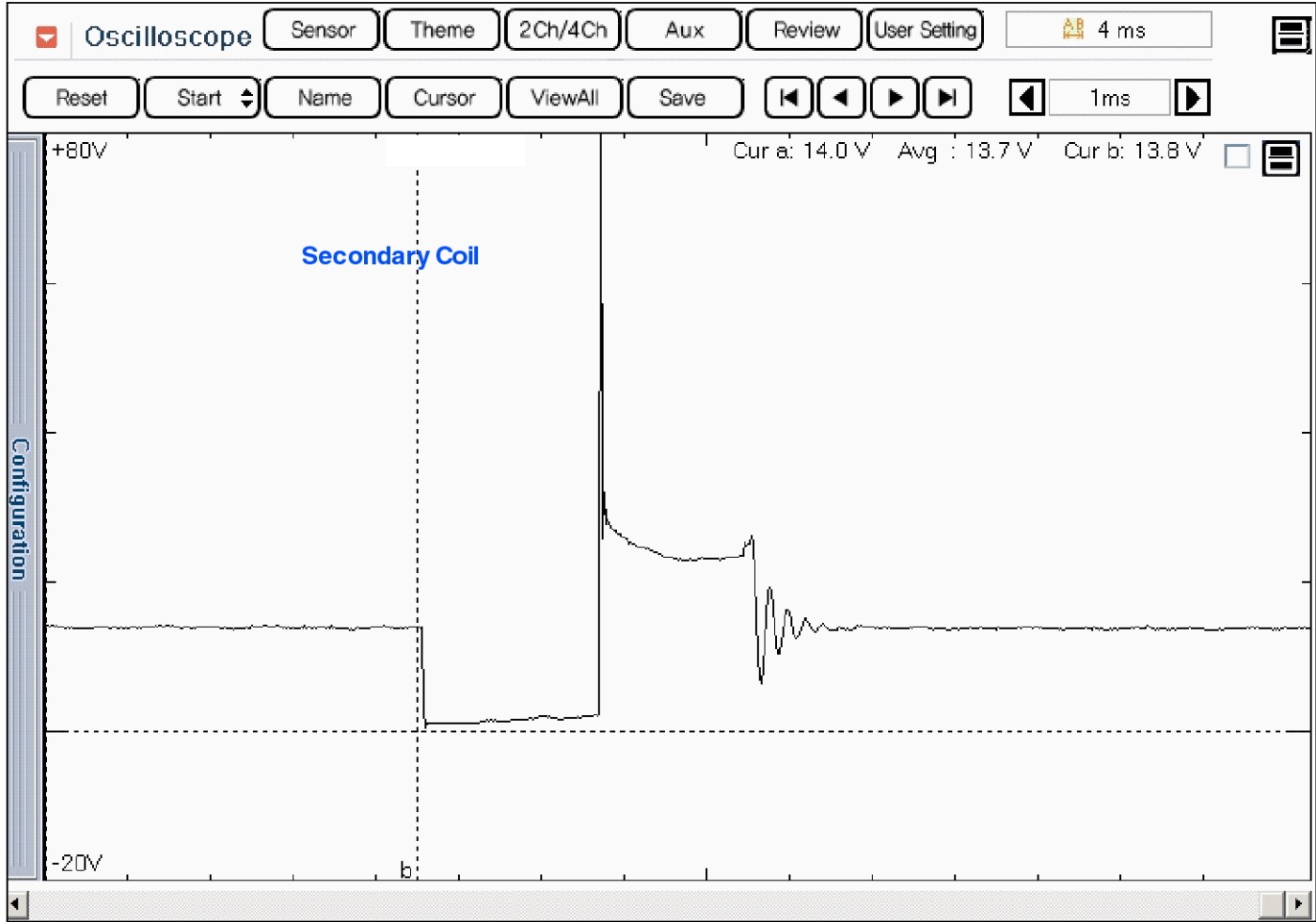


Fig.1

SBHFL9656L

Current Data			
Standard Display	Full List	Graph	Items List
Reset Min.Max.	Record	Stop	VSS
Sensor Name	Value	Unit	
☒ Cylinder 1 Injection Time	0.8	mS	
☒ Cylinder 2 Injection Time	0.8	mS	
☒ Cylinder 3 Injection Time	0.8	mS	
☒ Cylinder 4 Injection Time	0.8	mS	
☒ Cylinder 5 Injection Time	0.8	mS	
☒ Cylinder 6 Injection Time	0.8	mS	

Fig.2

SBHFL9657L

FL-508

Fuel System

☒ **Current Data**

Standard Display ▾ Full List ▾ Graph ▾ Items List ▾ Reset Min.Max. Record Stop ▾ VSS

Sensor Name	Value	Unit
☐ Cylinder 1 Injection Time	1.6	mS
☐ Cylinder 2 Injection Time	0.0	mS
☐ Cylinder 3 Injection Time	1.6	mS
☐ Cylinder 4 Injection Time	1.6	mS
☐ Cylinder 5 Injection Time	1.6	mS
☐ Cylinder 6 Injection Time	1.6	mS
☐ Actual Torque	13.8	%
☐ Torque Control Request	100.0	%

☒ **DTC**

Erase All DTC Freeze Frame DTC Status Erase Selective DTC

	Description	State
P0352	Ignition Coil 'B' Primary / Secondary Circuit	
P0302	Cylinder 2-Misfire detected	

Fig.3

SBHFL9658L

Fig 1) Normal waveforms of secondary coil at idle.

Fig 2) Normal data of Injection time at idle.

Fig 2) Abnormal data of Injection time when ignition coil (cylinder 2) open.

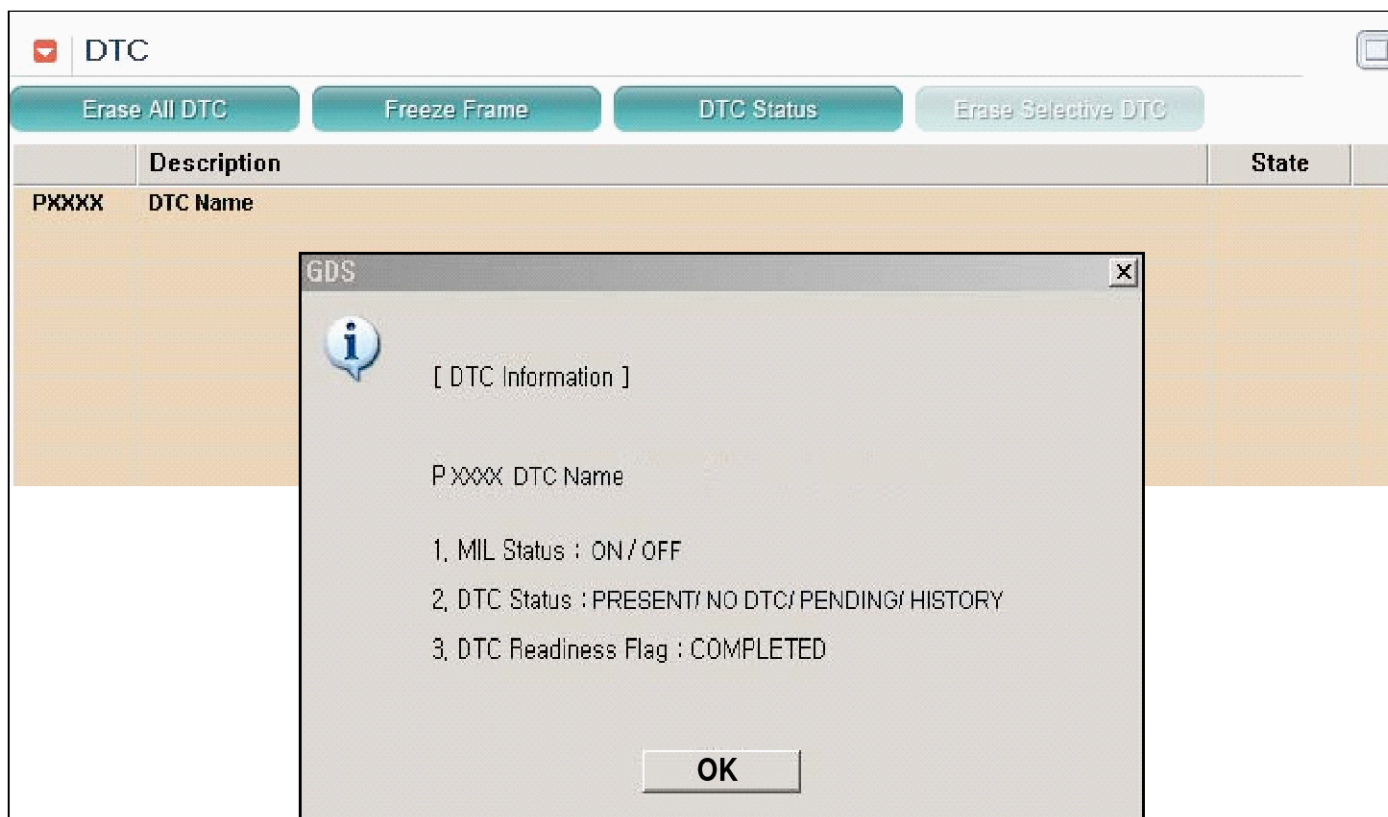
Engine Control System

FL-509

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Power Circuit Inspection " procedure .

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect Ignition Coil connector.
2. IG "ON".
3. Measure voltage between power terminal of ignition coil harness connector and chassis ground.

Specification : Approx. B+

4. Is the measured voltage within specification ?

YES ► Go to "Control Circuit Inspection" procedure.

NO ► Check fuse connected to ignition coil for open.
► Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

FL-510

Fuel System

Control Circuit Inspection

■ Check short to battery in harness

1. IG "OFF" and disconnect ignition coil connector and ECM connector.
2. Measure resistance between power and control terminals of ignition coil harness connector.

Specification : Infinite

3. Is the measured resistance within specification?

YES ▶ Go to "Check short to ground in harness" as follows.

NO ▶ Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check short to ground in harness

1. IG "OFF" and disconnect ignition coil connector and ECM connector.
2. Measure resistance between control terminal of ignition coil harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect Ignition Coil connector and ECM connector.
2. Measure resistance between control terminal of Ignition Coil harness connector and IG Coil #1 control terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check Ignition Coil

1. IG "OFF" and disconnect ignition coil connector.
2. Measure resistance between power and signal terminals of ignition coil connector.(Measurement "A")

3. Measure resistance between power terminal of ignition coil connector and out terminal of secondary ignition coil.(Measurement "B")

Specification :

	Primary Coil	Secondary Coil
Resistance(Ω)	$0.62 \pm 10\%$ (20℃)	$7.0k \pm 15\%$ (20℃)

4. Is the measured resistance within specification?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good Ignition Coil and check for proper operation. If the problem is corrected, replace Ignition Coil and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-511

P0352 Ignition Coil 'B' Primary / Secondary Circuit

Component Location

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

General Description

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

DTC Description

Checking output signals from ignition coils every 10 sec. under detecting condition, if the signals indicating open or short in the circuit are detected for more than 5 sec., ECM sets this DTC. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Detects a short to ground, to battery or open circuit	• Poor connection • Open or short in harness • Ignition Coil • ECM
Enable Conditions	• NO DTC related to this item • Engine running state • $11V \leq \text{Battery voltage} \leq 16V$ • The above conditions are met > 0.5 sec.	
Threshold value	• Open or short	
Diagnosis Time	• Continuous (More than 5 sec.failure for every 10 sec.test)	
MIL On Condition	• 2 driving cycles	

Specification

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Diagnostic Circuit Diagram

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Signal Waveform & Data

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Monitor Scantool Data

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Power Circuit Inspection " procedure .

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect Ignition Coil connector.
2. IG "ON".
3. Measure voltage between power terminal of ignition coil harness connector and chassis ground.

Specification : Approx. B+

4. Is the measured voltage within specification ?

YES ► Go to "Control Circuit Inspection" procedure.

NO ► Check fuse connected to ignition coil for open.
► Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

FL-512

Fuel System

Control Circuit Inspection

■ Check short to battery in harness

1. IG "OFF" and disconnect ignition coil connector and ECM connector.
2. Measure resistance between power and control terminals of ignition coil harness connector.

Specification : Infinite

3. Is the measured resistance within specification?

YES ▶ Go to "Check short to ground in harness" as follows.

NO ▶ Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check short to ground in harness

1. IG "OFF" and disconnect ignition coil connector and ECM connector.
2. Measure resistance between control terminal of ignition coil harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect Ignition Coil connector and ECM connector.
2. Measure resistance between control terminal of Ignition Coil harness connector and IG Coil #1 control terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check Ignition Coil

1. IG "OFF" and disconnect ignition coil connector.
2. Measure resistance between power and signal terminals of ignition coil connector.(Measurement "A")
3. Measure resistance between power terminal of ignition coil connector and out terminal of secondary ignition coil.(Measurement "B")

Specification :

	Primary Coil	Secondary Coil
Resistance(Ω)	$0.62 \pm 10\%$ (20℃)	$7.0k \pm 15\%$ (20℃)

4. Is the measured resistance within specification?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good Ignition Coil and check for proper operation. If the problem is corrected, replace Ignition Coil and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Engine Control System

FL-513

P0353 Ignition Coil 'C' Primary / Secondary Circuit

Component Location

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

General Description

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

DTC Description

Checking output signals from ignition coils every 10 sec. under detecting condition, if the signals indicating open or short in the circuit are detected for more than 5 sec., ECM sets this DTC. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Detects a short to ground, to battery or open circuit	• Poor connection • Open or short in harness • Ignition Coil • ECM
Enable Conditions	• NO DTC related to this item • Engine running state • $11V \leq \text{Battery voltage} \leq 16V$ • The above conditions are met > 0.5 sec.	
Threshold value	• Open or short	
Diagnosis Time	• Continuous (More than 5 sec.failure for every 10 sec.test)	
MIL On Condition	• 2 driving cycles	

Specification

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Diagnostic Circuit Diagram

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Signal Waveform & Data

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Monitor Scantool Data

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Power Circuit Inspection " procedure .

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect Ignition Coil connector.
2. IG "ON".
3. Measure voltage between power terminal of ignition coil harness connector and chassis ground.

Specification : Approx. B+

4. Is the measured voltage within specification ?

YES ► Go to "Control Circuit Inspection" procedure.

NO ► Check fuse connected to ignition coil for open.
► Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

FL-514

Fuel System

Control Circuit Inspection

■ Check short to battery in harness

1. IG "OFF" and disconnect ignition coil connector and ECM connector.
2. Measure resistance between power and control terminals of ignition coil harness connector.

Specification : Infinite

3. Is the measured resistance within specification?

YES ▶ Go to "Check short to ground in harness" as follows.

NO ▶ Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check short to ground in harness

1. IG "OFF" and disconnect ignition coil connector and ECM connector.
2. Measure resistance between control terminal of ignition coil harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect Ignition Coil connector and ECM connector.
2. Measure resistance between control terminal of Ignition Coil harness connector and IG Coil #1 control terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check Ignition Coil

1. IG "OFF" and disconnect ignition coil connector.
2. Measure resistance between power and signal terminals of ignition coil connector.(Measurement "A")
3. Measure resistance between power terminal of ignition coil connector and out terminal of secondary ignition coil.(Measurement "B")

Specification :

	Primary Coil	Secondary Coil
Resistance(Ω)	$0.62 \pm 10\%$ (20℃)	$7.0k \pm 15\%$ (20℃)

4. Is the measured resistance within specification?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good Ignition Coil and check for proper operation. If the problem is corrected, replace Ignition Coil and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Engine Control System

FL-515

P0354 Ignition Coil 'D' Primary / Secondary Circuit

Component Location

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

General Description

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

DTC Description

Checking output signals from ignition coils every 10 sec. under detecting condition, if the signals indicating open or short in the circuit are detected for more than 5 sec., ECM sets this DTC. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Detects a short to ground, to battery or open circuit	• Poor connection • Open or short in harness • Ignition Coil • ECM
Enable Conditions	• NO DTC related to this item • Engine running state • $11V \leq \text{Battery voltage} \leq 16V$ • The above conditions are met > 0.5 sec.	
Threshold value	• Open or short	
Diagnosis Time	• Continuous (More than 5 sec.failure for every 10 sec.test)	
MIL On Condition	• 2 driving cycles	

Specification

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Diagnostic Circuit Diagram

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Signal Waveform & Data

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Monitor Scantool Data

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Power Circuit Inspection " procedure .

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect Ignition Coil connector.
2. IG "ON".
3. Measure voltage between power terminal of ignition coil harness connector and chassis ground.

Specification : Approx. B+

4. Is the measured voltage within specification ?

YES ▶ Go to "Control Circuit Inspection" procedure.

NO ▶ Check fuse connected to ignition coil for open.
▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

FL-516

Fuel System

Control Circuit Inspection

■ Check short to battery in harness

1. IG "OFF" and disconnect ignition coil connector and ECM connector.
2. Measure resistance between power and control terminals of ignition coil harness connector.

Specification : Infinite

3. Is the measured resistance within specification?

YES ▶ Go to "Check short to ground in harness" as follows.

NO ▶ Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check short to ground in harness

1. IG "OFF" and disconnect ignition coil connector and ECM connector.
2. Measure resistance between control terminal of ignition coil harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect Ignition Coil connector and ECM connector.
2. Measure resistance between control terminal of Ignition Coil harness connector and IG Coil #1 control terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check Ignition Coil

1. IG "OFF" and disconnect ignition coil connector.
2. Measure resistance between power and signal terminals of ignition coil connector.(Measurement "A")
3. Measure resistance between power terminal of ignition coil connector and out terminal of secondary ignition coil.(Measurement "B")

Specification :

	Primary Coil	Secondary Coil
Resistance(Ω)	$0.62 \pm 10\%$ (20℃)	$7.0k \pm 15\%$ (20℃)

4. Is the measured resistance within specification?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good Ignition Coil and check for proper operation. If the problem is corrected, replace Ignition Coil and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Engine Control System

FL-517

P0355 Ignition Coil 'E' Primary / Secondary Circuit

Component Location

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

General Description

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

DTC Description

Checking output signals from ignition coils every 10 sec. under detecting condition, if the signals indicating open or short in the circuit are detected for more than 5 sec., ECM sets this DTC. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Detects a short to ground, to battery or open circuit	• Poor connection • Open or short in harness • Ignition Coil • ECM
Enable Conditions	• NO DTC related to this item • Engine running state • $11V \leq \text{Battery voltage} \leq 16V$ • The above conditions are met > 0.5 sec.	
Threshold value	• Open or short	
Diagnosis Time	• Continuous (More than 5 sec.failure for every 10 sec.test)	
MIL On Condition	• 2 driving cycles	

Specification

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Diagnostic Circuit Diagram

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Signal Waveform & Data

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Monitor Scantool Data

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ▶ Go to " Power Circuit Inspection " procedure .

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect Ignition Coil connector.
2. IG "ON".
3. Measure voltage between power terminal of ignition coil harness connector and chassis ground.

Specification : Approx. B+

4. Is the measured voltage within specification ?

YES ▶ Go to "Control Circuit Inspection" procedure.

NO ▶ Check fuse connected to ignition coil for open.
▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

FL-518

Fuel System

Control Circuit Inspection

■ Check short to battery in harness

1. IG "OFF" and disconnect ignition coil connector and ECM connector.
2. Measure resistance between power and control terminals of ignition coil harness connector.

Specification : Infinite

3. Is the measured resistance within specification?

YES ▶ Go to "Check short to ground in harness" as follows.

NO ▶ Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check short to ground in harness

1. IG "OFF" and disconnect ignition coil connector and ECM connector.
2. Measure resistance between control terminal of ignition coil harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect Ignition Coil connector and ECM connector.
2. Measure resistance between control terminal of Ignition Coil harness connector and IG Coil #1 control terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check Ignition Coil

1. IG "OFF" and disconnect ignition coil connector.
2. Measure resistance between power and signal terminals of ignition coil connector.(Measurement "A")
3. Measure resistance between power terminal of ignition coil connector and out terminal of secondary ignition coil.(Measurement "B")

Specification :

	Primary Coil	Secondary Coil
Resistance(Ω)	$0.62 \pm 10\%$ (20℃)	$7.0k \pm 15\%$ (20℃)

4. Is the measured resistance within specification?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good Ignition Coil and check for proper operation. If the problem is corrected, replace Ignition Coil and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Engine Control System

FL-519

P0356 Ignition Coil 'F' Primary / Secondary Circuit

Component Location

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

General Description

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

DTC Description

Checking output signals from ignition coils every 10 sec. under detecting condition, if the signals indicating open or short in the circuit are detected for more than 5 sec., ECM sets this DTC. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Detects a short to ground, to battery or open circuit	• Poor connection • Open or short in harness • Ignition Coil • ECM
Enable Conditions	• NO DTC related to this item • Engine running state • $11V \leq \text{Battery voltage} \leq 16V$ • The above conditions are met > 0.5 sec.	
Threshold value	• Open or short	
Diagnosis Time	• Continuous (More than 5 sec.failure for every 10 sec.test)	
MIL On Condition	• 2 driving cycles	

Specification

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Diagnostic Circuit Diagram

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Signal Waveform & Data

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Monitor Scantool Data

Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Power Circuit Inspection " procedure .

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect Ignition Coil connector.
2. IG "ON".
3. Measure voltage between power terminal of ignition coil harness connector and chassis ground.

Specification : Approx. B+

4. Is the measured voltage within specification ?

YES ► Go to "Control Circuit Inspection" procedure.

NO ► Check fuse connected to ignition coil for open.
► Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

FL-520

Fuel System

Control Circuit Inspection

■ Check short to battery in harness

1. IG "OFF" and disconnect ignition coil connector and ECM connector.
2. Measure resistance between power and control terminals of ignition coil harness connector.

Specification : Infinite

3. Is the measured resistance within specification?

YES ▶ Go to "Check short to ground in harness" as follows.

NO ▶ Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check short to ground in harness

1. IG "OFF" and disconnect ignition coil connector and ECM connector.
2. Measure resistance between control terminal of ignition coil harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect Ignition Coil connector and ECM connector.
2. Measure resistance between control terminal of Ignition Coil harness connector and IG Coil #1 control terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check Ignition Coil

1. IG "OFF" and disconnect ignition coil connector.
2. Measure resistance between power and signal terminals of ignition coil connector.(Measurement "A")
3. Measure resistance between power terminal of ignition coil connector and out terminal of secondary ignition coil.(Measurement "B")

Specification :

	Primary Coil	Secondary Coil
Resistance(Ω)	$0.62 \pm 10\%$ (20℃)	$7.0k \pm 15\%$ (20℃)

4. Is the measured resistance within specification?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good Ignition Coil and check for proper operation. If the problem is corrected, replace Ignition Coil and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

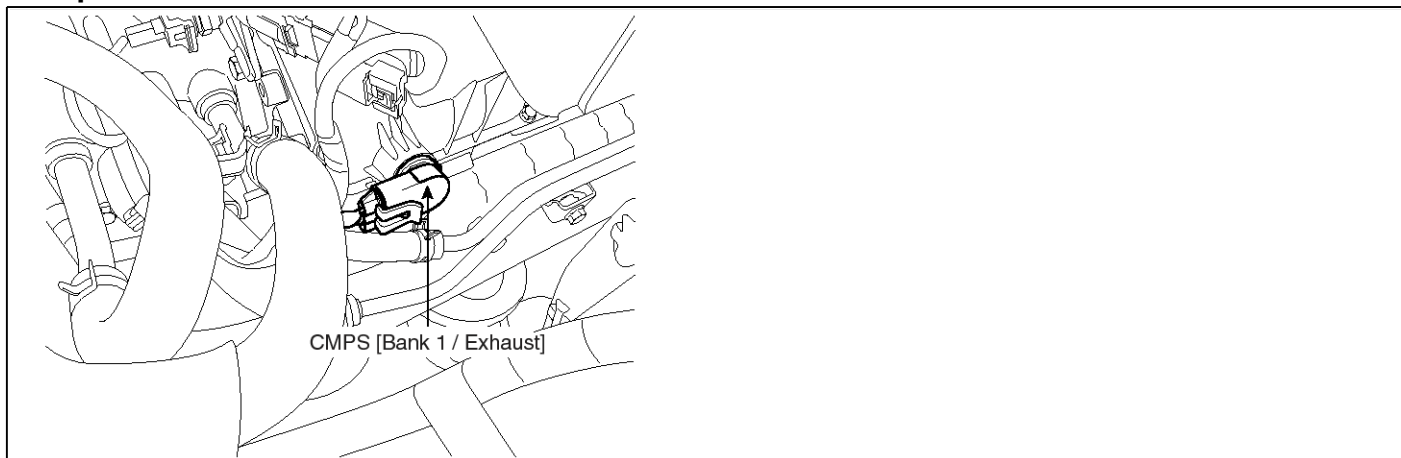
Refer to DTC P0351 : Ignition Coil 'A' Primary/Secondary Circuit

Engine Control System

FL-521

P0366 Camshaft Position Sensor "B" Circuit Range/Performance (Bank 1)

Component Location



SBHFL9306L

General Description

The Camshaft Position Sensor (CMPS) is a sensor that detects the compression TDC of the NO. 1 cylinder. The CMPS consists of a hall type sensor and a target on the end of the intake camshaft. When the target triggers the sensor, the sensor voltage is 5V. If not, the sensor voltage is 0V. These CMPS signal is sent to the ECM and the ECM uses the CMPS signal for synchronizing the firing of sequential fuel injectors.

DTC Description

Checking oputput signals from CMP during engine running, if the expected number of cam tooth count is not observed, ECM sets P0366.

MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

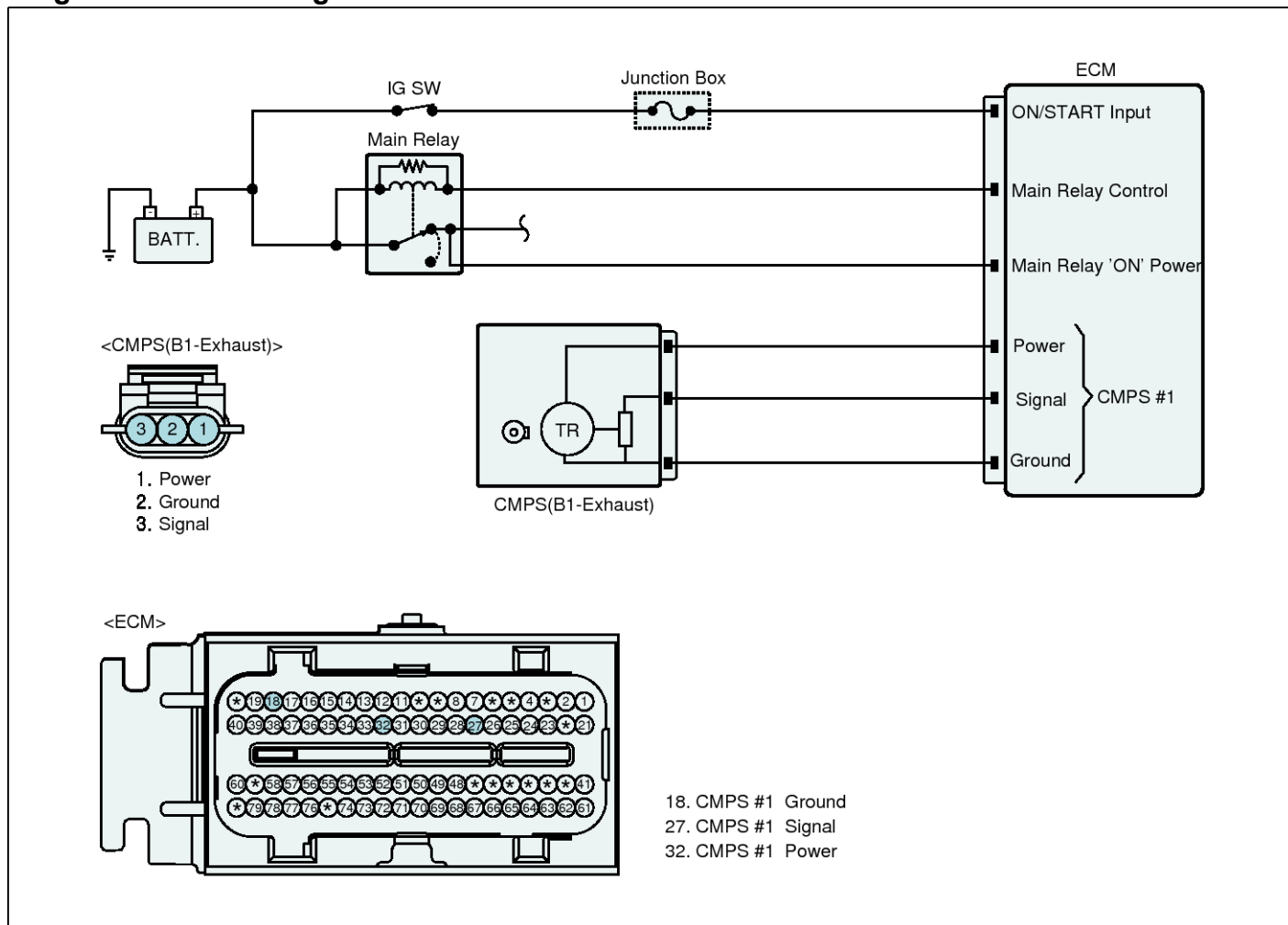
DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Check if CAM sensor is synchronized correctly	• Poor connection • Short in harness • Electrical noise • Target wheel • CMPS(B1-Exhaust) • ECM
Enable Conditions	• Engine running state	
Threshold value	• Cam tooth count $\neq$ 6	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

Specification

Item	Specification	
Output Voltage(V)	Hi : 5.0V	Low : 0.7V
Airgap(mm)	0.5 ~ 1.5	

Diagnostic Circuit Diagram



SBHFL9527L

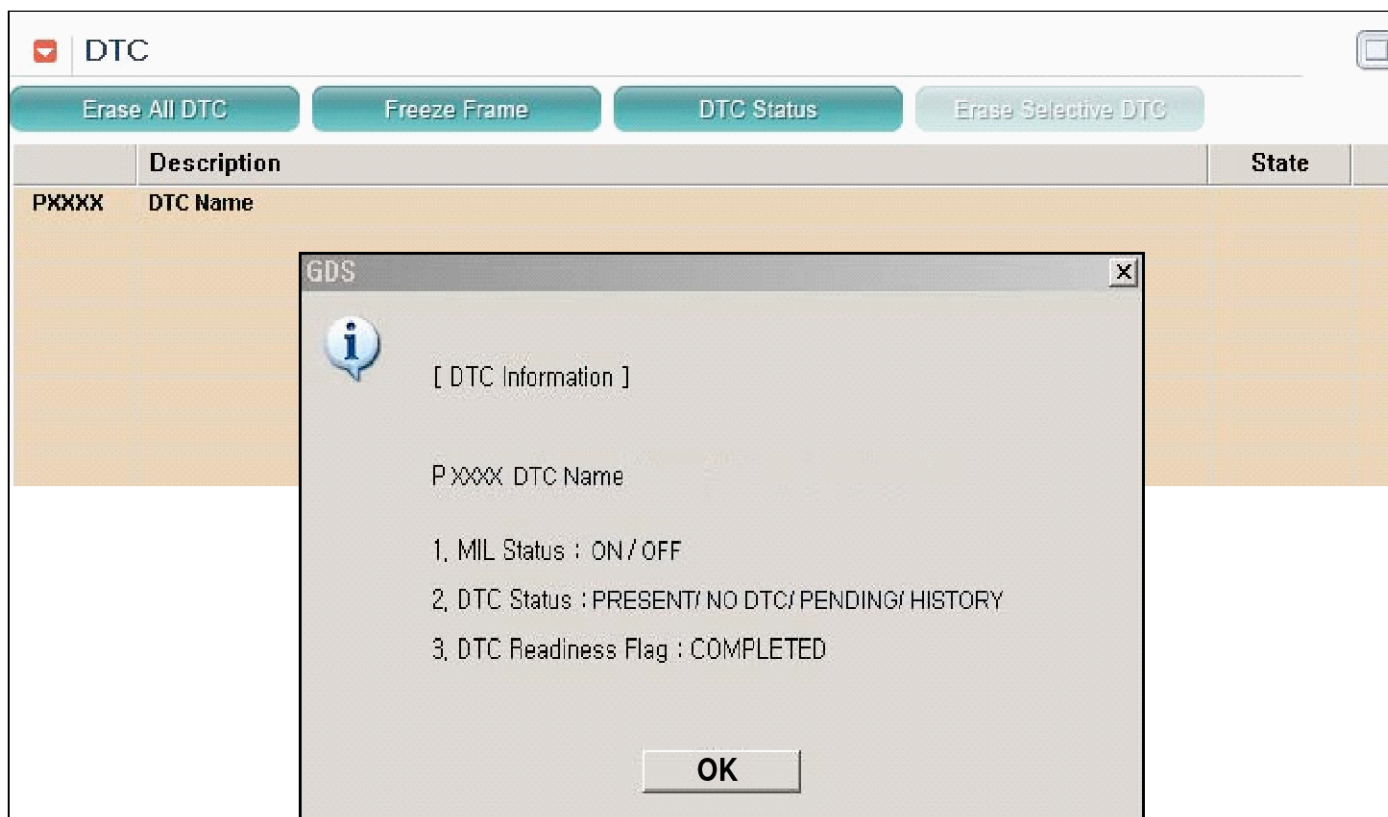
FL-524

Fuel System

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Power Circuit Inspection " procedure .

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect CMPS(B1-Exhaust) connector.
2. IG "ON".
3. Measure voltage between power terminal of CMPS(B1-Exhaust) harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ► Go to "Signal Circuit Inspection" procedure.

Engine Control System

FL-525

- NO** ▶ Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

Signal Circuit Inspection

■ Check short to battery in harness

1. IG "OFF" and disconnect CMPS(B1-Exhaust) connector.
2. IG "ON".
3. Measure voltage between signal terminal of CMPS(B1-Exhaust) harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ▶ Go to "Check short in harness" as follows.

NO ▶ Go to "Check open in harness" as follows.

■ Check short in harness

1. IG "OFF" and disconnect CMPS(B1-Exhaust) connector.
2. Measure resistance between signal and power terminals of CMPS(B1-Exhaust) harness connector.

Specification : Infinite

3. Is the measured resistance within specification?

YES ▶ Go to "Check short to ground in harness" as follows.

NO ▶ Repair short in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check short to ground in harness

1. IG "OFF" and disconnect CMPS(B1-Exhaust) connector and ECM connector.
2. Measure resistance between signal terminal of CMPS(B1-Exhaust) harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect CMPS(B1-Exhaust) connector and ECM connector.
2. Measure resistance between signal terminal of CMPS(B1-Exhaust) harness connector and CMPS(B1-Exhaust) signal terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Ground Circuit Inspection

■ Check open in harness

1. IG "OFF" and disconnect CMPS(B1-Exhaust) connector and then IG "ON".
2. Measure voltage between signal terminal of CMPS(B1-Exhaust) harness connector and chassis ground. (Measurement "A")
3. Measure voltage between signal and ground terminals of CMPS(B1-Exhaust) harness connector. (Measurement "B")

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair contact resistance or open in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check CMPS

1. IG "OFF" and connect scantool.
2. ENG "ON" and Measure signal waveform at signal terminal of CMPS.

Reference signal waveform :

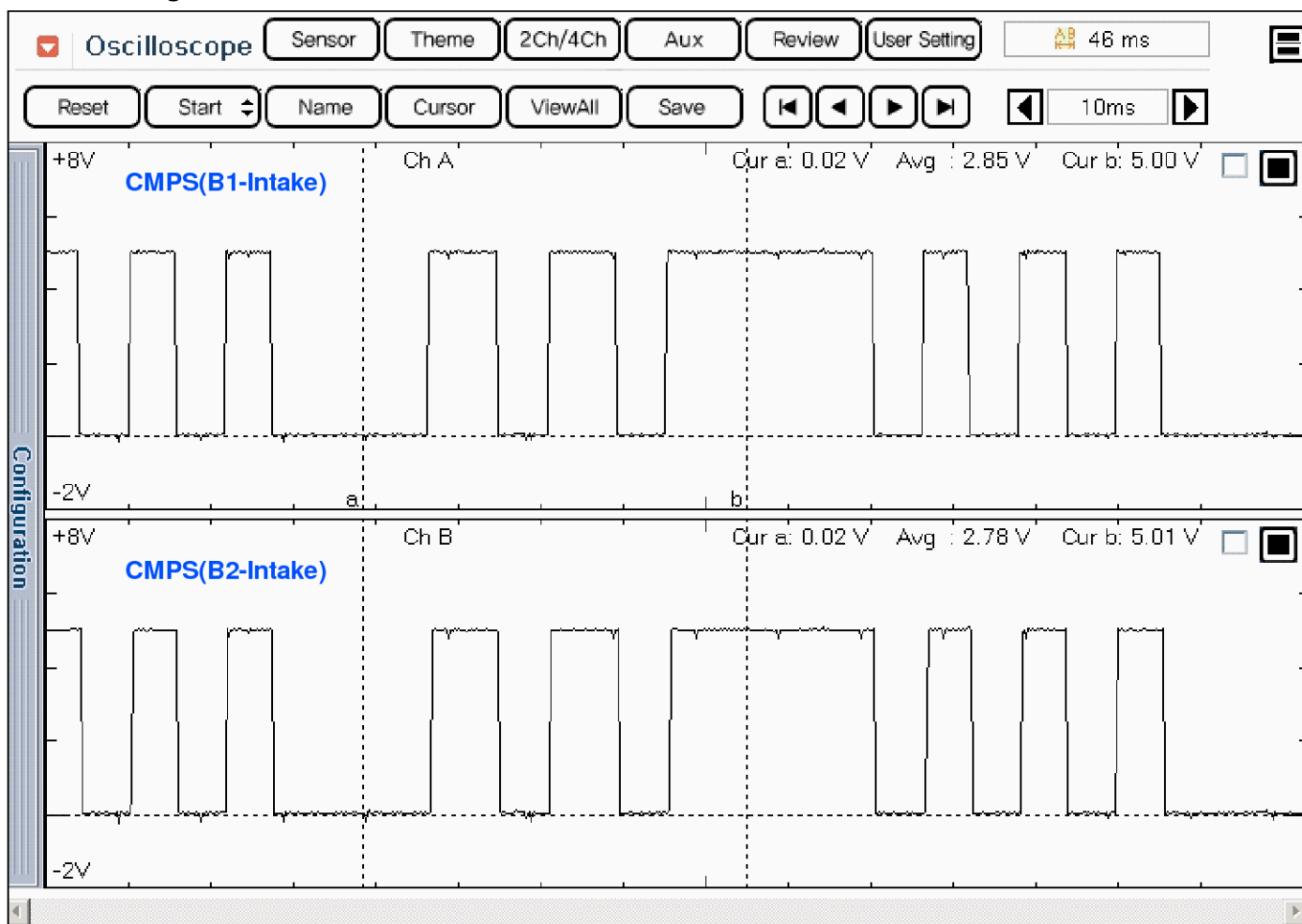


Fig.1

SBHFL9654L

Fig 1) Normal waveform of CMPS1 & 2 at idle.

3. Is the measured signal waveform normal?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good CMPS and check for proper operation. If the problem is corrected, replace CMPS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-527

P0391 Camshaft Position Sensor "B" Circuit Range/Performance (Bank 2)

Component Location

Refer to DTC P0366 : Camshaft Position Sensor "B" Circuit Range/Performance (Bank 1)

General Description

Refer to DTC P0366 : Camshaft Position Sensor "B" Circuit Range/Performance (Bank 1)

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Check if CAM sensor is synchronized correctly	• Poor connection • Short in harness • electrical noise • Target wheel • CMPS(B2-Exhaust) • ECM
Enable Conditions	• Engine running state	
Threshold value	• Cam tooth count $\neq$ 6	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

Specification

Refer to DTC P0366 : Camshaft Position Sensor "B" Circuit Range/Performance (Bank 1)

Diagnostic Circuit Diagram

Refer to DTC P0366 : Camshaft Position Sensor "B" Circuit Range/Performance (Bank 1)

Signal Waveform & Data

Refer to DTC P0366 : Camshaft Position Sensor "B" Circuit Range/Performance (Bank 1)

Monitor Scantool Data

Refer to DTC P0366 : Camshaft Position Sensor "B" Circuit Range/Performance (Bank 1)

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to " Power Circuit Inspection " procedure

DTC Description

Checking ooutput signals from CMP during engine running, if the expected number of cam tooth count is not observed, ECM sets P0391. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect CMPS(B2-Exhaust) connector.
2. IG "ON".
3. Measure voltage between power terminal of CMPS(B2-Exhaust) harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ► Go to "Signal Circuit Inspection" procedure.

NO ► Repair open or short to ground inharness, and go to "Verification of Vehicle Repair" procedure.

Signal Circuit Inspection

■ Check short to battery in harness

1. IG "OFF" and disconnect CMPS(B2-Exhaust) connector.
2. IG "ON".
3. Measure voltage between signal terminal of CMPS(B2-Exhaust) harness connector and chassis ground.

Specification : Approx. 5V

FL-528

Fuel System

4. Is the measured voltage within specification ?

YES ▶ Go to "Check short in harness" as follows.

NO ▶ Go to "Check open in harness" as follows.

■ Check short in harness

1. IG "OFF" and disconnect CMPS(B2-Exhaust) connector.
2. Measure resistance between signal and power terminals of CMPS(B2-Exhaust) harness connector.

Specification : Infinite

3. Is the measured resistance within specification?

YES ▶ Go to "Check short to ground in harness" as follows.

NO ▶ Repair short in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check short to ground in harness

1. IG "OFF" and disconnect CMPS(B2-Exhaust) connector and ECM connector.
2. Measure resistance between signal terminal of CMPS(B2-Exhaust) harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect CMPS(B2-Exhaust) connector and ECM connector.
2. Measure resistance between signal terminal of CMPS(B2-Exhaust) harness connector and CMPS(B2-Exhaust) signal terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Ground Circuit Inspection

■ Check open in harness

1. IG "OFF" and disconnect CMPS(B2-Exhaust) connector and then IG "ON".
2. Measure voltage between signal terminal of CMPS(B2-Exhaust) harness connector and chassis ground.(Measurement "A")
3. Measure voltage between signal and ground terminals of CMPS(B2-Exhaust) harness connector.(Measurement "B")

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair contact resistance or open in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check CMPS

1. IG "OFF" and connect scantool.
2. ENG "ON" and Measure signal waveform at signal terminal of CMPS.

Reference signal waveform :

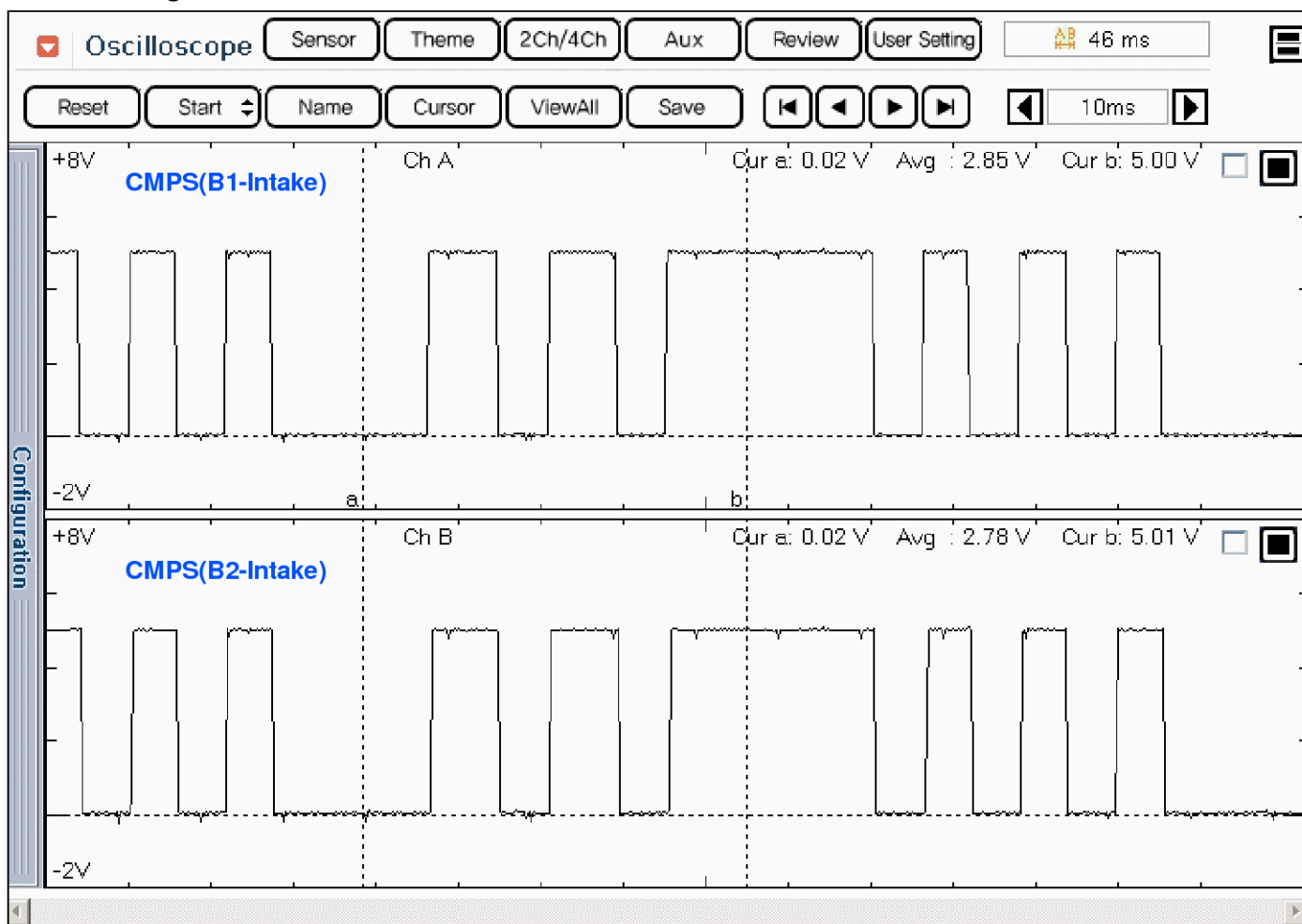


Fig.1

SBHFL9654L

3. Is the measured signal waveform normal?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good CMPS and check for proper operation. If the problem is corrected, replace CMPS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0366 : Camshaft Position Sensor "B" Circuit Range/Performance (Bank 1)

FL-530

Fuel System

P0420 Catalyst System Efficiency below Threshold (Bank 1)

Component Location



SBHFL9330L

General Description

The ECM uses dual oxygen sensors to monitor the efficiency of the manifold catalytic converter (warm-up catalytic converter). By monitoring the oxygen storage capacity of a catalyst, its efficiency can be indirectly calculated. The upstream (front) HO₂S is used to detect the amount of oxygen in the exhaust gas before it enters the catalytic converter. A low voltage indicates high oxygen contents (lean air mixture). A high voltage indicates low oxygen contents (rich air mixture). When the catalyst efficiency drops, no chemical reaction takes place. This means the concentration of oxygen will be the same at the rear as it is at the front.

DTC Description

If the oxygen storage time for Bank 1 is lower than threshold, the ECM determines that a fault exists and a DTC is stored and MIL (Malfunction Indication Lamp) turns on.

Engine Control System

FL-531

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Manipulates Airfuel and stores the times it takes for the pre and post converter oxygen sensors to switch.	Catalyst Converter
EnableConditions	- Engine Runtime ≥ 580 sec. - Purge Concentration Learned $3 \text{ g/s} \leq \text{Airflow} \leq 10 \text{ g/s}$ - Throttle closed $\leq 1.5\%$ $70^{\circ}\text{C}(158^{\circ}\text{F}) \leq \text{Coolant Temp.} \leq 120^{\circ}\text{C}(248^{\circ}\text{F})$ $-7^{\circ}\text{C}(19.4^{\circ}\text{F}) \leq \text{Ambient Temp.} \leq 105^{\circ}\text{C}(221^{\circ}\text{F})$ - Barometer $\geq 72 \text{ kPa}$ - Max number of test attempts ≤ 12 - Closed Loop $250^{\circ}\text{C}(482^{\circ}\text{F}) \leq \text{Catalyst Temp.} \leq 950^{\circ}\text{C}(1742^{\circ}\text{F})$ - Fuel learning completed - Vehicle speed $\leq 3 \text{ kph}(1.8 \text{ mph})$ - Not airfuel ramping - Max idle time(about 60 sec.) not exceeded - No disabling faults present - No instrumentation slews active	
Threshold value	Oxygen Storage Time < 3.25 sec.	
Diagnosis Time	15 sec.	
MIL On Condition	1 Driving cycle	

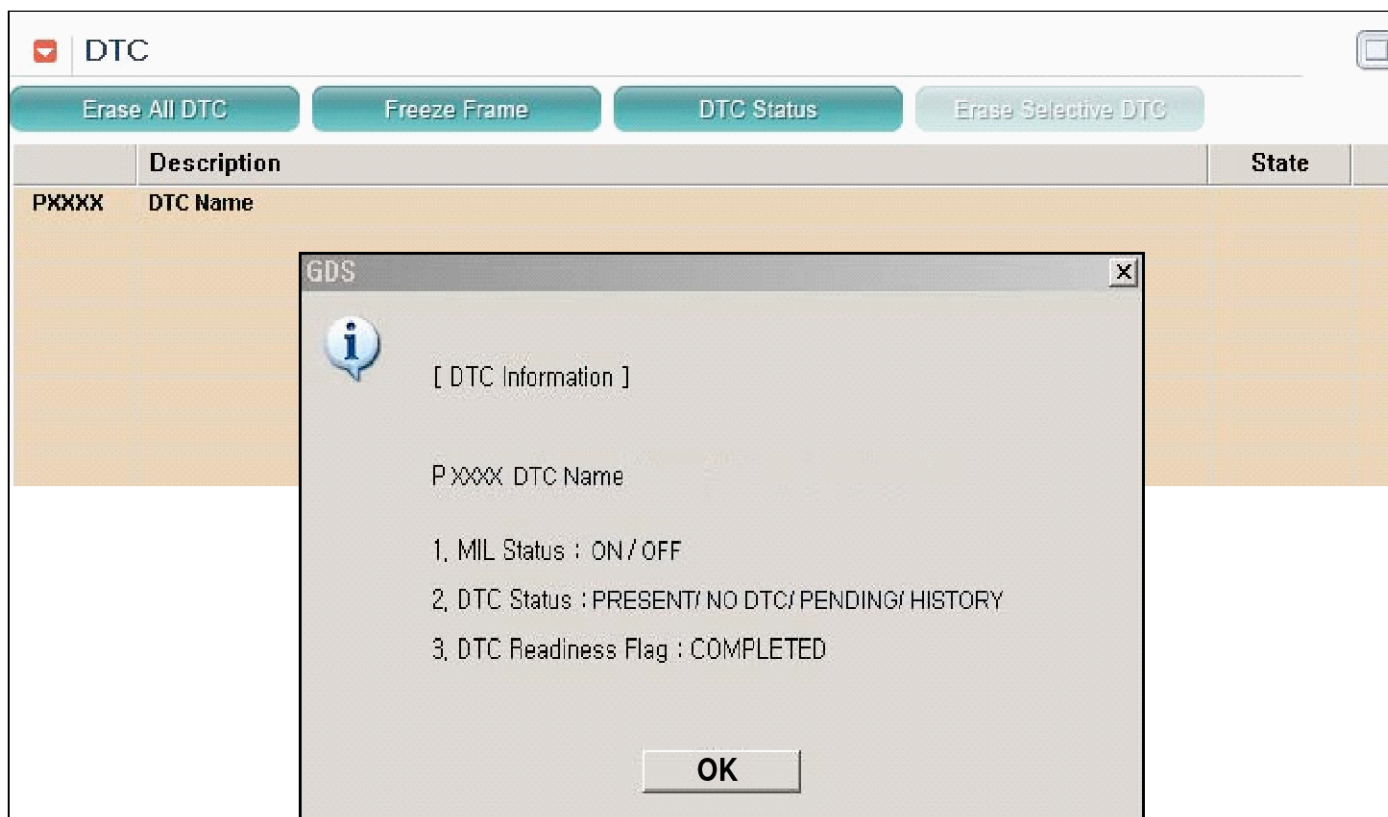
FL-532

Fuel System

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ▶ Substitute with a known - good Catalyst Converter and check for proper operation. If the problem is corrected, Go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" procedure.

Component Inspection

■ Monitor the Catalyst Converter

1. Clear DTC.
2. Start the engine and warm it up until the radiator fan comes on(more than at least 10 minutes).
3. Drive at a steady speed between 45-55 mph(72-88 km/h) for 30 seconds.
4. Stop and then maintain idle state for 120 seconds in D-position.
5. Repeat step 3 once again.
6. Stop and then keep it in idle state(D-position) for 120 seconds.

7. Repeat step 3 once again.

8. Stop and then maintain idle state for 120 seconds in D-position.

9. IG "OFF"

10. Repeat steps 3 through 9 three times.

11. Check if catalyst monitoring readiness is complete. so, if the readiness is incomplete, repeat steps 2 through 10.

12. Does the scan tool show DTC P0420??

YES ▶ Substitute with a known - good Catalyst Converter and check the signal waveform of HO2 S for proper operation. If the problem is corrected, Go to "Verification of Vehicle Repair" procedure.

NO ▶ It was intermittent failure.

Engine Control System

FL-533

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

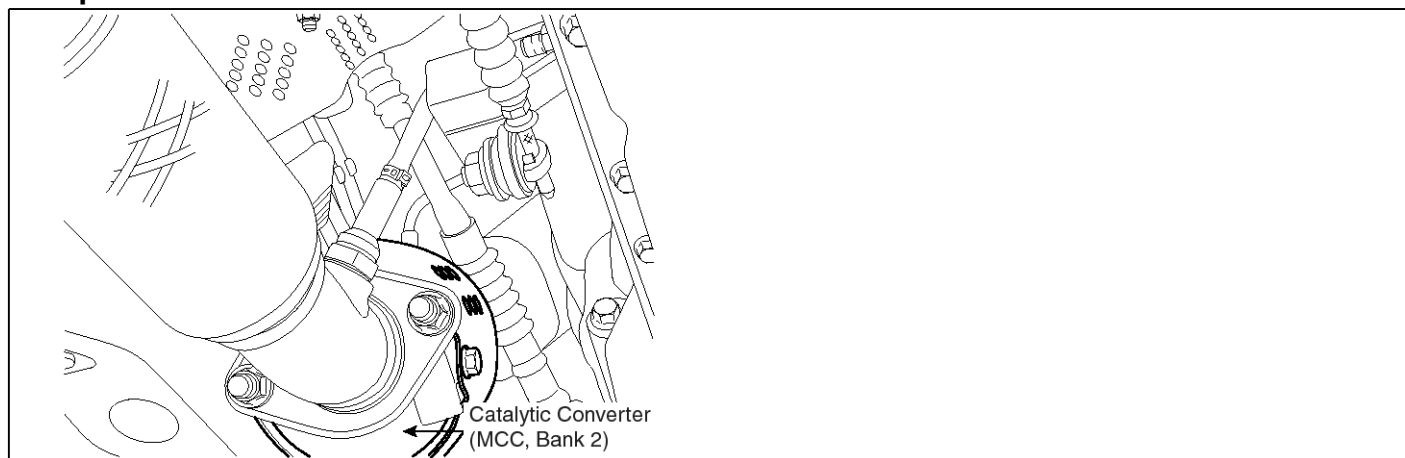
NO ► Go to the applicable troubleshooting procedure.

FL-534

Fuel System

P0430 Catalyst System Efficiency Below Threshold (Bank 2)

Component Location



SBHFL9331L

General Description

The ECM uses dual oxygen sensors to monitor the efficiency of the manifold catalytic converter (warm-up catalytic converter). By monitoring the oxygen storage capacity of a catalyst, its efficiency can be indirectly calculated. The upstream (front) HO₂S is used to detect the amount of oxygen in the exhaust gas before it enters the catalytic converter. A low voltage indicates high oxygen contents (lean air mixture). A high voltage indicates low oxygen contents (rich air mixture). When the catalyst efficiency drops, no chemical reaction takes place. This means the concentration of oxygen will be the same at the rear as it is at the front.

DTC Description

If the oxygen storage time for Bank 2 is lower than threshold, the ECM determines that a fault exists and a DTC is stored and MIL (Malfunction Indication Lamp) turns on.

Engine Control System

FL-535

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Manipulates Airfuel and stores the times it takes for the pre and post converter oxygen sensors to switch.	Catalyst Converter
EnableConditions	- Engine Runtime ≥ 580 sec. - Purge Concentration Learned $3 \text{ g/s} \leq \text{Airflow} \leq 10 \text{ g/s}$ - Throttle closed $\leq 1.5\%$ $70^{\circ}\text{C}(158^{\circ}\text{F}) \leq \text{Coolant Temp.} \leq 120^{\circ}\text{C}(248^{\circ}\text{F})$ $-7^{\circ}\text{C}(19.4^{\circ}\text{F}) \leq \text{Ambient Temp.} \leq 105^{\circ}\text{C}(221^{\circ}\text{F})$ - Barometer $\geq 72 \text{ kPa}$ - Max number of test attempts ≤ 12 - Closed Loop $250^{\circ}\text{C}(482^{\circ}\text{F}) \leq \text{Catalyst Temp.} \leq 950^{\circ}\text{C}(1742^{\circ}\text{F})$ - Fuel learning completed - Vehicle speed $\leq 3 \text{ kph}(1.8 \text{ mph})$ - Not airfuel ramping - Max idle time(about 60 sec.) not exceeded - No disabling faults present - No instrumentation slews active	
Threshold value	Oxygen Storage Time < 3.25 sec.	
Diagnosis Time	15 sec.	
MIL On Condition	1 Driving cycle	

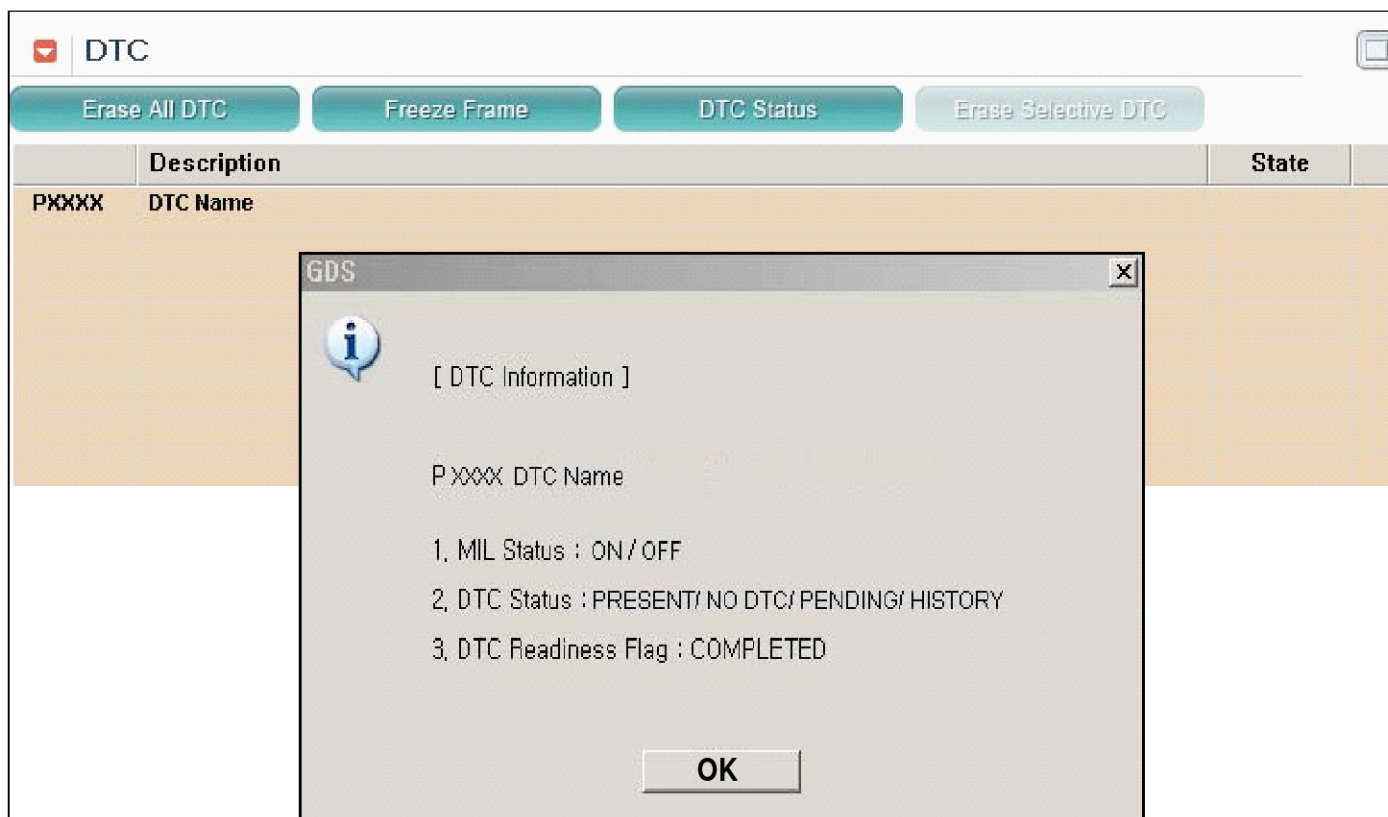
FL-536

Fuel System

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ▶ Substitute with a known - good Catalyst Converter and check for proper operation. If the problem is corrected, Go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Component Inspection" procedure.

Component Inspection

■ Monitor the Catalyst Converter

1. Clear DTC.
2. Start the engine and warm it up until the radiator fan comes on(more than at least 10 minutes).
3. Drive at a steady speed between 45-55 mph(72-88 km/h) for 30 seconds.
4. Stop and then maintain idle state for 120 seconds in D-position.
5. Repeat step 3 once again.
6. Stop and then keep it in idle state(D-position) for 120 seconds.
7. Repeat step 3 once again.

8. Stop and then maintain idle state for 120 seconds in D-position.

9. IG "OFF"

10. Repeat steps 3 through 9 three times.

11. Check if catalyst monitoring readiness is complete. so, if the readiness is incomplete, repeat steps 2 through 10.

12. Does the scan tool show DTC P0430?

YES ▶ Substitute with a known - good Catalyst Converter and check the signal waveform of HO2 S for proper operation. If the problem is corrected, Go to "Verification of Vehicle Repair" procedure.

NO ▶ It was intermittent failure.

Engine Control System

FL-537

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

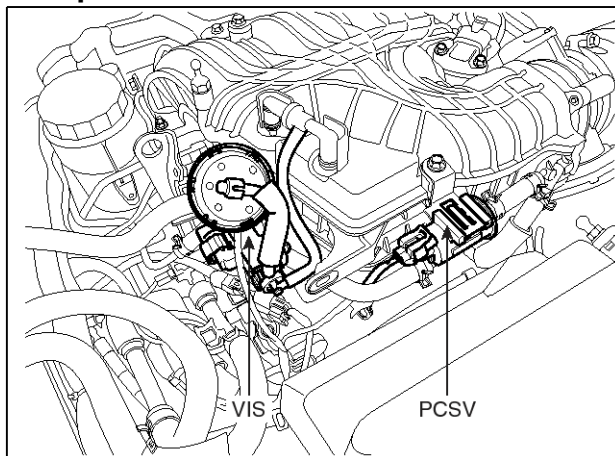
NO ► Go to the applicable troubleshooting procedure.

FL-538

Fuel System

P0444 Evaporative Emission System-Purge Control Valve Circuit Open

Component Location



SBHFL9319L

General Description

The evaporative emission control system prevents hydrocarbon (HC) vapors from the fuel tank from escaping into the atmosphere where they could form photochemical smog. Gasoline vapors are collected in the charcoal canister. The ECM controls the Purge Control Solenoid Valve (PCSV) to purge any collected vapors from the canister back to the engine for combustion. This valve is actuated by the purge control signal from the ECM and controls fuel vapor from the canister to the intake manifold.

DTC Description

Checking output signals from PCSV every 10 sec. under detecting condition, if signals indicating open or short to ground in the circuit are detected for more than 5 sec., ECM sets P0444. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Open, short to ground	- Poor connection - Open or short to ground in harness - PCSV - ECM
Enable Conditions	- Engine running state $11V \leq \text{Battery voltage} \leq 16V$ - Above enable conditions are met > 0.5 sec.	
Threshold value	Open or short to ground	
Diagnosis Time	Continuous (More than 5 sec.failure for every 10 sec.test)	
MIL On Condition	2 driving cycles	

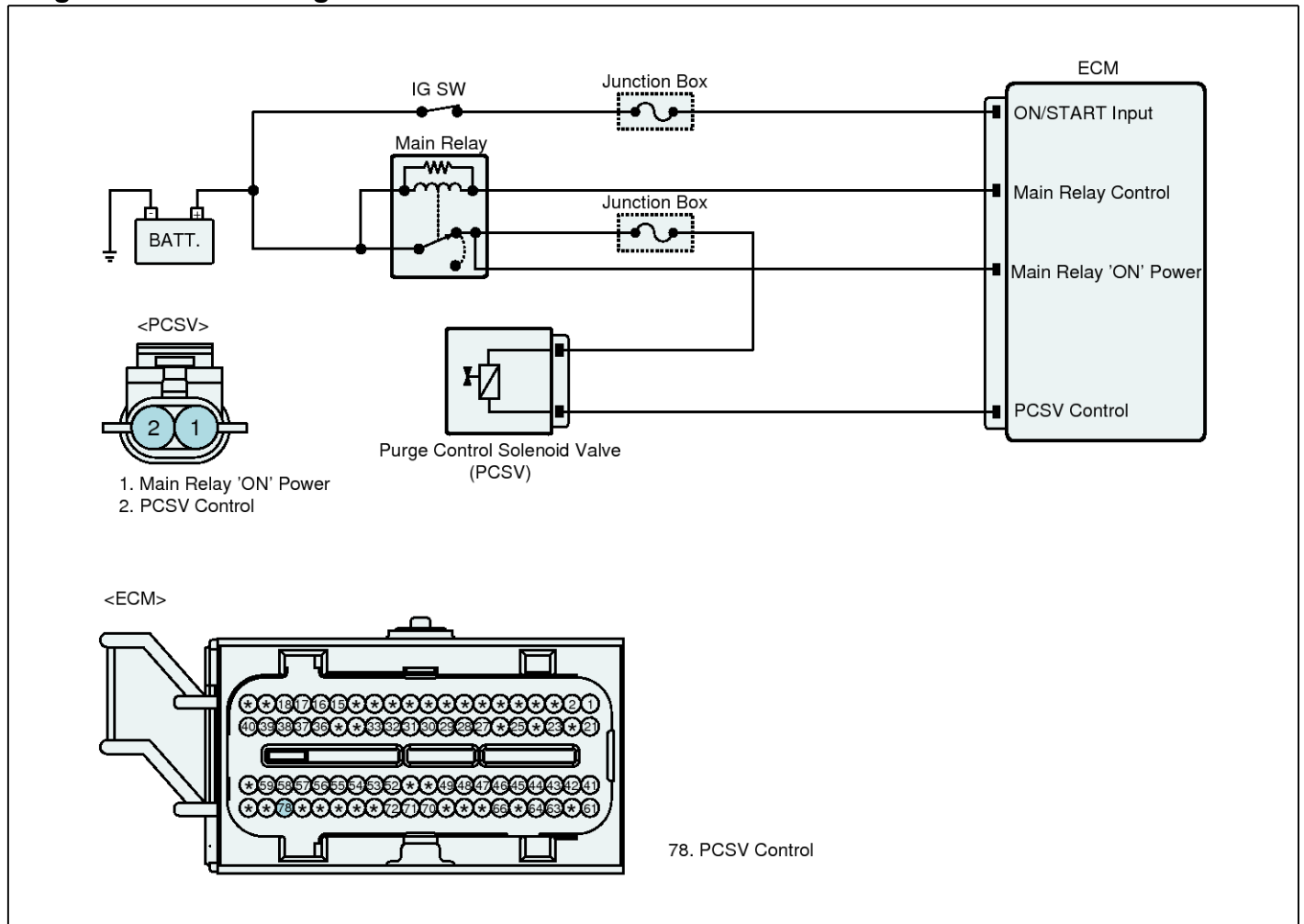
Specification

Item	Coil resistance(Ω)
PCSV	$19.0 \sim 22.0\Omega$ (at $20^{\circ}\text{C}/68^{\circ}\text{F}$)

Engine Control System

FL-539

Diagnostic Circuit Diagram



SBHFL9529L

Signal Waveform & Data

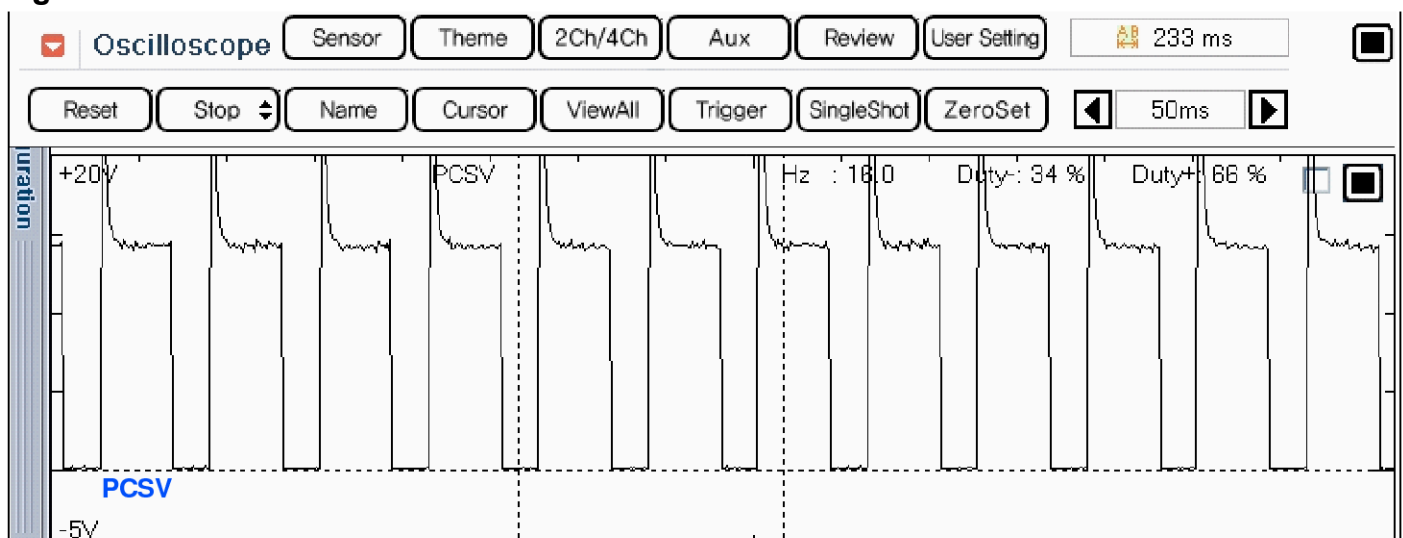


Fig.1

SBHFL9661L

FL-540

Fuel System

Current Data			
Standard Display ▾	Full List ▾	Graph ▾	Items List ▾
Reset Min.Max.		Record	Stop ▾
VSS			
Sensor Name	Value	Unit	
☒ Engine Speed	640	RPM	
☒ Canister Purge Control	33.6	%	
☒ Fuel Tank Pressure	0	VAC	

Fig.2

SBHFL9662L

Sensor Name	Value	Unit
☒ Engine Speed	640	RPM
☒ Canister Purge Control	9.0	%
☒ Fuel Tank Pressure	0	VAC

Fig.3

SBHFL9663L

Fig 1) Normal waveform of PCSV under 34% control condition.

Fig 2) Normal data of PCSV under 33% control condition.

Fig 3) Abnormal data of PCSV when PCSV circuit open.

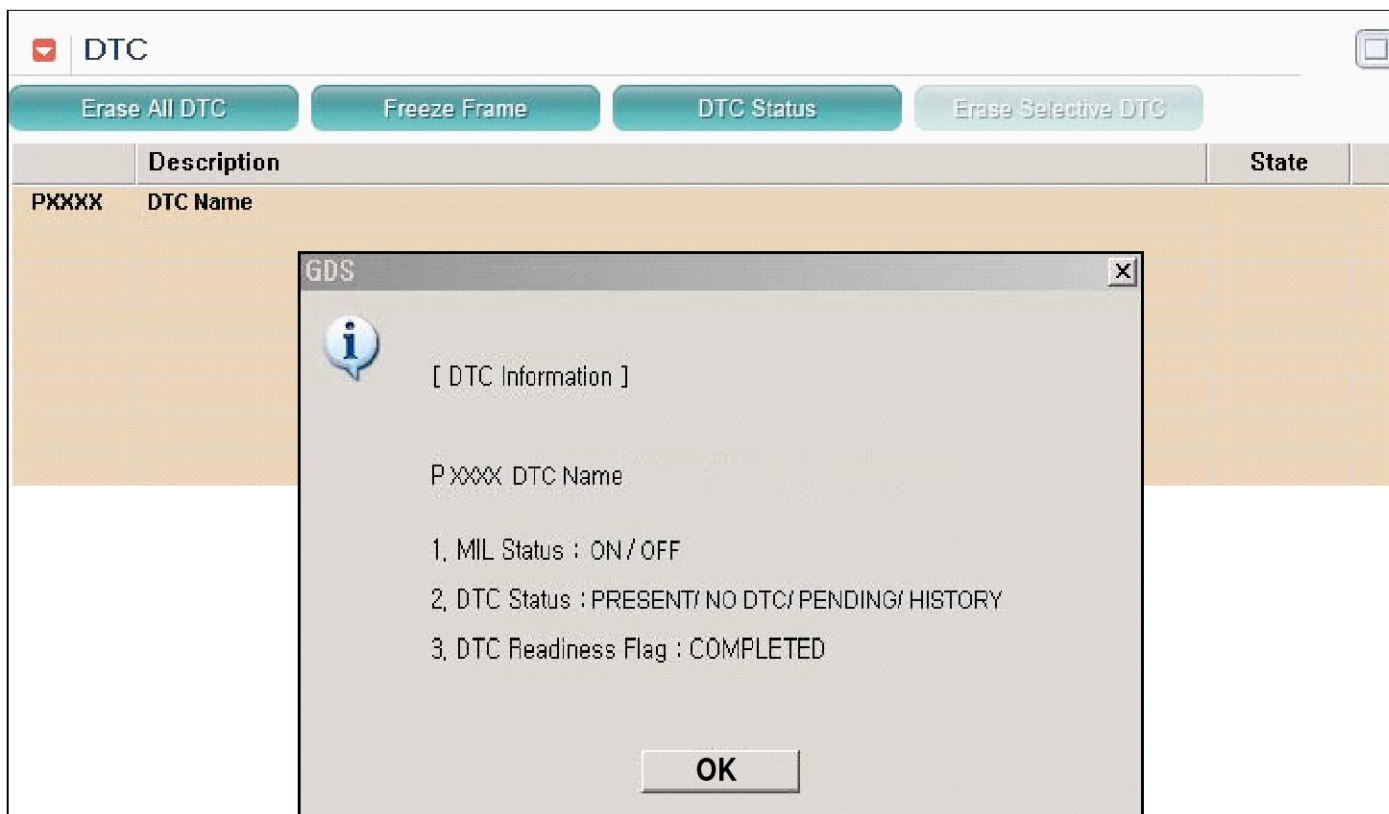
The Purge Control Solenoid Valve(PCSV) is open or closed by ECM and vacuum of intake manifold.

At opening, fuel vapor from canister enters into intake manifold. To prevent vacuum from forming inside canister, ECM controls to open it.

This photo shows the signal waveform of PCSV operating normally.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to " Power Circuit Inspection " procedure

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect PCSV connector.
2. IG "ON".
3. Measure voltage between control terminal of PCSV harness connector and chassis ground.

Specification : B+

4. Is the measured voltage within specification ?

YES ► Go to "Control Circuit Inspection" procedure.

NO ► Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

Control Circuit Inspection

■ Check short to ground in harness

1. IG "OFF" and disconnect PCSV connector and ECM connector.
2. Measure resistance between control terminal of PCSV harness connector and chassis ground..

Specification : Infinite

FL-542

Fuel System

3. Is the measured voltage within specification ?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect PCSV connector and ECM connector.
2. Measure resistance between control terminal of PCSV harness connector and PCSV control terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check PCSV

1. IG "OFF" and disconnect PCSV connector.
2. Measure resistance between power and control terminals of PCSV connector.(Component side)

Specification : 19.0 ~ 22.0Ω (at 20°C/ 68°F)

3. Is the measured signal waveform normal?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good PCSV and check for proper operation. If the problem is corrected, replace PCSV and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-543

P0445 Evaporative Emission System-Purge Control Valve Circuit Shorted

Component Location

Refer to DTC P0444 : Evaporative Emission System-Purge Control Valve Circuit Open

General Description

Refer to DTC P0444 : Evaporative Emission System-Purge Control Valve Circuit Open

DTC Description

Checking output signals from PCSV every 10 sec. under detecting condition, if signals indicating short to battery in the circuit are detected for more than 5 sec., ECM sets P0445. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Short to battery	• Poor connection • Short to battery in harness • PCSV • ECM
Enable Conditions	• Engine running state • $11V \leq \text{Battery voltage} \leq 16V$ • Above enable conditions are met > 0.5 sec.	
Threshold value	• Short to battery	
Diagnosis Time	• Continuous (More than 5 sec.failure for every 10 sec.test)	
MIL On Condition	• 2 driving cycles)	

Specification

Refer to DTC P0444 : Evaporative Emission System-Purge Control Valve Circuit Open

Diagnostic Circuit Diagram

Refer to DTC P0444 : Evaporative Emission System-Purge Control Valve Circuit Open

Signal Waveform & Data

Refer to DTC P0444 : Evaporative Emission System-Purge Control Valve Circuit Open

Monitor Scantool Data

Refer to DTC P0444 : Evaporative Emission System-Purge Control Valve Circuit Open

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ▶ Go to " Control Circuit Inspection " procedure.

Control Circuit Inspection

■ Check short to battery in harness

1. IG "OFF" and disconnect PCSV connector.
2. IG "ON".
3. Measure voltage between control terminal of PCSV harness connector and chassis ground.

Specification : Approx.0 V

4. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short to battery in harness, and go to " Verification of Vehicle Repair" procedure.

Component Inspection

■ Check PCSV

1. IG "OFF" and disconnect PCSV connector.
2. Measure resistance between power and control terminals of PCSV connector.(Component side)

Specification : $19.0 \sim 22.0\Omega$ (at $20^{\circ}\text{C} / 68^{\circ}\text{F}$)

FL-544

Fuel System

3. Is the measured signal waveform normal?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

 NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good PCSV and check for proper operation. If the problem is corrected, replace PCSV and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0444 : Evaporative Emission System-Purge Control Valve Circuit Open

Engine Control System

FL-545

P0501 Vehicle Speed Sensor "A" Range/Performance

General Description

The Wheel Speed Sensor (WSS) generates a waveform with a frequency proportional to the speed of the vehicle. The signal generated by the WSS informs the ECM not only if the vehicle speed is low or high but also if the vehicle is or is not moving. The ECM uses this signal to control the fuel injection, ignition timing, transaxle shift scheduling and torque converter clutch scheduling. The WSS signal is also used to detect rough road conditions.

DTC Description

Checking vehicle speed signal every from ABS(or ESC) control every 30 sec. under detecting condition, if an signal is in the detecting condition for more than 20 sec., ECM sets P0501. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

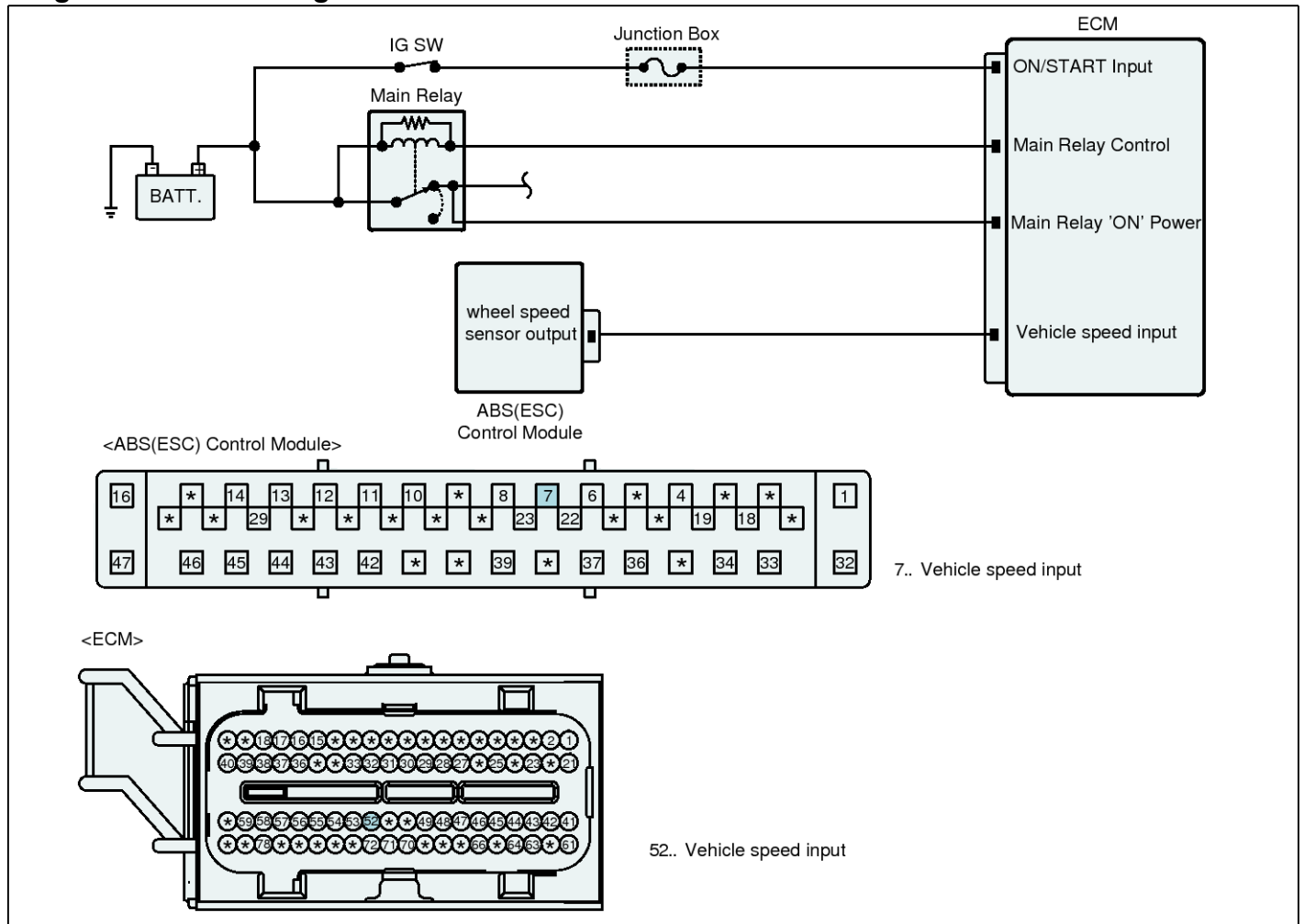
DTC Detecting Condition

Item		Detecting Condition	Possible cause
DTC Strategy		Detects the lack of vehicle speed signal	- Poor connection - Open or short in harness - Wheel speed sensor(FR) - ABS or ESC control unit - ECM
Enable Conditions	Case 1	- Engine Running - No VSS disabling malfunction present - No TPS fault present - No MAP fault present 11V < Ignition Voltage < 16V - Engine Coolant Temperature > 60°C(140°F) - MAP > 55kPa 25% ≤ TPS ≤ 60% 1200rpm ≤ Engine Speed ≤ 4000rpm - Vehicle Speed derived from transmission ≥ 10KPH(6.2MPH)	
	Case 2	- Engine Running - No VSS disabling malfunction present - No TPS fault present - No MAP fault present 11V < Ignition Voltage < 16V - Engine Coolant Temperature > 60°C(140°F) - MAP < 32kPa - TPS < 1% 1800rpm ≤ Engine Speed ≤ 6000rpm - Transmission in gear	
Threshold value	Case 1	Vehicle Speed ≤ 10kph	
	Case 2	- Vehicle Speed < 5kph - Delta Engine Speed ≥ 100rpm	
Diagnosis Time		Continuous (More than 20 seconds failure for every 30 seconds test)	
MIL On Condition		2 Driving Cycles	

FL-546

Fuel System

Diagnostic Circuit Diagram



SBHFL9530L

Signal Waveform & Data

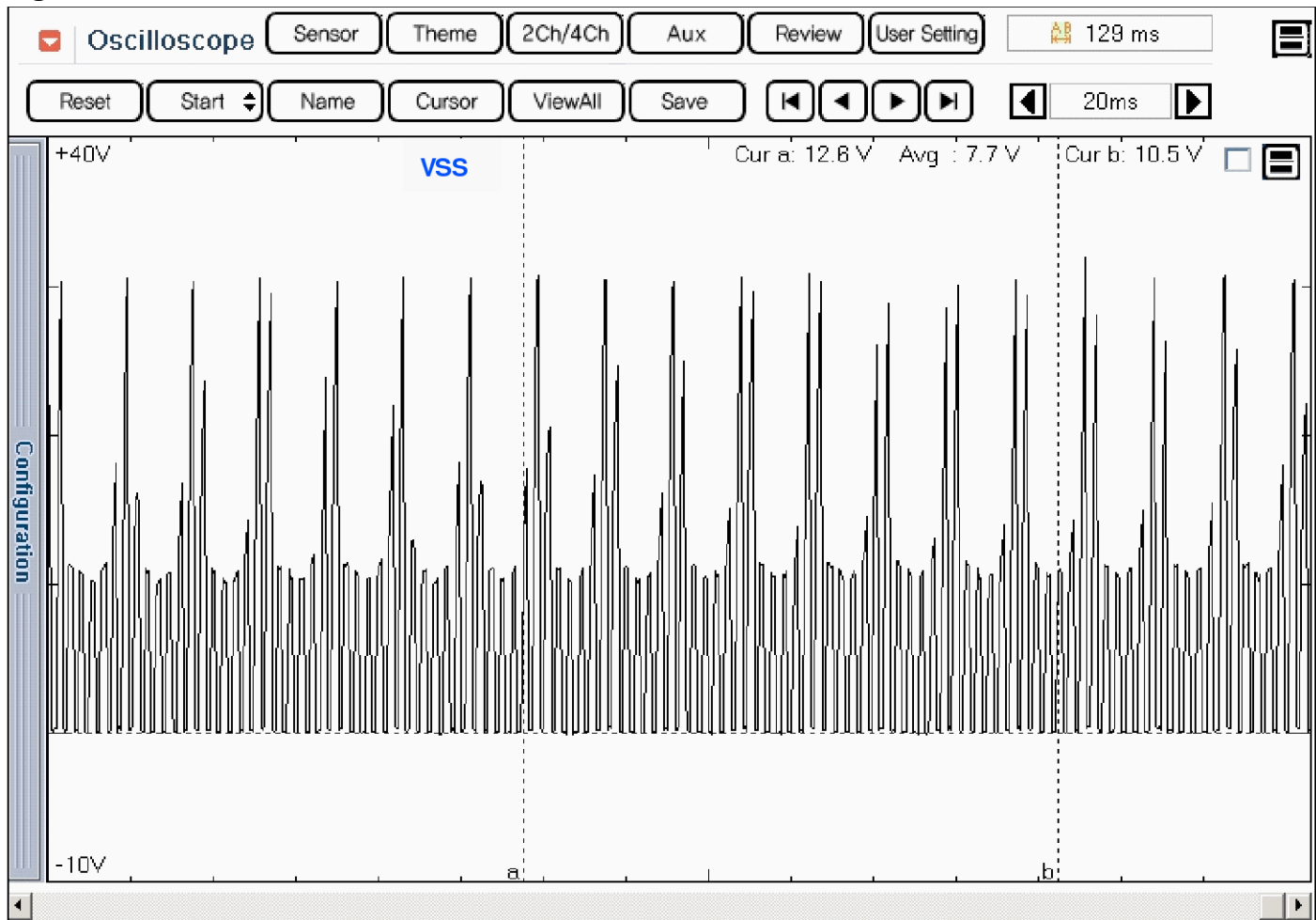


Fig.1

SBHFL9670L

Fig 1) Normal waveforms of VSS (from ESC(ESP) ECU)

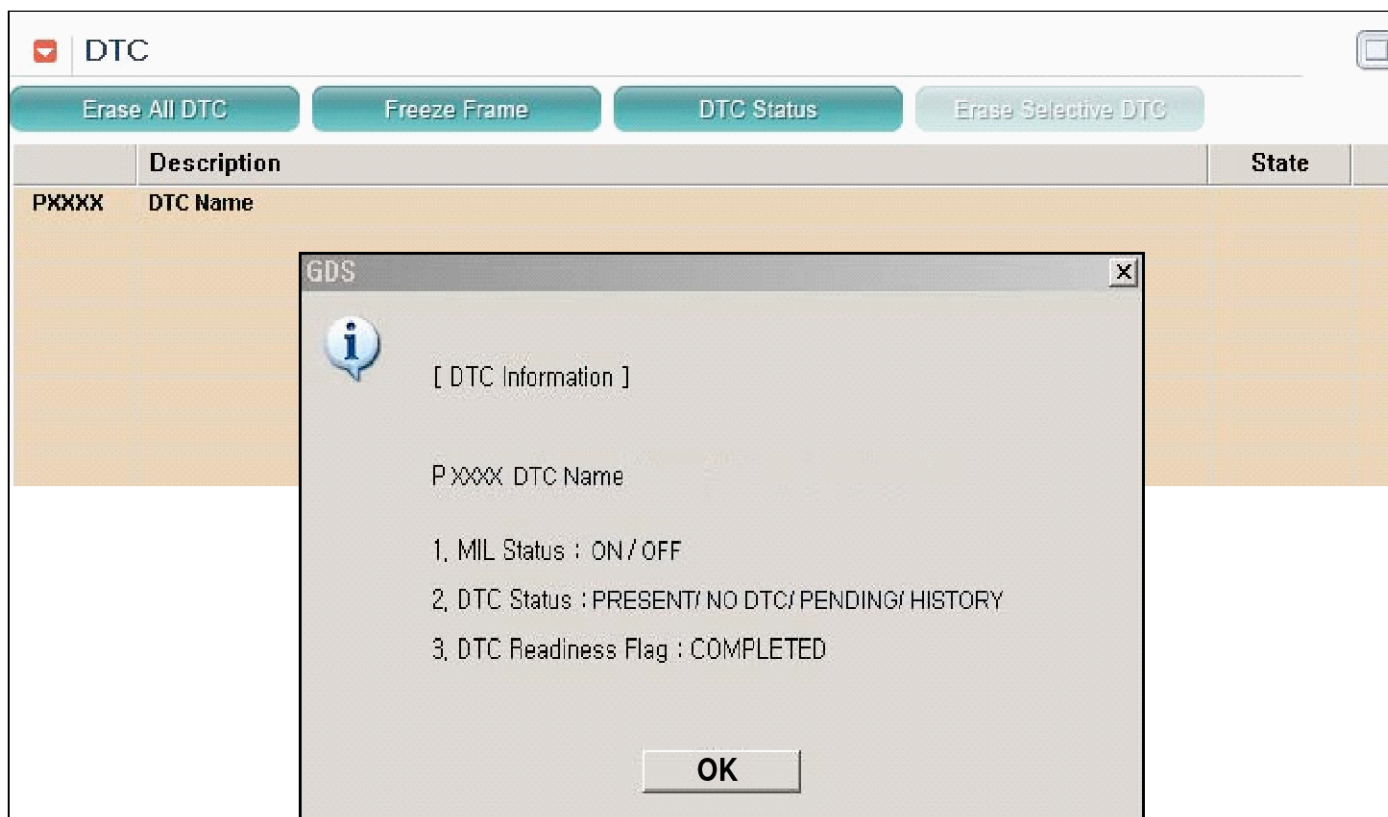
FL-548

Fuel System

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to "Signal Circuit Inspection" procedure

Signal Circuit Inspection

■ Check short to ground in harness

1. IG "OFF" and disconnect ECM connector and ABS(ESC) control module connector.
2. Measure resistance between vehicle speed input signal terminal of ECM harness connector and chassis ground.

S

3. Is the measured resistance within specification?

YES ► Go to "Check open in harness" as follows.

NO ► Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

Engine Control System

FL-549

■ Check open in harness

1. IG "OFF" and disconnect ECM connector and ABS(ESC) control module connector.
2. Measure resistance between vehicle speed input signal terminal of ECM harness connector and wheel speed sensor output signal terminal of ABS(ESC) control module harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification?

YES ► Go to " Check wheel speed sensor " procedure.

NO ► Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check wheel speed sensor

1. IG "OFF"
2. Check open or short in wheel speed sensor (Refer to "C1203 Wheel speed sensor front-RH open/short")
3. Is the wheel speed sensor normal?

YES ► Substitute with a known - good ECM/ ABS(ESC) control unit and check for proper operation. If the problem is corrected, replace ECM/ ABS(ESC) control unit and go to "Verification of Vehicle Repair" procedure.

NO ► Repair or replace it as necessary, and then go to " Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

FL-550

Fuel System

P0504 Brake Switch "A" / "B" Correlation

General Description

The Stop lamp switch is used to judge whether the acceleration system is abnormal or not. The stop lamp switch has a duplex system(signals brake test or brake light) to memorize the abnormality when the signals of depressing and releasing the brake pedal are detected simultaneously.

DTC Description

Checking output signals from both Stop lamp switch when all of them are On or OFF simultaneously, if abnormal signal is detected for more than 0.5 sec., an error is recognized. And if this condition lasts for certain period, ECM sets P0504. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item		Detecting Condition	Possible cause
DTC Strategy		Comparing 2 brake signals during driving	- Poor connection - Open or short in Stop lamp switch - Faulty Stop lamp switch
Enable Conditions	Case 1	- Engine works - Vehicle Speed Sensor is abnormal.	
	Case 2	- Engine works - Vehicle Speed Sensor is normal and Vehicle Speed is over 20kph driving 1sec or more.	
Threshold value		The one brake signal's change duration when another signal has been changed > 0.5 sec	
Diagnosis Time		Continuous	
MIL On Condition		NO MIL ON(DTC only)	

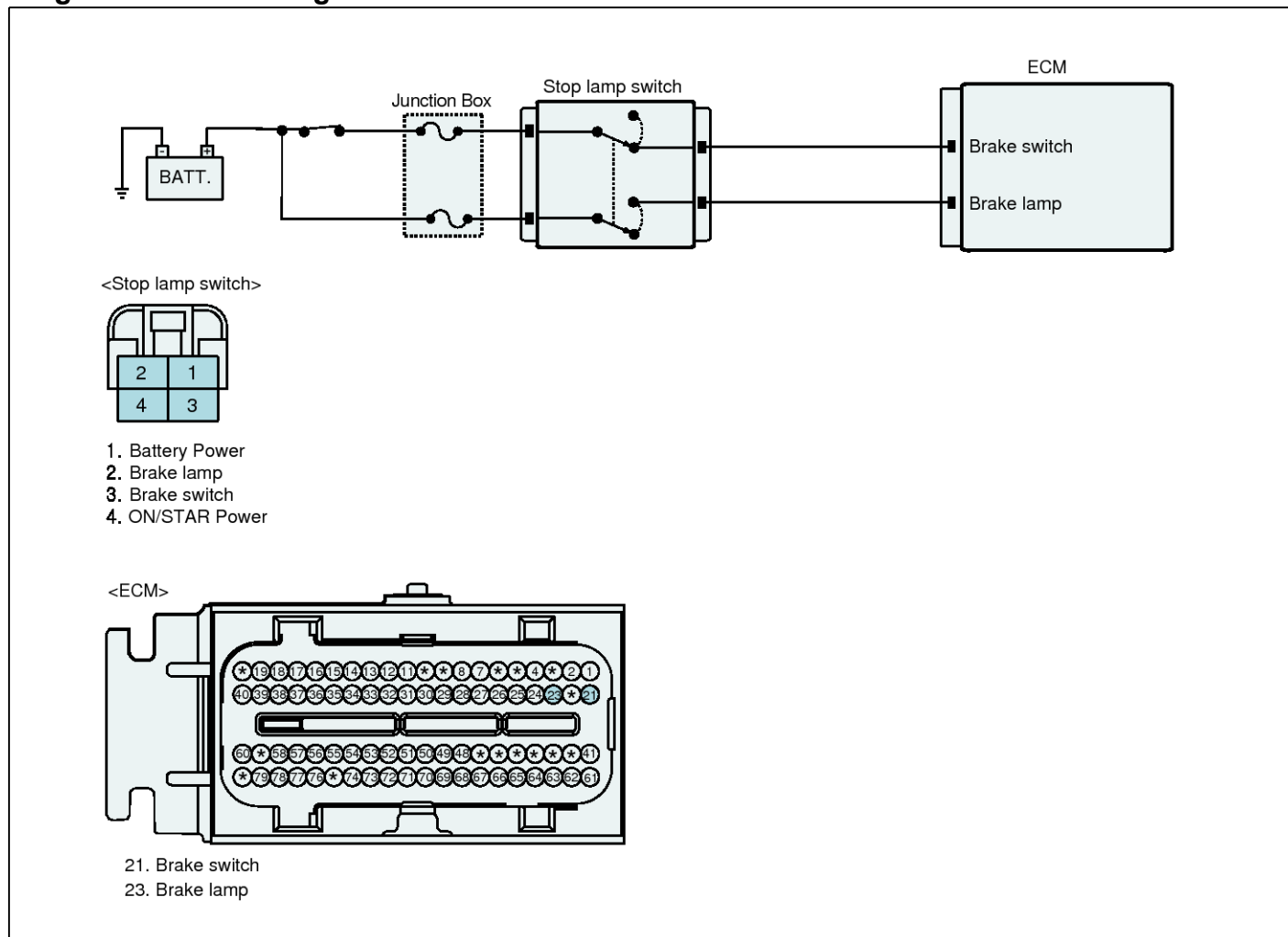
Specification

Item	During taking off the brake	During stepping on the brake
Stop Lamp	0V	Battery voltage
Stop Lamp Switch	Battery voltage	0V

Engine Control System

FL-551

Diagnostic Circuit Diagram



SBHFL9531L

Signal Waveform & Data



Fig.1

SBHFL9671L

Fig 1) Normal data of Brake Switch during brake pedal released after depressed.

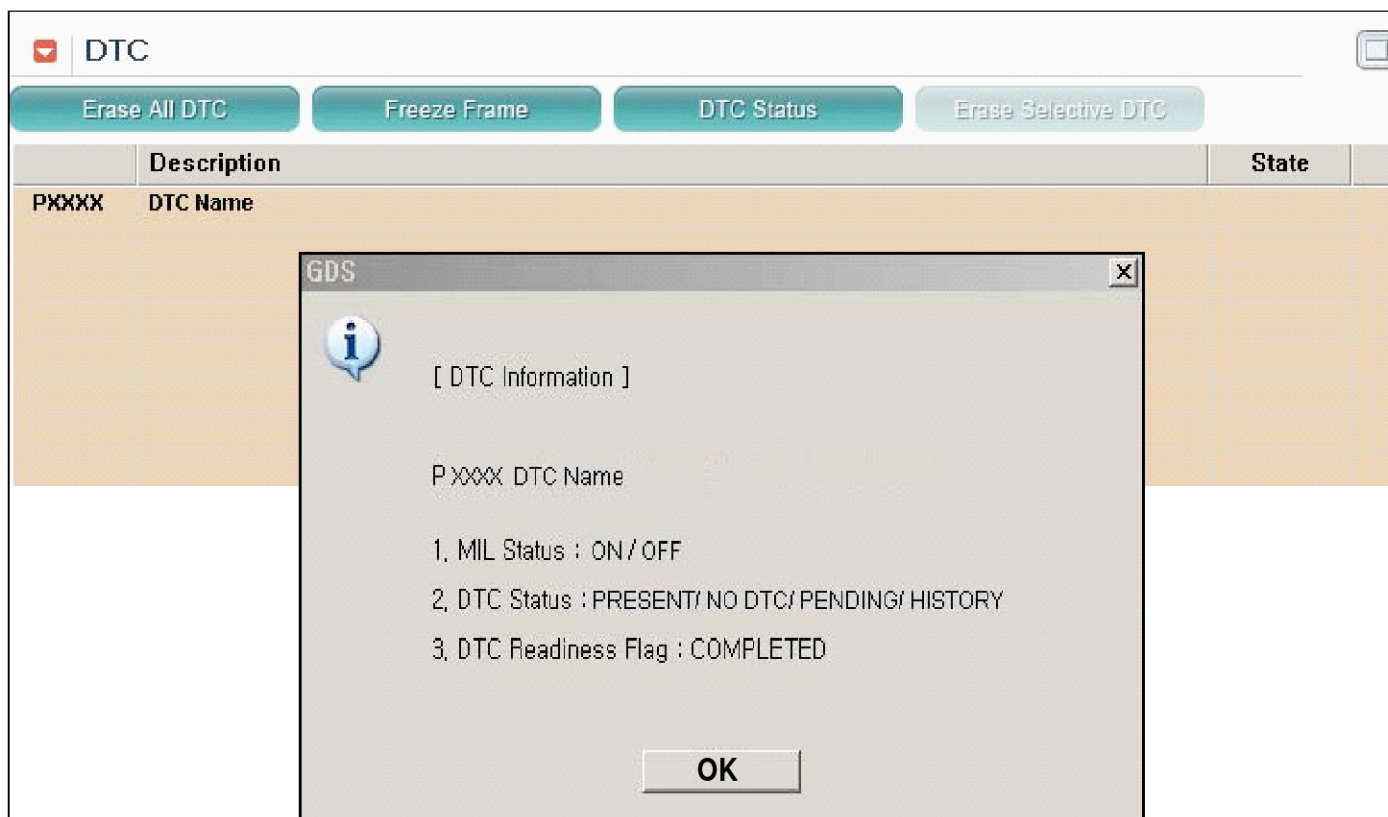
FL-552

Fuel System

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to " Power Circuit Inspection " procedure

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect ECM connector.
2. IG "ON" and keep the brake taking off. (Measurement "A").
3. Measure the voltage between brake switch signal terminal of ECM harness connector and chassis ground.
4. Measure the voltage between brake lamp signal terminal of ECM harness connector and chassis ground .
5. Keep the brake stepping on.(Measurement "B")
6. Measure the voltage between brake switch signal terminal of ECM harness connector and chassis ground.

Engine Control System

FL-553

7. Measure the voltage between brake lamp signal terminal of ECM harness connector and chassis ground.

Specification : B+

Item	During taking off the brake	During stepping on the brake
Stop Lamp	0V	Battery voltage
Stop Lamp Switch	Battery voltage	0V

8. Is the measured voltage within specification ?

YES ▶ Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check open in harness" as follows.

■ Check open in harness

1. IG "OFF" and disconnect stop lamp switch and ECM connector.
2. Measure the resistance between brake switch signal terminal of ECM harness connector and brake switch signal terminal of Stop lamp switch harness connector.
3. Measure the resistance between brake lamp signal terminal of ECM harness connector and brake lamp signal terminal of Stop lamp switch harness connector.

Specification : Below 1Ω

4. Is the measured resistance within specification ?

YES ▶ Go to "Check Battery voltage" procedure.

NO ▶ Repair open in circuit and go to "Verification of Vehicle Repair" procedure.

■ Check battery voltage

1. IG "OFF" and disconnect stop lamp switch connector.
2. Measure the voltage between power supply terminals of stop lamp switch harness connector and chassis ground.
3. IG "ON"
4. Measure the voltage between power supply terminals of stop lamp switch harness connector and chassis ground.

Specification :

Item		
Power supply to brake switch side	Battery voltage	Battery voltage
Power supply to brake lamp side	0V	Battery voltage

5. Is the measured voltage within specification ?

YES ▶ Substitute with a known - good stop lamp switch and check for proper operation. If the problem is corrected, replace stop lamp switch and go to "Verification of Vehicle Repair" procedure.

NO ▶ Check the fuse between battery and stop lamp switch.
▶ Repair open or short in power circuit of stop lamp switch and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

FL-554

Fuel System

P0506 Idle Air Control System-RPM Lower than Expected

General Description

The idle speed is controlled by the Electrical Throttle Control(ETC) System. ETC system is composed of the throttle motor to operate the throttle valve and the throttle position sensor to detect the opening angle of the throttle valve, the accelerator pedal position sensor to detect the accelerator pedal position and the one valve type throttle body. The ECM controls the throttle motor to provide the proper throttle valve opening angle for the target idle speed.

DTC Description

Checking idle RPM under detecting condition, if the real idle speed is lower than desired idle speed by 100 RPM over 10 sec., ECM sets P0506. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor idle speed	• Intake system for blockage
Enable Conditions	• Normal idle conditions	
Threshold value	• Real engine speed is lower than target engine speed by 100 RPM	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

Signal Waveform & Data

☒ Current Data				
Standard Display ▾	Full List ▾	Graph ▾	Items List ▾	Reset Min.Max.
Record	Stop ▾	VSS		
Sensor Name	Value	Unit		
☒ Engine Speed	640	RPM		
☒ Target Idle Speed	650	RPM		

Fig.1

SBHFL9672L

Fig 1) Normal data of Engine RPM after engine warmed up.

Monitor Scantool Data

1. Monitor DTCs related to HO2S, MAFS, MAPS, ECTS, PCSV, Injector, CVVT items, ETC system, A/C system, or power steering system with scantool.
2. Are there the DTCs above-mentioned?

YES ▶ Do all repairs associated with those codes before proceeding with this procedure.

NO ▶ Go to "System Inspection" procedure

System Inspection

■ Check intake system for blockage

1. Visually/physically inspect the following items:
 - ▶ Air cleaner filter element for excessive dirt or for any foreign objects
 - ▶ Hoses of intake system for blockage
 - ▶ Throttle body inlet for damage or for any foreign objects
 - ▶ Throttle plate for carbon deposits

Engine Control System

FL-555

2. Has a problem been found in any of the above areas?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Clear DTC and Test-drive under enable conditions above-mentioned. After the test, If this DTC is set, go to "Inspection & Repair" procedure. If not, troubleshooting is completed.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

FL-556

Fuel System

P0507 Idle Air Control System-RPM Higher than Expected

General Description

Refer to DTC P0506 : Idle Air Control System-RPM Lower than Expected

DTC Description

Checking idle RPM under detecting condition, if the real idle speed is higher than desired idle speed by 200 RPM over 10 sec., ECM sets P0507. MIL (Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor idle speed	• Intake system for air leakage
Enable Conditions	• Normal idle conditions	
Threshold value	• Real engine speed is higher than target engine speed by 200 RPM	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

Signal Waveform & Data

Refer to DTC P0506 : Idle Air Control System-RPM Lower than Expected

Monitor Scantool Data

Refer to DTC P0506 : Idle Air Control System-RPM Lower than Expected

System Inspection

■ Check intake system/vapor hoses for air leakage or disconnection

1. Visually/physically inspect the following items:
 - ▶ Intake system for air leakage
 - ▶ Vapor hoses for cracks or disconnection
2. Has a problem been found in any of the above areas?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ▶ Clear DTC and Test-drive under enable conditions above-mentioned. After the test, If this DTC is set, go to "Inspection & Repair" procedure. If not, troubleshooting is completed.

Verification of Vehicle Repair

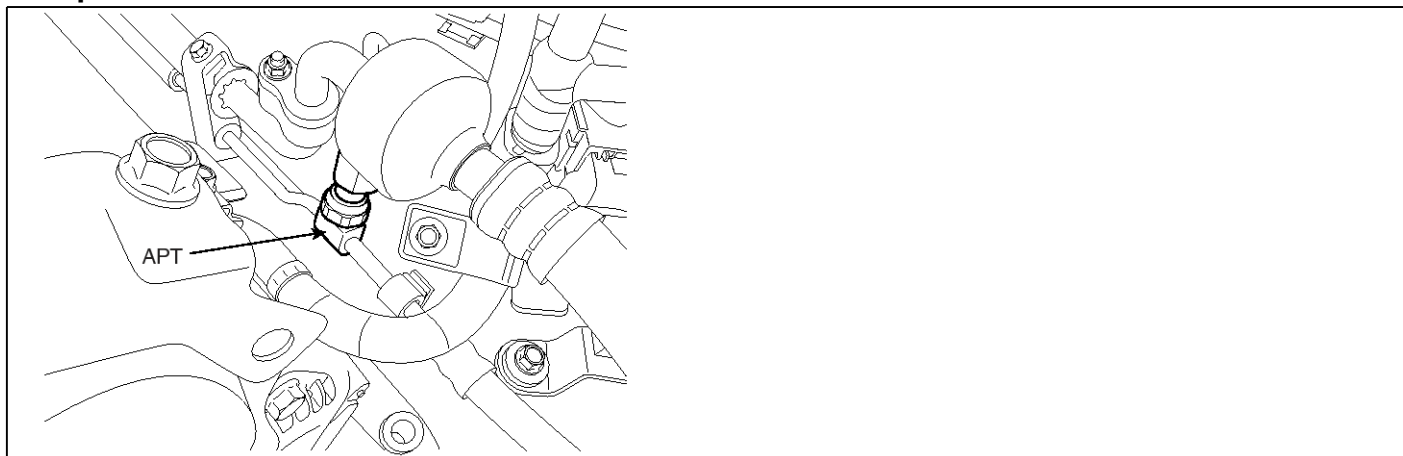
Refer to DTC P0506 : Idle Air Control System-RPM Lower than Expected

Engine Control System

FL-557

P0532 A/C Refrigerant Pressure Sensor "A" Circuit Low Input

Component Location



SBHFL9316L

General Description

The ECM (Engine Control Module) receives pressure signal in the A/C refrigerant high pressure side from the A/C refrigerant pressure sensor. This input indicates how much load the A/C compressor is putting on the engine and is one of the factors used by the ECM in order to determine the idle air control position for the idle speed. The circuits consist of a 5V reference and a ground, both provided by the ECM, and a signal from the sensor. The signal is a voltage which is proportional to the A/C pressure from 0 to 5V. Low pressure produces a low voltage signal and high pressure a high-voltage signal.

DTC Description

Checking output signals from A/C pressure sensor under detecting condition, if an signal below 0.25V lasts for more than 10 sec., ECM sets P0532.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects sensor signal short to low voltage	• Poor connection • Open in power circuit • Open or short to ground in signal circuit • Faulty A/C pressure sensor • Faulty ECM
Enable Conditions	• Engine works	
Threshold value	• Sensor output voltage < 0.25V	
Diagnosis Time	• Continuous (More than 10 seconds failure for every 20 seconds test)	
MIL On Condition	• DTC only (NO MIL ON)	

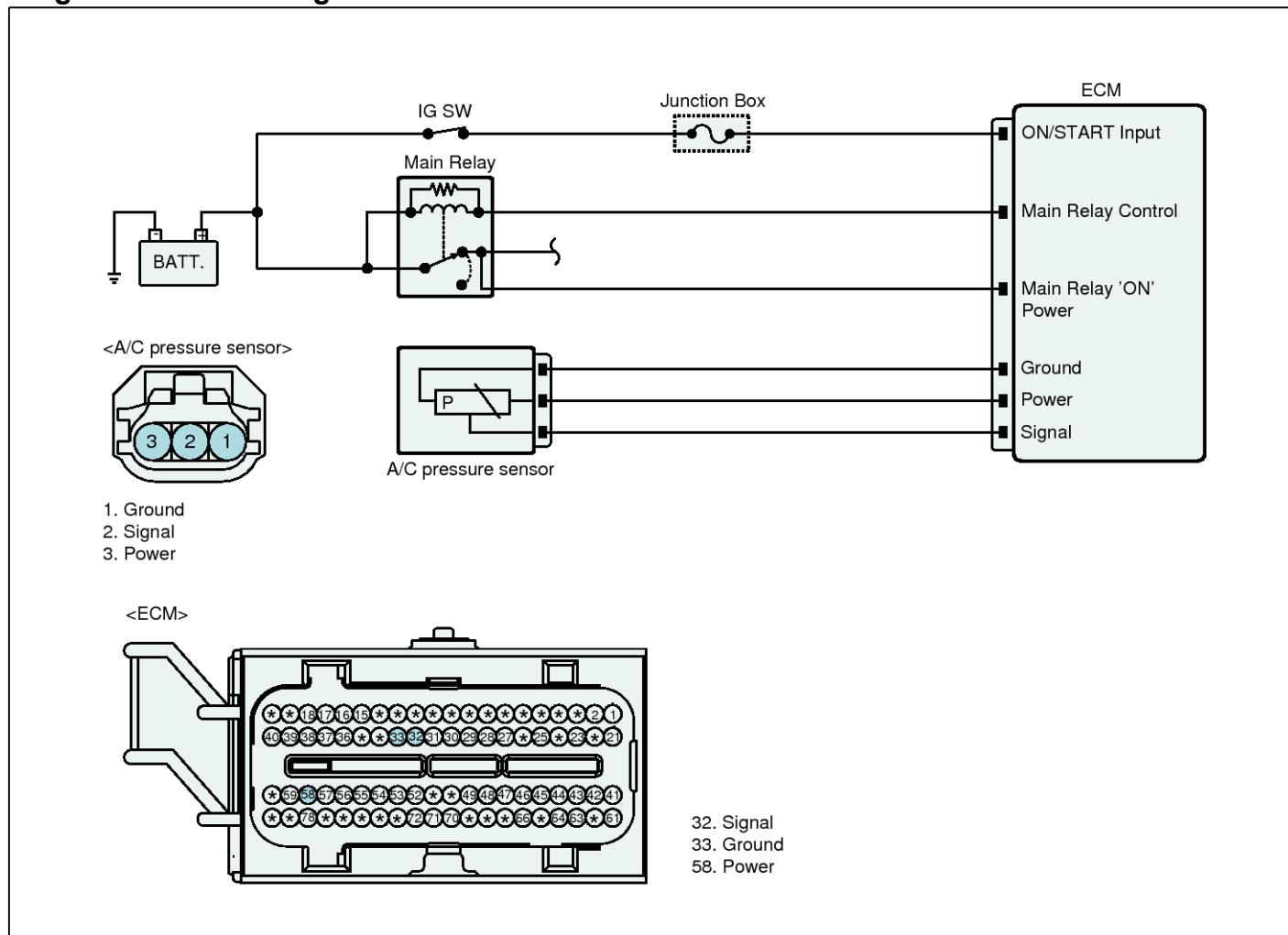
Specification

Pressure(psi)	392	1176	1961	2745	3138
Voltage(V)	1	2	3	4	4.5

FL-558

Fuel System

Diagnostic Circuit Diagram



SBHFL9532L

Signal Waveform & Data

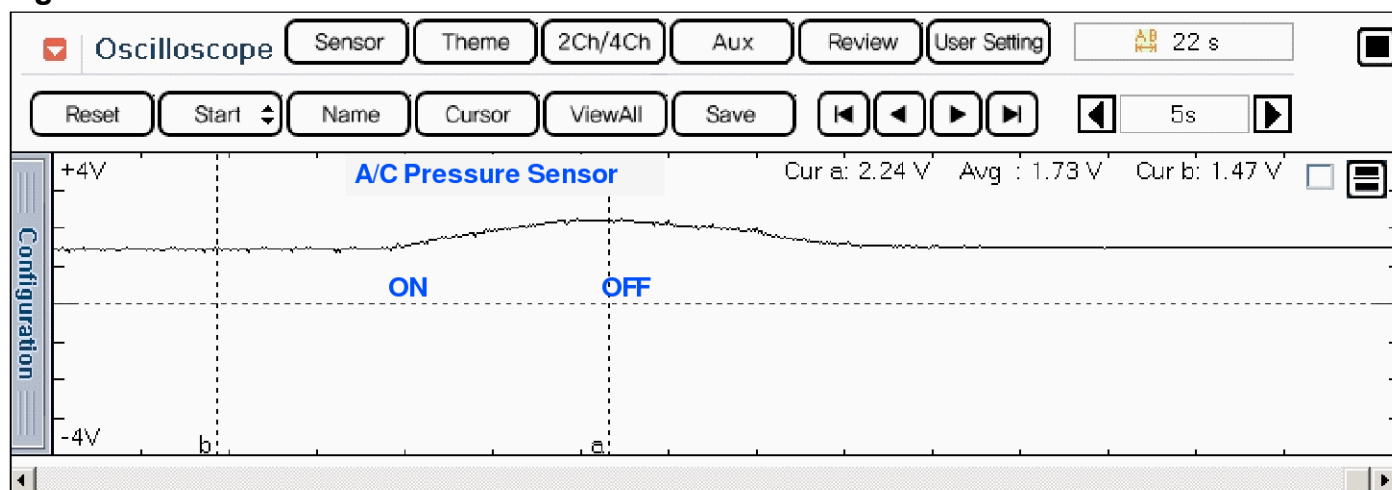


Fig.1

SBHFL9673L

Engine Control System

FL-559

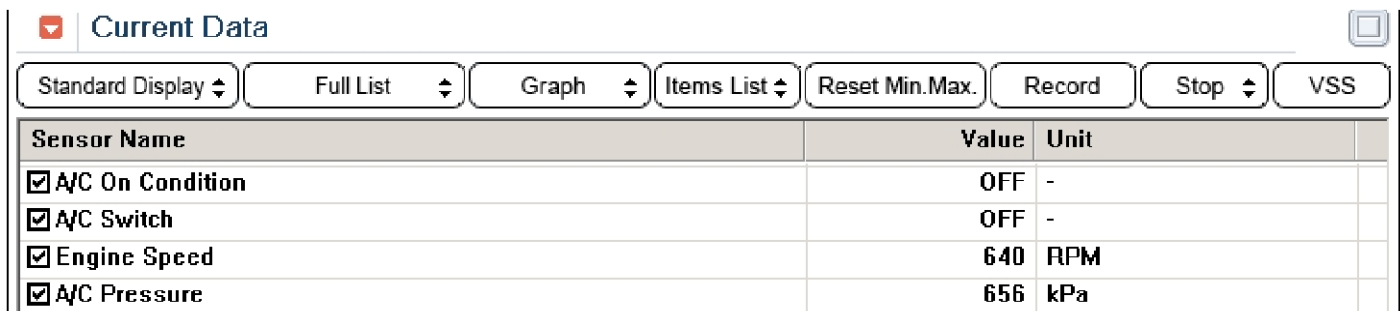


Fig.2

SBHFL9674L

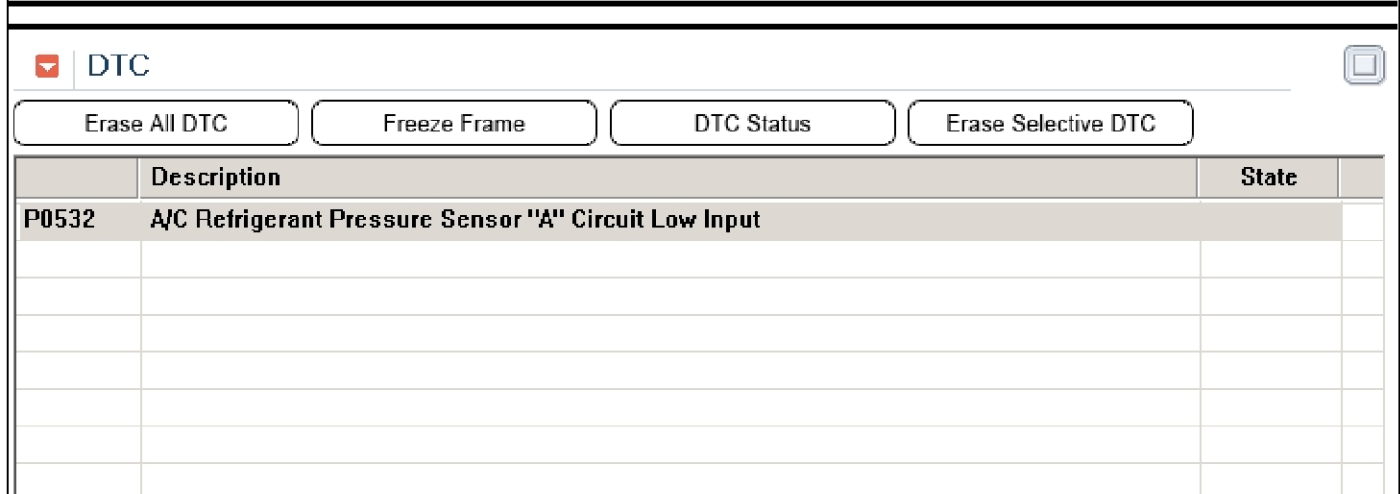
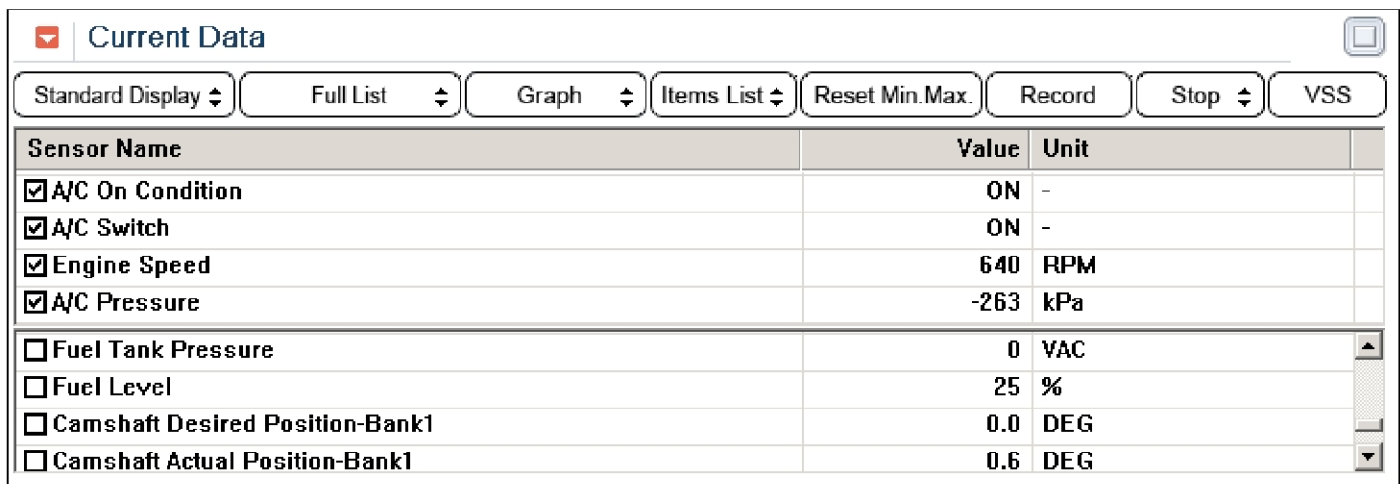


Fig.3

SBHFL9675L

Fig 1) Normal waveforms of A/C pressure sensor during the time from turning on A/C switch to turning off A/C switch.

Fig 2) Normal data of A/C pressure sensor without A/C switch ON.

Fig 3) Abnormal data of A/C pressure sensor when A/C pressure sensor circuit open.

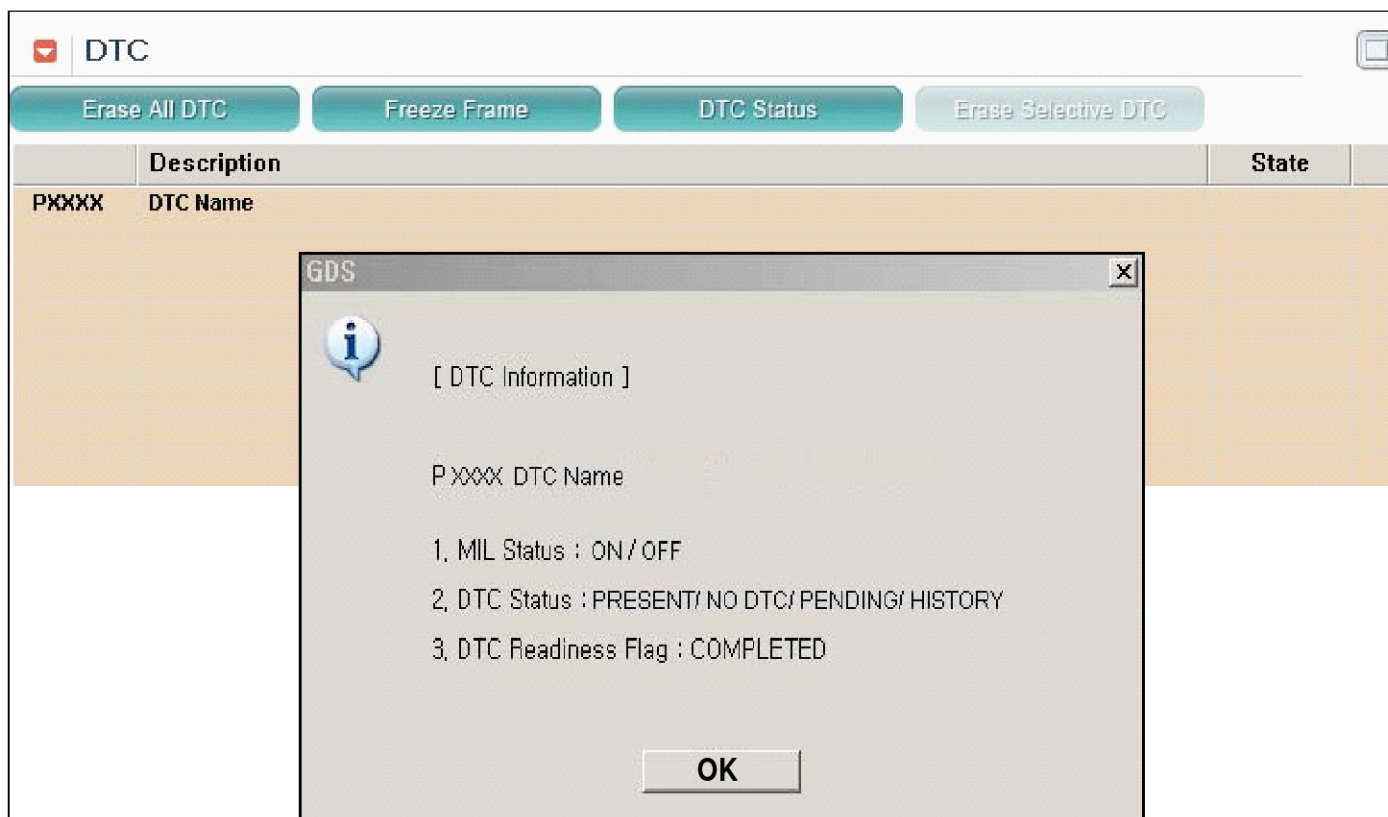
FL-560

Fuel System

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage..
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to " Power Circuit Inspection " procedure

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect the A/C pressure sensor connector.
2. IG "ON"
3. Measure the voltage between power terminal of A/C pressure sensor harness connector and chassis ground.

Specification : Approx. 5V

Engine Control System

FL-561

4. Is the measured voltage within specification ?

YES ▶ Go to "Signal Circuit Inspection" procedure.

NO ▶ Repair open or short to ground in harness and go to "Verification of Vehicle Repair" procedure.

Signal Circuit Inspection

■ Check short to ground in harness

1. IG "OFF" and disconnect A/C pressure sensor and ECM connector.
2. Measure the resistance between signal terminal of A/C pressure sensor harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect A/C pressure sensor and ECM connector.
2. Measure the resistance between signal terminal of A/C pressure sensor harness connector and A/C pressure sensor signal terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification?

YES ▶ Go to "Component inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

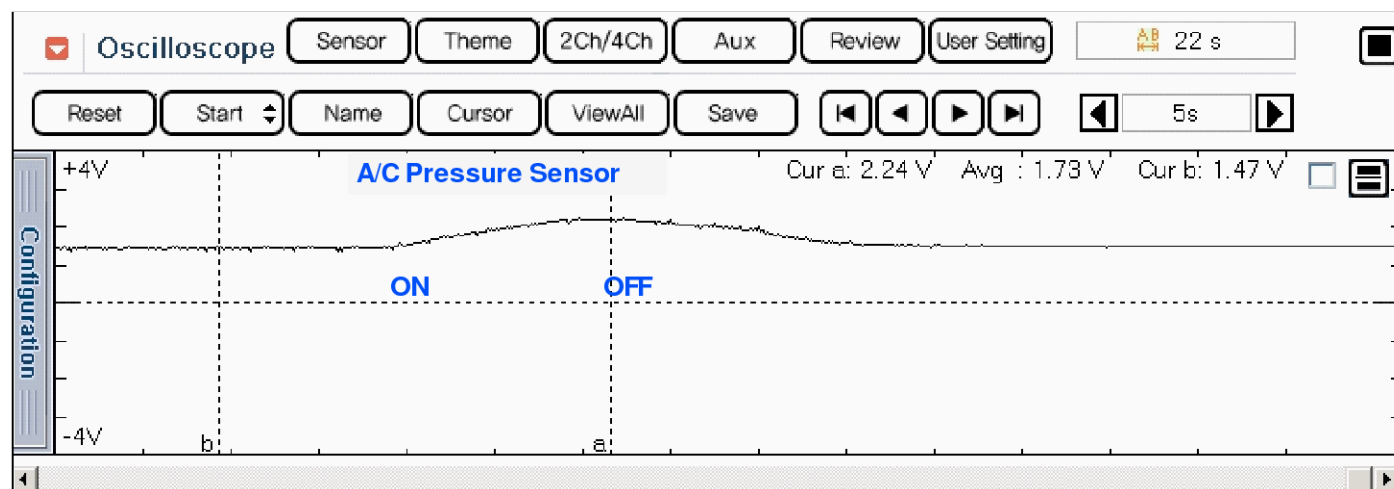
Component Inspection

■ Check A/C pressure sensor

1. IG "OFF" and connect the scantool.
2. Connect the probe to A/C pressure sensor signal and select the oscilloscope in the menu.
3. Check the waveform with turning on and off a/c switch after engine start.

Specification :

Pressure(psi)	Voltage(V)
392	1
1176	2
1961	3
2745	4
3138	4.5



SBHFL9676L

4. Is the measured waveform of A/C pressure sensor normal?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

 NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good A/C pressure sensor and check for proper operation. If the problem is corrected, replace A/C pressure sensor and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-563

P0533 A/C Refrigerant Pressure Sensor "A" Circuit High Input

Component Location

Refer to DTC P0532 : A/C Refrigerant Pressure Sensor "A" Circuit Low Input

General Description

Refer to DTC P0532 : A/C Refrigerant Pressure Sensor "A" Circuit Low Input

DTC Description

Checking output signals from A/C pressure sensor under detecting condition, if an signal above 4.65V lasts for more than 10 sec., ECM sets P0533.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects sensor signal short to high voltage	• Poor connection • Short in signal circuit • Open in ground circuit • Faulty A/C Pressure sensor • Faulty ECM
Enable Conditions	• Engine works	
Threshold value	• Sensor output voltage > 4.65V	
Diagnosis Time	• Continuous (More than 10 seconds failure for every 20 seconds test)	
MIL On Condition	• DTC only (NO MIL ON)	

Specification

Refer to DTC P0532 : A/C Refrigerant Pressure Sensor "A" Circuit Low Input

Diagnostic Circuit Diagram

Refer to DTC P0532 : A/C Refrigerant Pressure Sensor "A" Circuit Low Input

Signal Waveform & Data

Refer to DTC P0532 : A/C Refrigerant Pressure Sensor "A" Circuit Low Input

Monitor Scantool Data

Refer to DTC P0532 : A/C Refrigerant Pressure Sensor "A" Circuit Low Input

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage..
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to " Power Circuit Inspection " procedure

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect the A/C pressure sensor connector.
2. IG "ON"
3. Measure the voltage between power terminal of A/C pressure sensor harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ► Go to "Ground Circuit Inspection" procedure

NO ► Repair open or short to ground in harness and go to "Verification of Vehicle Repair" procedure.

Ground Circuit Inspection

■ Check open in harness

1. IG "OFF" and disconnect P/S pressure sensor connector and ECM connector.
2. IG "ON"
3. Measure the voltage between power terminal of A/C pressure sensor harness connector and chassis ground.(Measurement "A")

FL-564

Fuel System

4. Measure the voltage between power and ground terminals of A/C pressure sensor harness connector.(Measurement "B")

Specification : The Difference between "A" and "B" is below 200mV.

5. Is the measured voltage within specification ?

YES ▶ Go to "Signal Circuit Inspection" procedure.

NO ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

Signal Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect the A/C pressure sensor connector.
2. IG "ON"
3. Measure the voltage between signal terminal of A/C pressure sensor harness connector and chassis ground.

Specification : Approx. 0V

4. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Go to "Check short to battery in harness" procedure.

■ Check short to battery in harness

1. IG "OFF" and disconnect A/C pressure sensor and ECM connector.
2. Measure the resistance between signal and power terminals of A/C pressure sensor harness connector.

Specification : Infinite

3. Is the measured resistance within specification?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

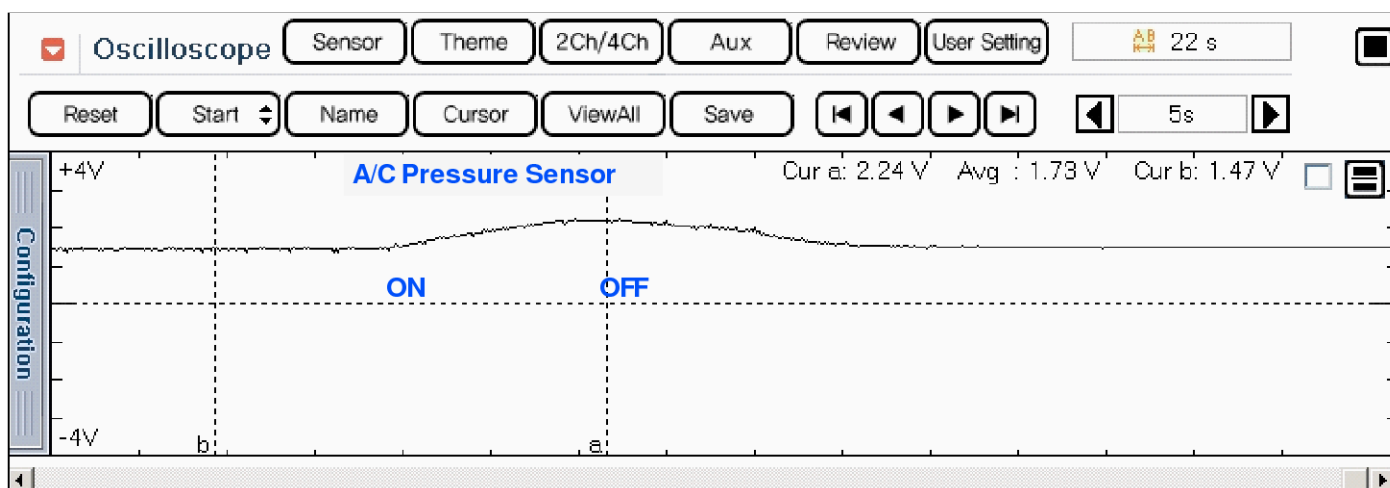
Component Inspection

■ Check A/C pressure sensor

1. IG "OFF" and connect the scantool.
2. Connect the probe to A/C pressure sensor signal and select the oscilloscope in the menu.
3. Check the waveform with turning on and off a/c switch after engine start.

Specification :

Pressure(psi)	Voltage(V)
392	1
1176	2
1961	3
2745	4
3138	4.5



SBHFL9676L

Engine Control System

FL-565

4. Is the measured waveform of A/C pressure sensor normal?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

 NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good A/C pressure sensor and check for proper operation. If the problem is corrected, replace A/C pressure sensor and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

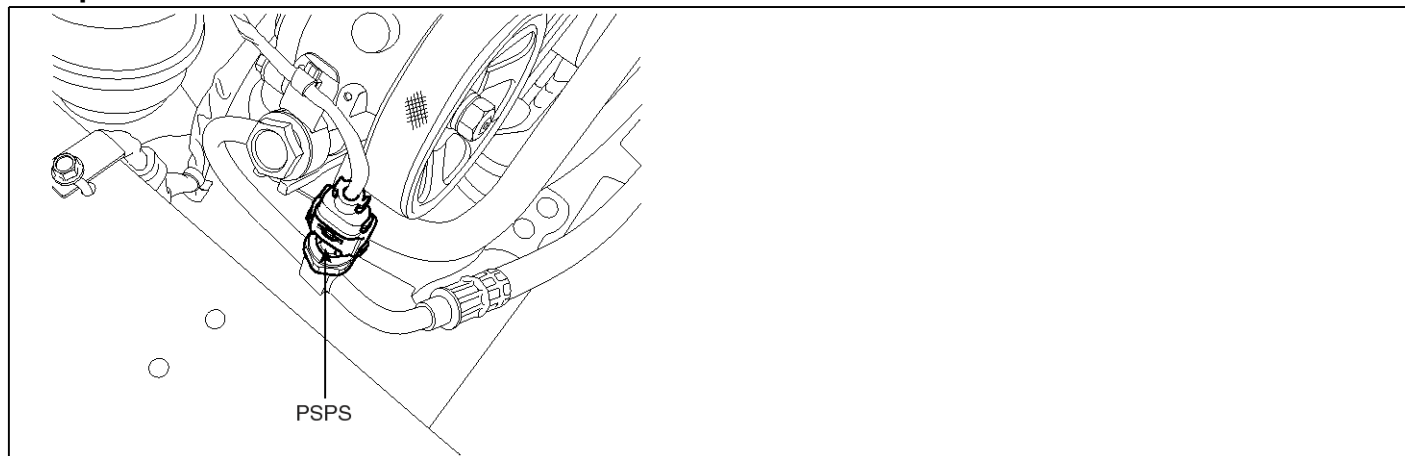
Refer to DTC P0532 : A/C Refrigerant Pressure Sensor "A" Circuit Low Input

FL-566

Fuel System

P0552 Power Steering Pressure Sensor/Switch Circuit Low input

Component Location



SBHFL9317L

General Description

To reduce the required power to manipulate steering wheel, hydraulic pressure is used in power steering system. A load is sensed at steering oil pressure sensor then inputted to ECM as a wheel position signal. Controlling idle speed valve, ECM performs appropriate electric load correction With this signal.

DTC Description

Checking output signals from P/S PS(power steering pressure sensor) every 2.5 sec. under detecting condition, if an signal below 0.05V lasts for more than 1.25 sec., ECM sets P0552. MIL(Malfunction Indicatin Lamp) turns on when the malfunction lasts till consecutive 2 driving cycles.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects sensor signal short to low voltage	• Poor connection • Open in power circuit • Open or short to ground in signal circuit • Faulty P/S pressure sensor • Faulty ECM
Enable Conditions	• Engine works • $11V \leq \text{Battery voltage} \leq 16V$	
Threshold value	• Sensor output voltage $< 0.25V$	
Diagnosis Time	• Continuous (More than 10 seconds failure for every 20 seconds test)	
MIL On Condition	• NO MIL ON(DTC only)	

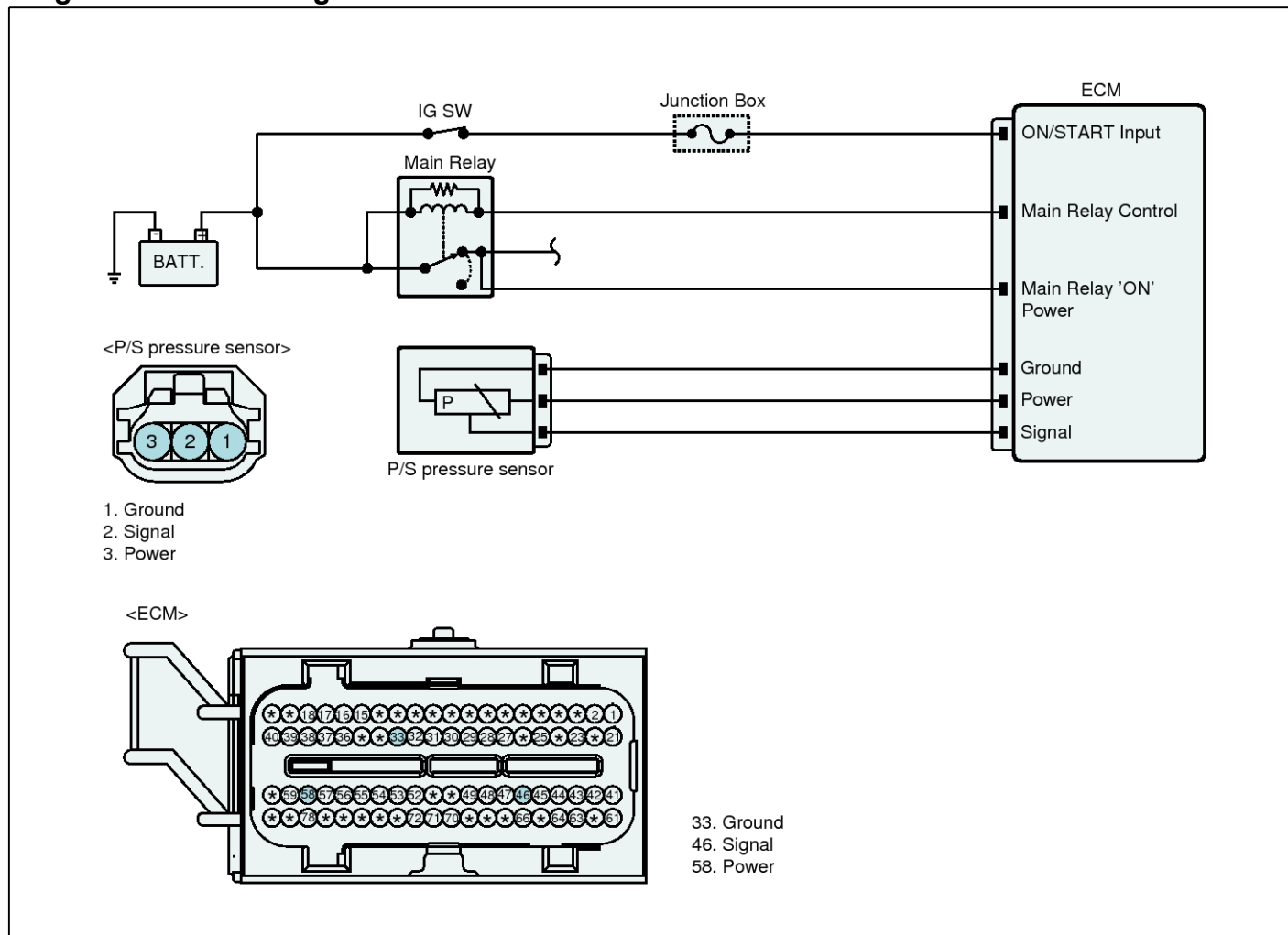
Specification

Pressure(kpa)	1350	4050	6749	9449	10800
Voltage(V)	1	2	3	4	4.5

Engine Control System

FL-567

Diagnostic Circuit Diagram



SBHFL9533L

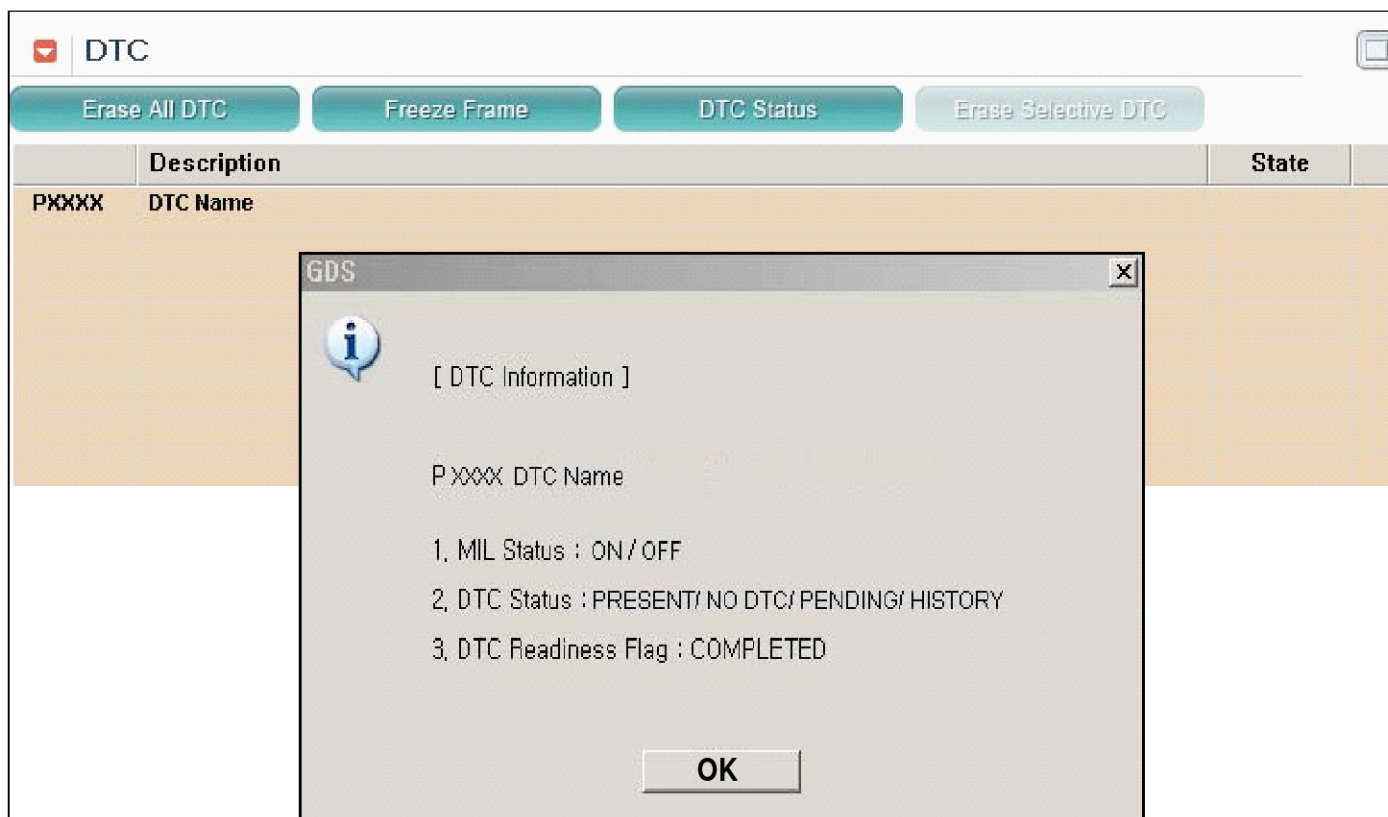
FL-568

Fuel System

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage..
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to " Power Circuit Inspection " procedure

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect the P/S pressure sensor connector.
2. IG "ON"
3. Measure the voltage between power terminal of P/S pressure sensor harness connector and chassis ground.

Specification : Approx. 5V

Engine Control System

FL-569

4. Is the measured voltage within specification ?

YES ▶ Go to "Signal Circuit Inspection" procedure.

NO ▶ Repair open or short to ground in harness and go to "Verification of Vehicle Repair" procedure.

Signal Circuit Inspection

■ Check short to ground in harness

1. IG "OFF" and disconnect P/S pressure sensor connector and ECM connector.
2. Measure the resistance between signal terminal of P/S pressure sensor harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect P/S pressure sensor connector and ECM connector.
2. Measure the resistance between signal terminal of P/S pressure sensor harness connector and P/S pressure sensor signal terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification?

YES ▶ Go to "Component inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check P/S pressure sensor

1. IG "OFF" and connect the scantool.
2. Connect the probe to signal line of P/S pressure sensor and select the oscilloscope in menu.
3. Check the waveform with steering handle movement after engine start.

Specification :

Pressure(psi)	Voltage(V)
1350	1
4050	2
6749	3
9449	4
10800	4.5

4. Is the measured waveform of P/S pressure sensor normal?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good P/S pressure sensor and check for proper operation. If the problem is corrected, replace P/S pressure sensor and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

FL-570

Fuel System

P0553 Power Steering Pressure Sensor/Switch Circuit High input

Component Location

Refer to DTC P0552 : Power Steering Pressure Sensor/Switch Circuit Low input

General Description

Refer to DTC P0552 : Power Steering Pressure Sensor/Switch Circuit Low input

DTC Description

Checking output signals from P/S PS(power steering pressure sensor) every 2.5 sec. under detecting condition, if an signal above 4.95V lasts for more than 1.25 sec., ECM sets P0553. MIL(Malfunction Indicatin Lamp) turns on when the malfunction lasts till consecutive 2 driving cycles.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects sensor signal short to high voltage	• Poor connection • Short in signal circuit • Open in ground circuit • Faulty P/S pressure sensor • Faulty ECM
Enable Conditions	• Engine works • $11V \leq \text{Battery voltage} \leq 16V$	
Threshold value	• Sensor output voltage $> 4.65V$	
Diagnosis Time	• Continuous (More than 1.25 seconds failure for every 2.5 seconds test)	
MIL On Condition	• NO MIL ON(DTC only)	

Specification

Refer to DTC P0552 : Power Steering Pressure Sensor/Switch Circuit Low input

Diagnostic Circuit Diagram

Refer to DTC P0552 : Power Steering Pressure Sensor/Switch Circuit Low input

Monitor Scantool Data

Refer to DTC P0552 : Power Steering Pressure Sensor/Switch Circuit Low input

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage..
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to " Power Circuit Inspection " procedure

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect the P/S pressure sensor connector.
2. IG "ON"
3. Measure the voltage between power terminal of P/S pressure sensor harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ► Go to "Ground Circuit Inspection" procedure

NO ► Repair open or short to ground in harness and go to "Verification of Vehicle Repair" procedure.

Ground Circuit Inspection

■ Check open in harness

1. IG "OFF" and disconnect the P/S pressure sensor connector.
2. IG "ON"
3. Measure the voltage between power terminal of P/S pressure sensor harness connector and chassis ground.(Measurement "A")

Engine Control System

FL-571

4. Measure the voltage between power and ground terminals of P/S pressure sensor harness connector.(Measurement "B")

Specification : The Difference between "A" and "B" is below 200mV.

5. Is the measured voltage within specification ?

YES ▶ Go to "Signal Circuit Inspection" procedure.

NO ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure.

Signal Circuit Inspection

■ Check short to battery in harness

1. IG "OFF" and disconnect the P/S pressure sensor connector and ECM connector.
2. Measure the resistance between signal and power terminals of P/S pressure sensor harness connector.

Specification : Approx. 0V

3. Is the measured resistance within specification?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short to battery in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check P/S pressure sensor

1. IG "OFF" and connect the scantool.
2. Connect the probe to signal line of P/S pressure sensor and select the oscilloscope in menu.
3. Check the waveform with steering handle movement after engine start.

Specification :

Pressure(psi)	Voltage(V)
1350	1
4050	2
6749	3
9449	4
10800	4.5

4. Is the measured waveform of P/S pressure sensor normal?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good P/S pressure sensor and check for proper operation. If the problem is corrected, replace P/S pressure sensor and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

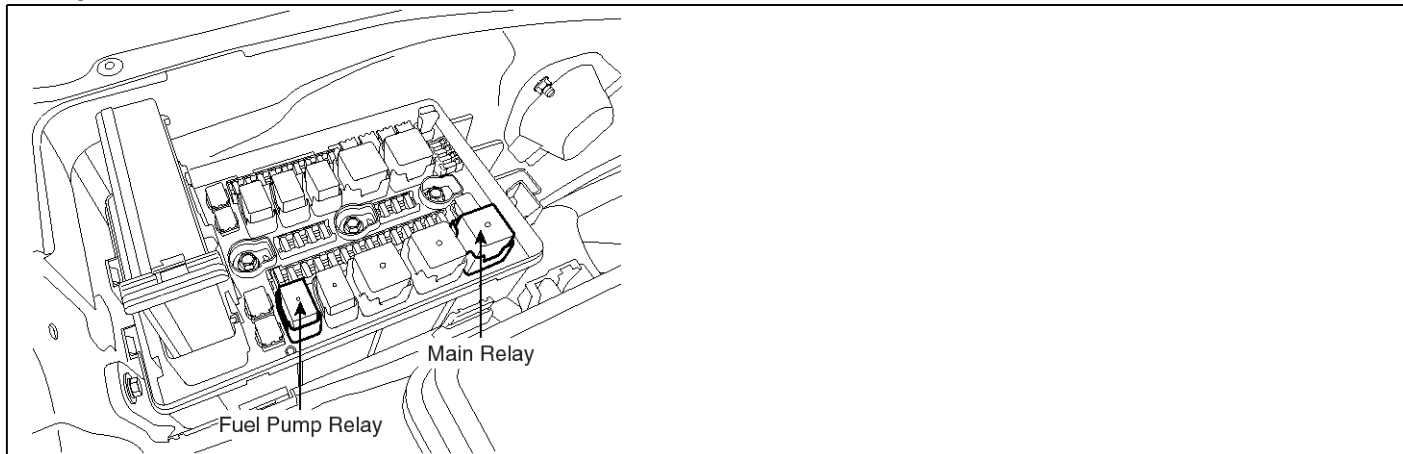
Refer to DTC P0552 : Power Steering Pressure Sensor/Switch Circuit Low input

FL-572

Fuel System

P0562 System Voltage Low

Component Location



SBHFL9323L

General Description

The ECM provides ground to one side of the coil of the main relay and the other side is connected to the battery. The ECM monitors battery voltage and the voltage after the main relay.

DTC Description

During engine running, if system voltage is below 11V, ECM sets P0562. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Voltage too low	• Poor connection • Open in circuit • Faulty charging system • Faulty main relay • Faulty ECM
Enable Conditions	• Engine works	
Threshold value	• System voltage < 11V	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

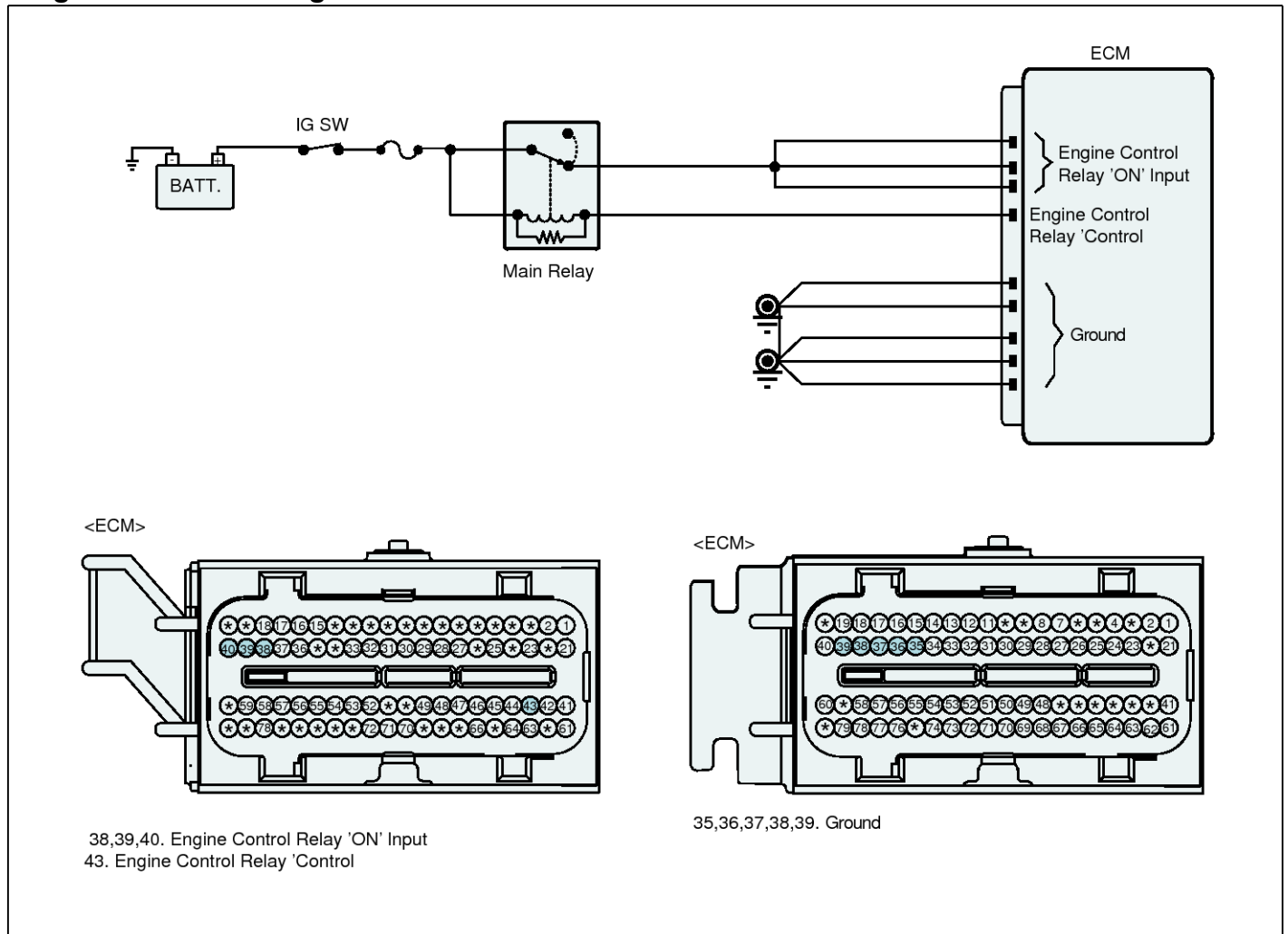
Specification

Coil Resistance	70Ω ~ 120Ω

Engine Control System

FL-573

Diagnostic Circuit Diagram



SBHFL9534L

Signal Waveform & Data

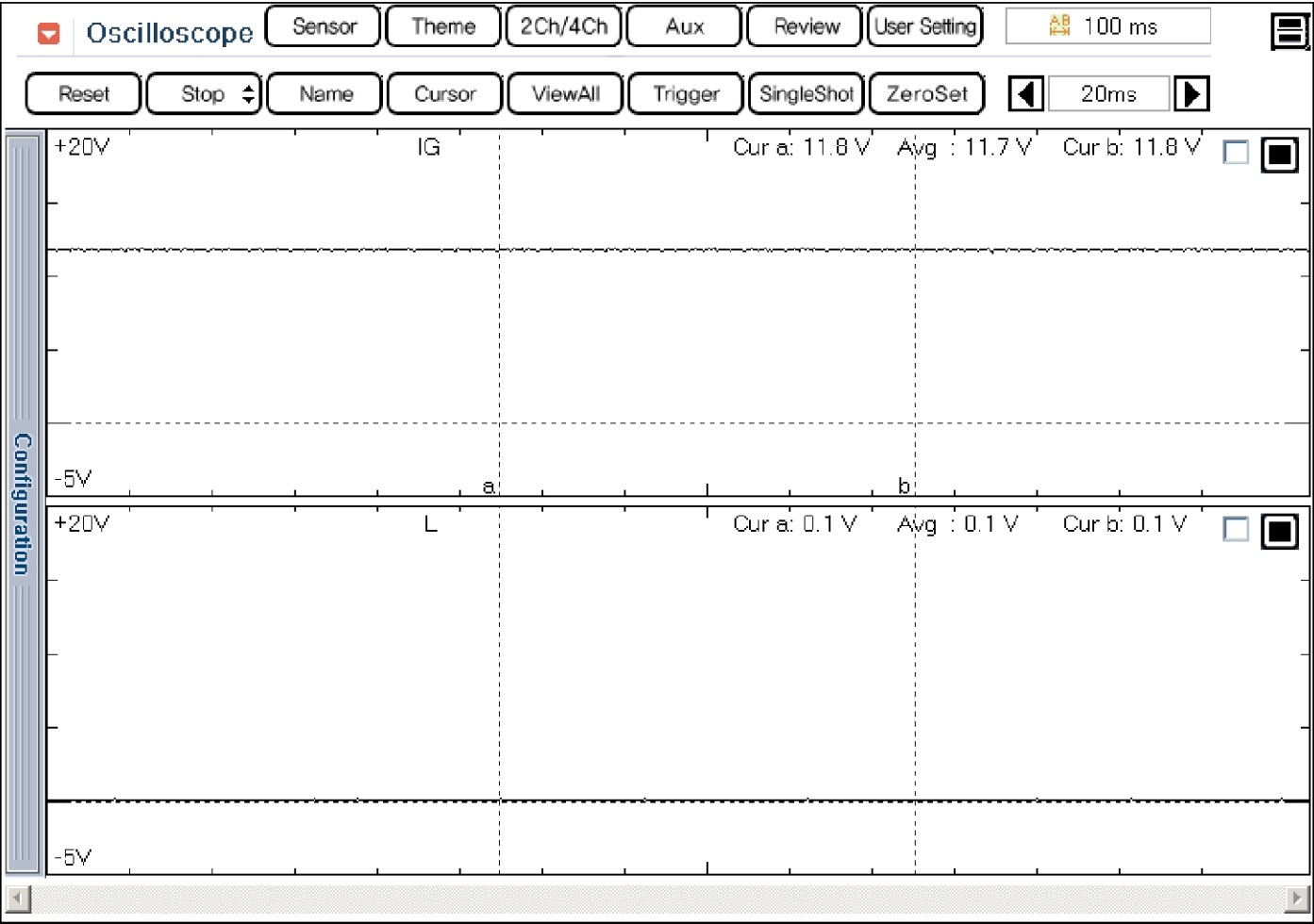


Fig.1

SBHFL9677L

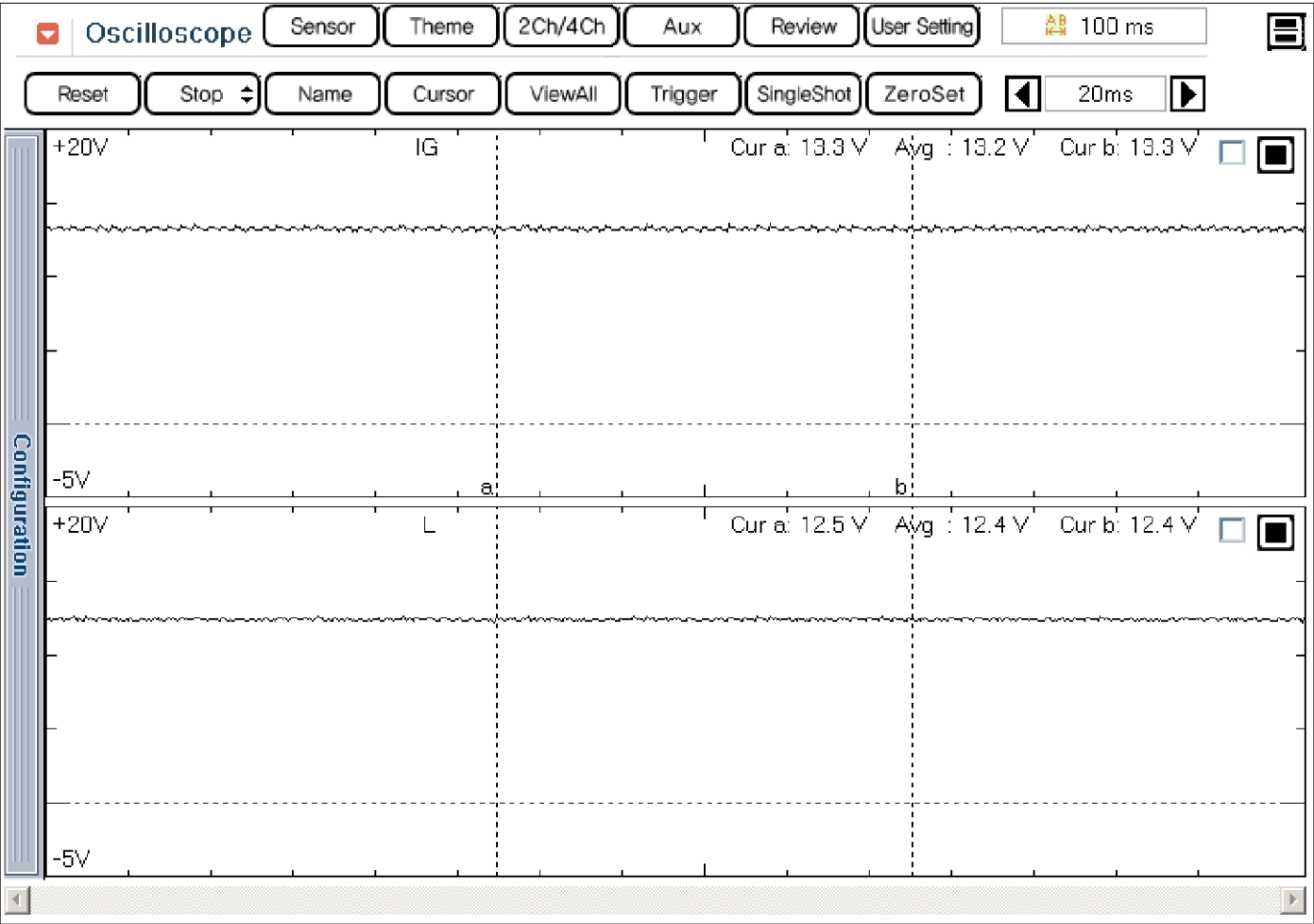


Fig.2

SBHFL9678L

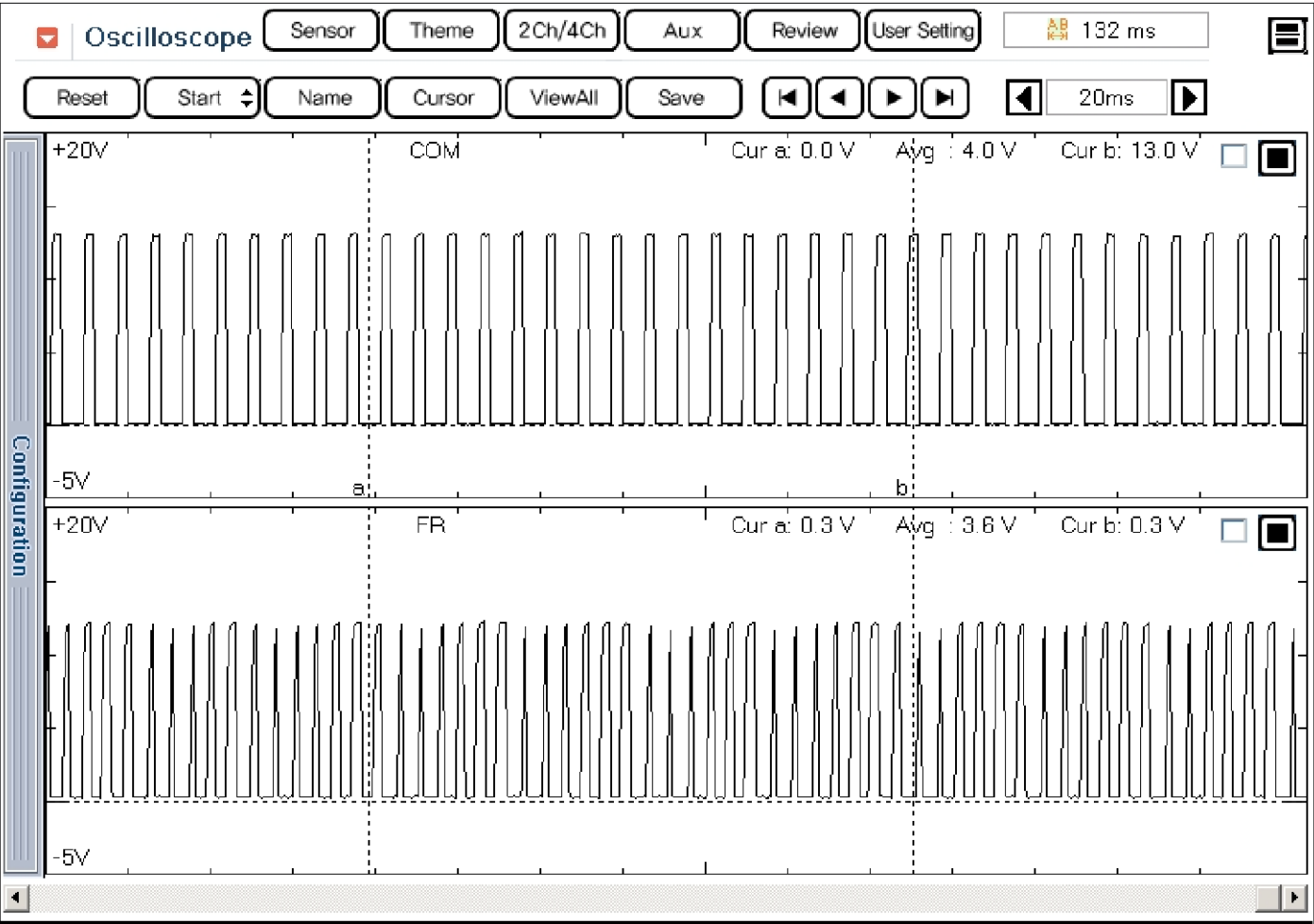


Fig.3

SBHFL9679L

Engine Control System

FL-577

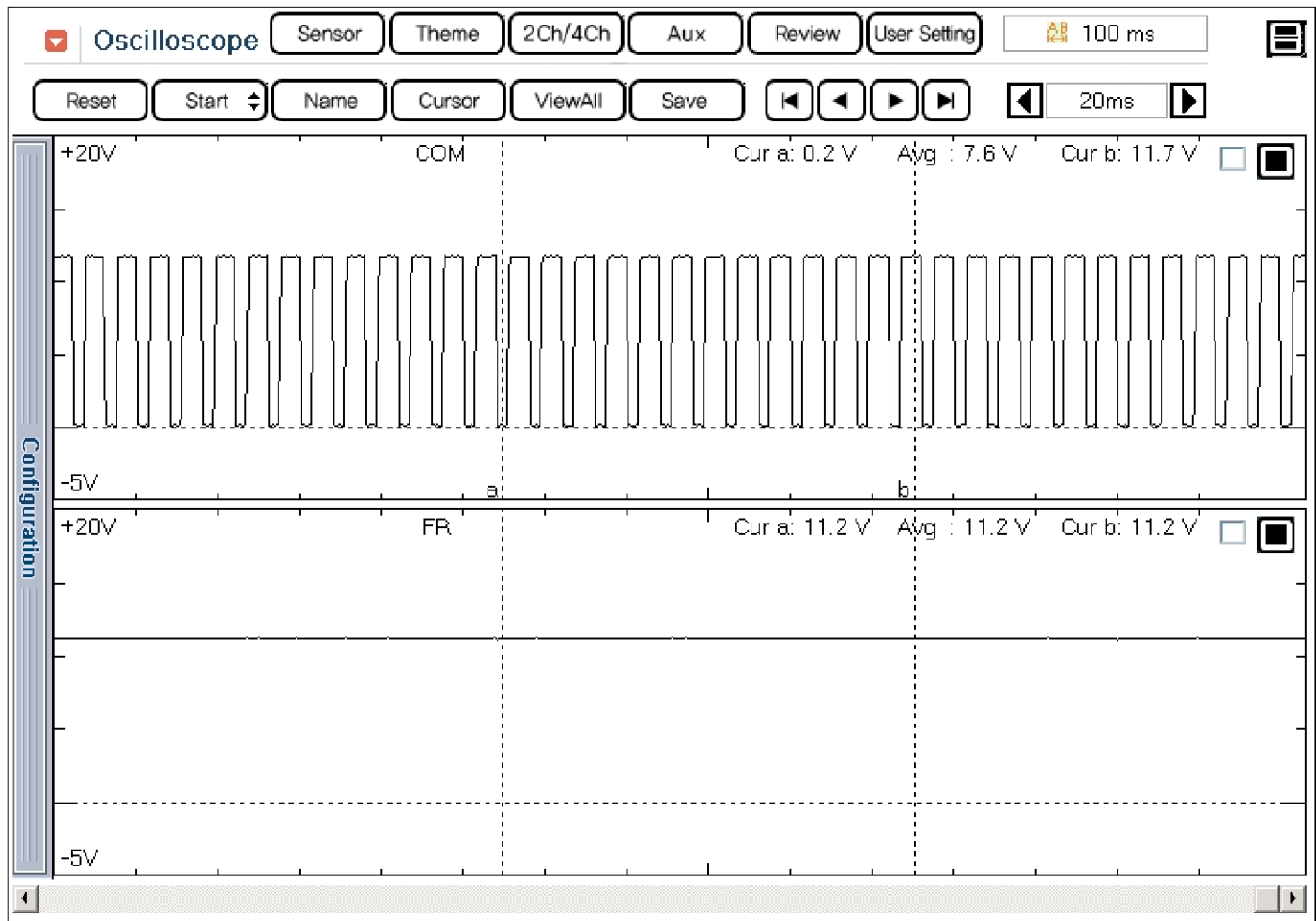


Fig.4

SBHFL9680L

Fig 1) Normal waveforms of IG, L terminal of alternator during charge warning lamp is ON

Fig 2) Normal waveforms of IG, L terminal of alternator during charge warning lamp is OFF

Fig 3) Normal waveforms of COM, FR terminal of alternator at idle

Fig 4) Normal waveforms of COM, FR terminal of alternator under connector disconnected condition

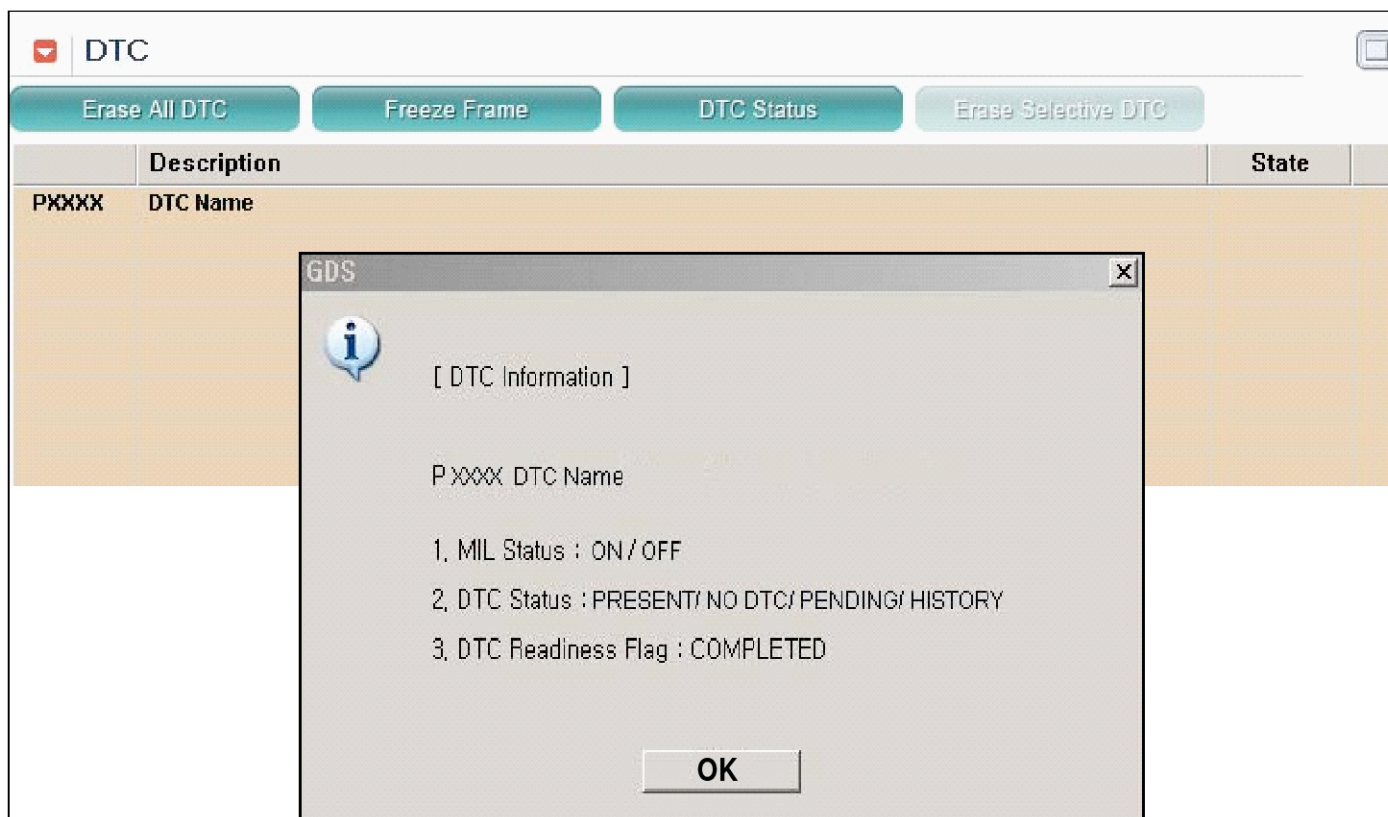
FL-578

Fuel System

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage..
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to " Power Circuit Inspection " procedure

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect Cruise switch connector.
2. IG "ON"
3. Measure the voltage between power supply terminals of main relay harness connector and chassis ground.

Specification : Approx. B+

Engine Control System

FL-579

4. Is the measured voltage within specification ?

YES ▶ Go to "Check short in harness" procedure.

NO ▶ Check the fuse between battery and main relay.
▶ Repair open or short to ground in power harness and go to "Verification of Vehicle Repair" procedure .

■ Check open in harness

1. IG "OFF" and disconnect the main relay and ECM connector.
2. Measure the resistance between main relay 'ON' power terminal of main relay harness connector and main relay 'ON' power terminals of ECM harness connector.

Specification : Approx. below 1Ω

3. Is the measured resistance within specification ?

YES ▶ Go to "Check short to ground in harness" procedure.

NO ▶ Repair open in harness and go to "Verification of Vehicle Repair" procedure .

■ Check short to ground in harness

1. IG "OFF" and disconnect the main relay and ECM connector.
2. Measure the resistance between main relay 'ON' power terminal of main relay harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification ?

YES ▶ Go to "Control Circuit Inspection" procedure.

NO ▶ Repair short to ground in harness and go to "Verification of Vehicle Repair" procedure.

Control Circuit Inspection

■ Check short to ground in harness

1. IG "OFF" and disconnect the main relay and ECM connector.
2. Measure the resistance between control terminal of main relay harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification ?

YES ▶ Go to "Check open in harness" procedure.

NO ▶ Repair short to ground in control harness and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect the main relay and ECM connector.
2. Measure the resistance between control terminal of main relay harness connector and main relay control terminal of ECM harness connector.

Specification : Approx. below 1Ω

3. Is the measured resistance within specification ?

YES ▶ Go to "System Inspection" procedure.

NO ▶ Repair open in control harness and go to "Verification of Vehicle Repair" procedure.

System Inspection

■ Check Generator circuit

1. Engine starts.
2. Maintain ENG RPM 2,500RPM over 2 minutes.
3. Measure voltage between the battery terminal(+) and the battery terminal(-).

Specification : Approx. 12.5 ~ 14.7V

4. Is the measured voltage within specification?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Check that the tension of drive belt, ENG RPM, fuse, terminal of battery, all terminals of generator are in good condition and Check for damaged harness and poor connection between generator and battery. If OK repair or replace generator and then go to "Verification of vehicle Repair" procedure.

Component Inspection

■ Check Main relay

1. IG "OFF" and disconnect main relay.
2. Measure the resistance between battery power supply and control terminals of main relay.(Measurement "A")

FL-580

Fuel System

3. Measure the resistance between battery power supply and power supply to ECM terminals of main relay. (Measurement "B")

Specification :

Terminal	Continuity
Battery power supply - Power supply to ECM	NO
Battery power supply - Main relay control	YES (Approx. $70\Omega \sim 120\Omega$)

4. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good Fuel Pump Relay and check for proper operation. If the problem is corrected, replace Fuel Pump Relay and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-581

P0563 System Voltage High

Component Location

Refer to DTC P0562 : System Voltage Low

General Description

Refer to DTC P0562 : System Voltage Low

DTC Description

During engine running, if system voltage is above 16V, ECM sets P0563. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Voltage too high	• Poor connection • Short in circuit • Faulty charging system • Faulty main relay • Faulty ECM
Enable Conditions	• Engine works	
Threshold value	• System voltage > 16V	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycles	

Specification

Refer to DTC P0562 : System Voltage Low

Diagnostic Circuit Diagram

Refer to DTC P0562 : System Voltage Low

Signal Waveform & Data

Refer to DTC P0562 : System Voltage Low

Monitor Scantool Data

Refer to DTC P0562 : System Voltage Low

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage..
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to " Power Circuit Inspection " procedure

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect Cruise switch connector.
2. IG "ON"

3. Measure the voltage between power supply terminals of main relay harness connector and chassis ground.

Specification : Approx. B+

4. Is the measured voltage within specification ?

YES ► Go to "Check short in harness" procedure.

NO ► Repair open or short to ground in harness and go to "Verification of Vehicle Repair" procedure.

■ Check short in harness

1. IG "ON"
2. Measure the voltage between main relay 'ON' power terminals of ECM harness terminal and chassis ground.

Specification : Approx. B+

3. Is the measured voltage within specification ?

YES ► Go to "System Inspection" procedure.

NO ► Repair short in power harness and go to "Verification of Vehicle Repair" procedure.

System Inspection

■ Check Generator circuit

1. Engine starts.
2. Maintain ENG RPM 2,500RPM over 2 minutes.

FL-582

Fuel System

3. Measure voltage between the battery terminal(+) and the battery terminal(-).

Specification : Approx. 12.5 ~ 14.7V

4. Is the measured voltage within specification?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Check that the tension of drive belt, ENG RPM, fuse, terminal of battery, all terminals of generator are in good condition and Check for damaged harness and poor connection between generator and battery. If OK repair or replace generator and then go to "Verification of vehicle Repair" procedure.

Component Inspection

■ Check Main relay

1. IG "OFF" and disconnect main relay.
2. Measure the resistance between battery power supply and control terminals of main relay.(Measurement "A")
3. Measure the resistance between battery power supply and power supply to ECM terminals of main relay.(Measurement "B")

Specification :

Terminal	Continuity
Battery power supply - Power supply to ECM	NO
Battery power supply - Main relay control	YES(Approx. 70Ω ~ 120Ω)

4. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good Fuel Pump Relay and check for proper operation. If the problem is corrected, replace Fuel Pump Relay and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0562 : System Voltage Low

Engine Control System

FL-583

P0571 Brake Switch "A" Circuit

General Description

The Stop lamp switch is used to judge whether the acceleration system is abnormal or not. The stop lamp switch has a duplex system(signals brake test or brake light) to memorize the abnormality when the signals of depressing and releasing the brake pedal are detected simultaneously.

DTC Description

Checking input signals from stop lamp switch under detecting condition, if the operation state of stop lamp switch does not change for more than 3 sec., ECM sets P0571. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

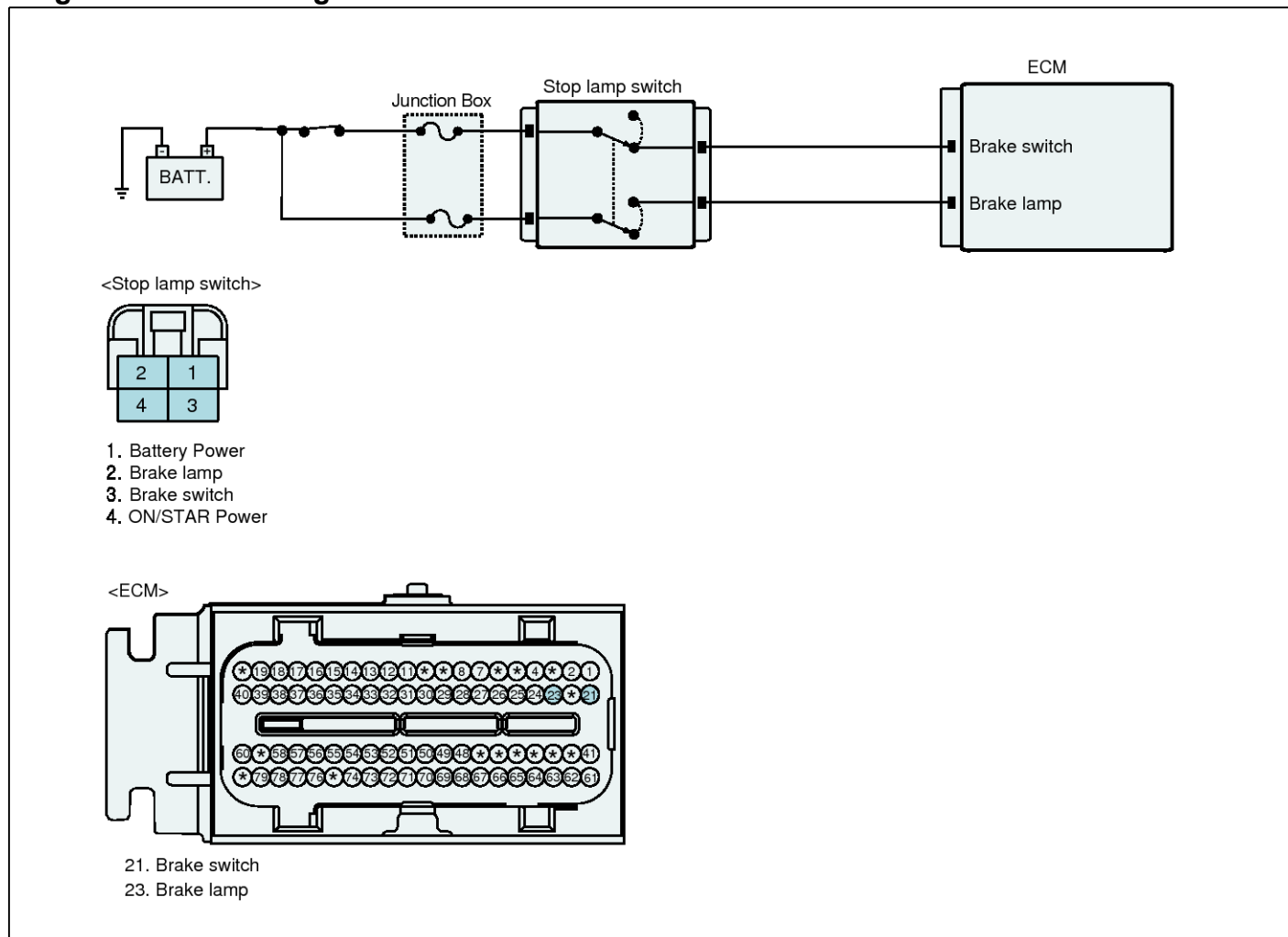
DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	ECM detects stop lamp input signal when vehicle stops.	- Poor connection - Open or short to ground in signal circuit - Faulty ECM
Enable Conditions	- Engine works - Vehicle speed signal is normal. - Vehicle speed > 20kph (during 1sec or more)	
Threshold value	- Vehicle speed < 3kph - Vehicle acceleration < -6kph/s - Stop lamp "OFF" and not changing of stop lamp signal for more 3 sec.	
Diagnosis Time	Continuous	
MIL On Condition	NO MIL ON(DTC only)	

FL-584

Fuel System

Diagnostic Circuit Diagram



SBHFL9531L

Signal Waveform & Data



Fig.1

SBHFL9681L

Fig 1) Normal data of Brake Switch during brake pedal released after depressed.

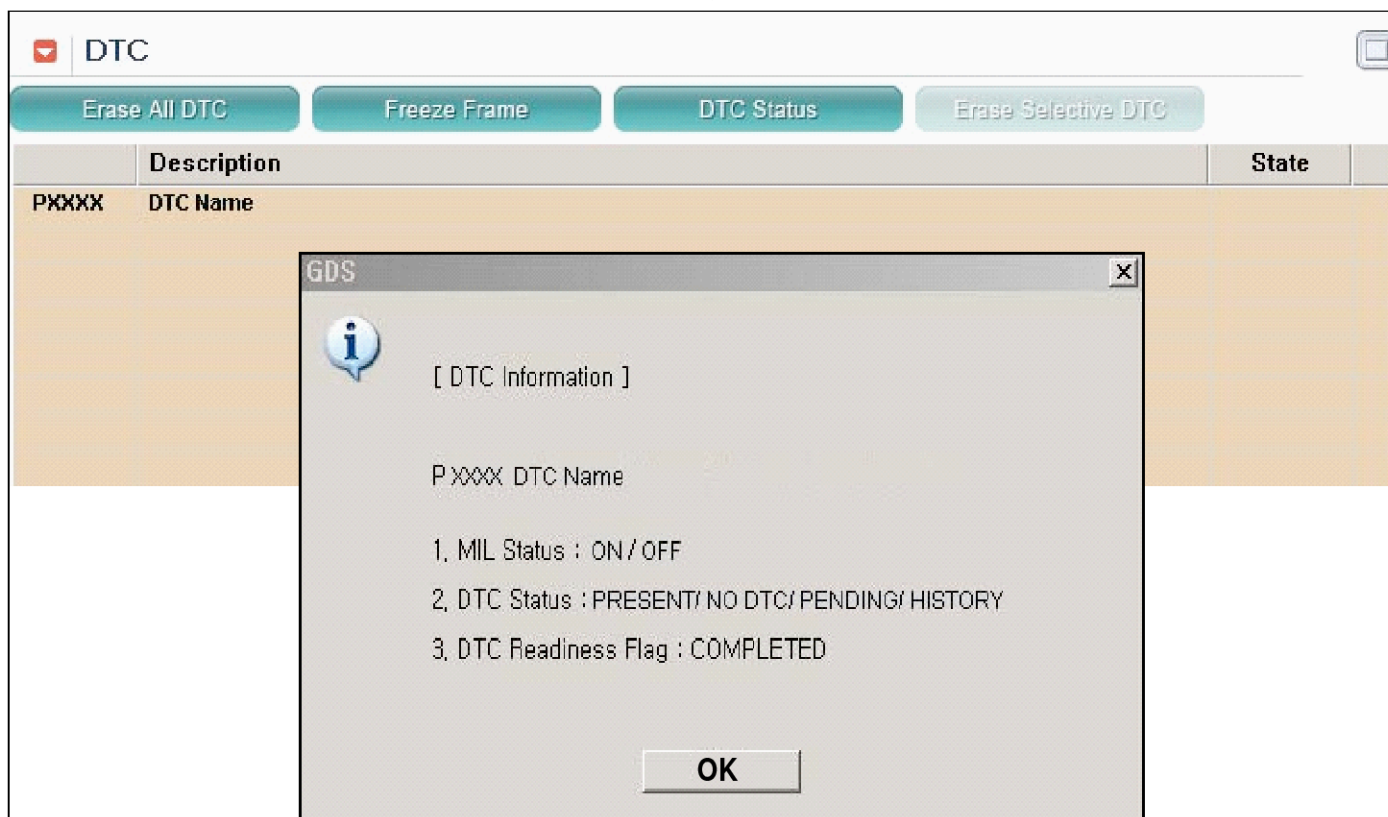
Engine Control System

FL-585

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage..
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to " Power Circuit Inspection " procedure

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect ECM connector.
2. IG "ON"
3. Brake 'OFF' : Measure the voltage between brake lamp signal terminal of ECM harness connector and chassis ground.(Measurement "A")
4. Brake 'ON' : Measure the voltage between brake lamp signal terminal of ECM harness connector and chassis ground.(Measurement "B")

Specification :

Item	Brake 'OFF'	Brake 'ON'
Brake Lamp side	0V	Battery voltage

FL-586

Fuel System

5. Is the measured voltage within specification ?

YES ► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Check open in harness" as follows.

■ Check open in harness

1. IG "OFF" and disconnect stop lamp switch and ECM connector.
2. Measure the resistance between brake lamp signal terminal of ECM harness connector and brake lamp signal terminal of Stop lamp switch harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification ?

YES ► Go to "Check Battery voltage" procedure.

NO ► Repair open in circuit and go to "Verification of Vehicle Repair" procedure.

■ Check battery voltage

1. IG "OFF" and disconnect stop lamp switch connector.
2. Measure the voltage between power supply terminals of stop lamp switch harness connector and chassis ground.
3. IG "ON"
4. Measure the voltage between power supply terminals of stop lamp switch harness connector and chassis ground.

Specification :

Item	IG "OFF"	IG "ON"
Power supply to brake switch side	Battery voltage	Battery voltage
Power supply to brake lamp side	0V	Battery voltage

5. Is the measured voltage within specification ?

YES ► Substitute with a known - good stop lamp switch and check for proper operation. If the problem is corrected, replace stop lamp switch and go to "Verification of Vehicle Repair" procedure.

NO ► Check the fuse between battery and stop lamp switch.
► Repair open or short in power circuit of stop lamp switch and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

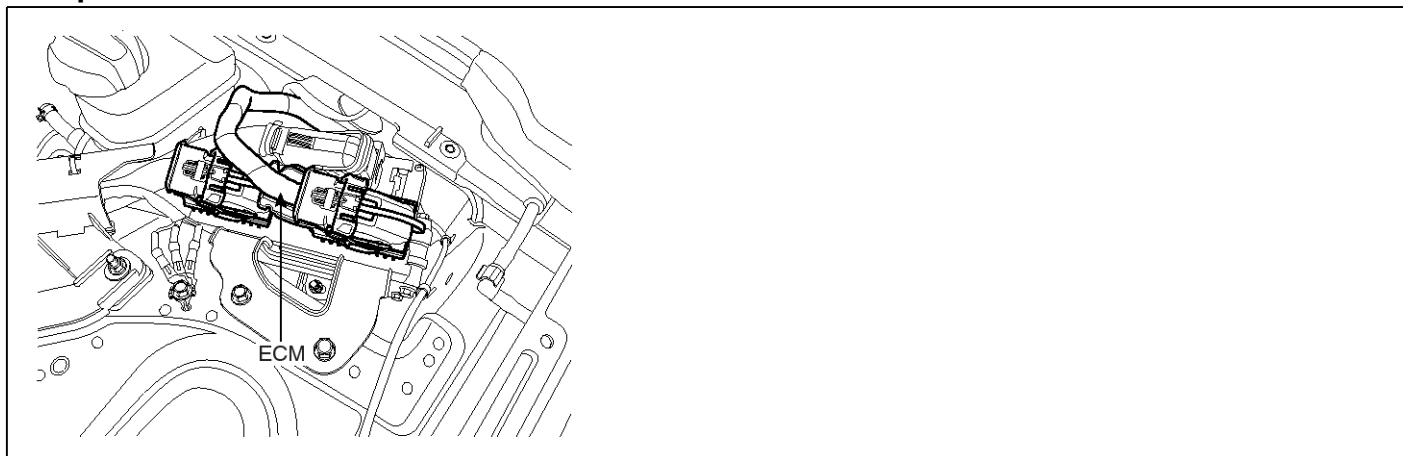
NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-587

P0601 Internal Control Module Memory Check Sum Error

Component Location



SBHFL9300L

General Description

A malfunction is detected by using a checksum technique for verifying data. The digital data is composed of zeros and ones. A checksum is the total of all ones in a string of data. By comparing the checksum value with a stored value, a malfunction can be detected.

DTC Description

If real checksum does not accord with memory checksum, ECM sets P0601 and MIL(Malfunction Indication Lamp) turns on.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Checksum check	Faulty ECM
Enable Conditions	-	
Threshold value	Discordance between the real checksum and the memorized checksum	
Diagnosis Time	Continuous	
MIL On Condition	1 driving cycle	

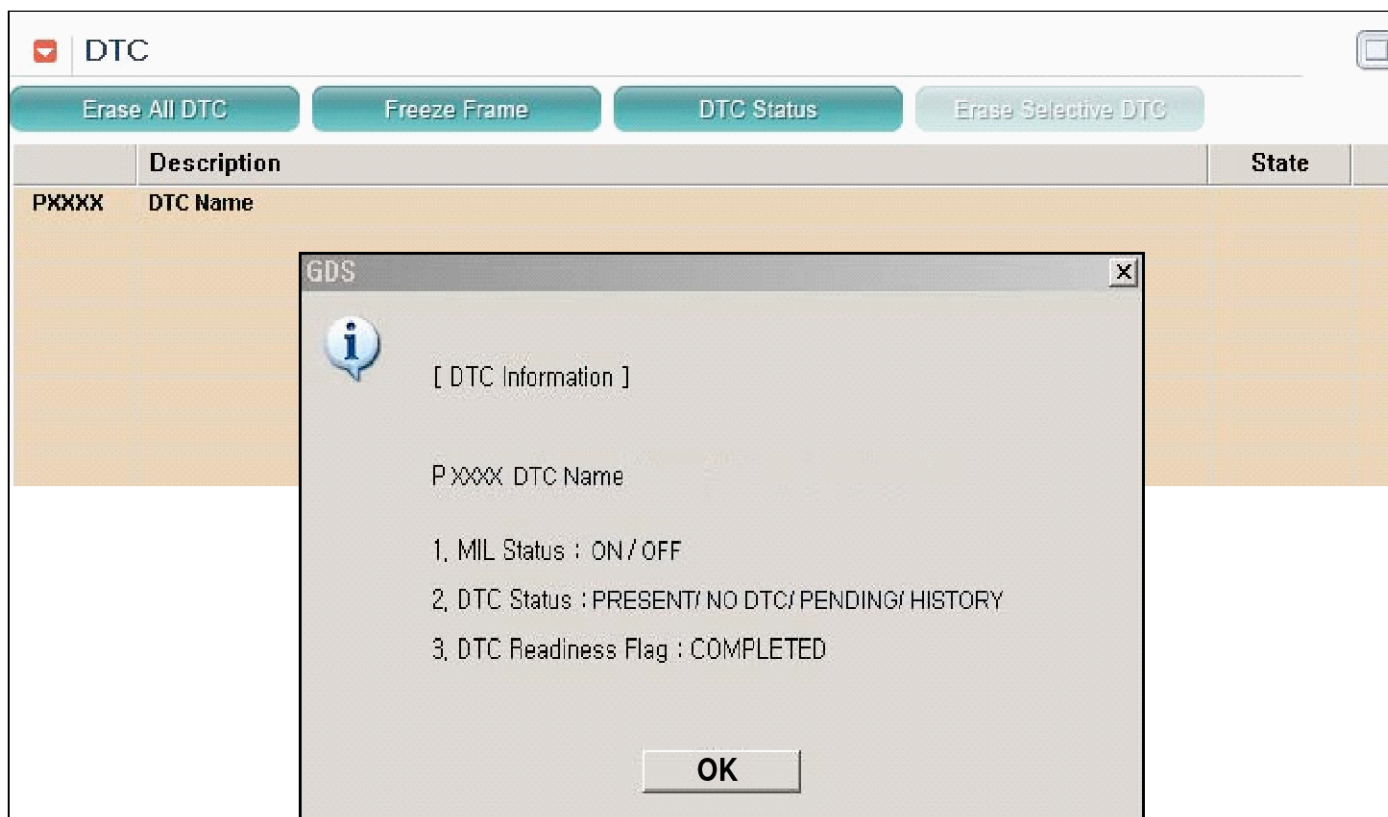
FL-588

Fuel System

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage..
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

Engine Control System

FL-589

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

FL-590

Fuel System

P0602 Control Module Programming Error

Component Location

Refer to DTC P0601 : Internal Control Module Memory Check Sum Error

General Description

Refer to DTC P0601 : Internal Control Module Memory Check Sum Error

DTC Description

If CPU software version dose not accord with main CPU, ECM sets P0602.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Check internal CPU	Faulty ECM
Enable Conditions	-	
Threshold value	The version discordance among PCU S/W or Calibration	
Diagnosis Time	Continuous	
MIL On Condition	1 driving cycle	

Monitor Scantool Data

Refer to DTC P0601 : Internal Control Module Memory Check Sum Error

Terminal and Connector inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage..
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

Verification of Vehicle Repair

Refer to DTC P0601 : Internal Control Module Memory Check Sum Error

Engine Control System

FL-591

P0604 Internal Control Module Random Access Memory (RAM) Error

Component Location

Refer to DTC P0601 : Internal Control Module Memory Check Sum Error

General Description

Refer to DTC P0601 : Internal Control Module Memory Check Sum Error

DTC Description

If the RAM in ECM has errors, ECM sets P0604 and MIL(Malfunction Indication Lamp) turns on.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Check internal CPU	• Faulty ECM
Enable Conditions	• -	
Threshold value	• RAM has errors	
Diagnosis Time	• Continuous	
MIL On Condition	• 1 driving cycle	

Monitor Scantool Data

Refer to DTC P0601 : Internal Control Module Memory Check Sum Error

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage..
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

Verification of Vehicle Repair

Refer to DTC P0601 : Internal Control Module Memory Check Sum Error

FL-592

Fuel System

P0606 ECM/PCM Processor

Component Location

Refer to DTC P0601 : Internal Control Module Memory Check Sum Error

General Description

Refer to DTC P0601 : Internal Control Module Memory Check Sum Error

DTC Description

Checking ECM under detecting condition, if internal error is detected, ECM sets P0606. And MIL(Malfunction Indication Lamp) turns on.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Check ECM internal error	• Faulty ECM
Enable Conditions	• 7V < Battery voltage < 20V	
Threshold value	• ECM internal error (A/D unit error)	
Diagnosis Time	• Continuous	
MIL On Condition	• 1 driving cycle	

Monitor Scantool Data

Refer to DTC P0601 : Internal Control Module Memory Check Sum Error

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage..
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

Verification of Vehicle Repair

Refer to DTC P0601 : Internal Control Module Memory Check Sum Error

Engine Control System

FL-593

P0638 Throttle Actuator Control Range/Performance (Bank 1)

Component Location



SBHFL9302L

General Description

The Electronic Throttle Control(ETC) system is made of the components throttle body, Throttle Position Sensor(TPS)1&2 and Accelerator Position Sensor(APS) 1&2. The throttle body contains the actuator, the throttle plate and the throttle position sensor (potentiometer), which are integrated in one housing. The actuator consists of a DC motor with a two-stage gear. The opening angle of the throttle valve is detected by the throttle position sensor which is mounted on the throttle body. And it provides feedback to the ECM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC Description

Checking output signals from TPS under detecting condition, if the difference between real and target throttle position is above the specified value, ECM sets P0638 and then MIL(Malfunction Indication Lamp) turns on.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor the throttle position	- Throttle stuck - Open in motor circuit - Faulty motor - Faulty ECM
Enable Conditions	- Engine works - Battery voltage >5V	
Threshold value	The difference between the real ETS motor & TPS value and the target ETS motor & TPS value is over 4.5°.	
	When real Throttle position is below 36°, (the real throttle position - the target throttle position) < - 4.5°	
	(the real throttle position - the target throttle position) < - 18°	
Diagnosis Time	Continuous	
MIL On Condition	1 driving cycle	

※ If Main relay has a fault(ex. Open) under engine running, the DTCs,P0638/P0685/P1295/P2106, can happen at the same time.

FL-594

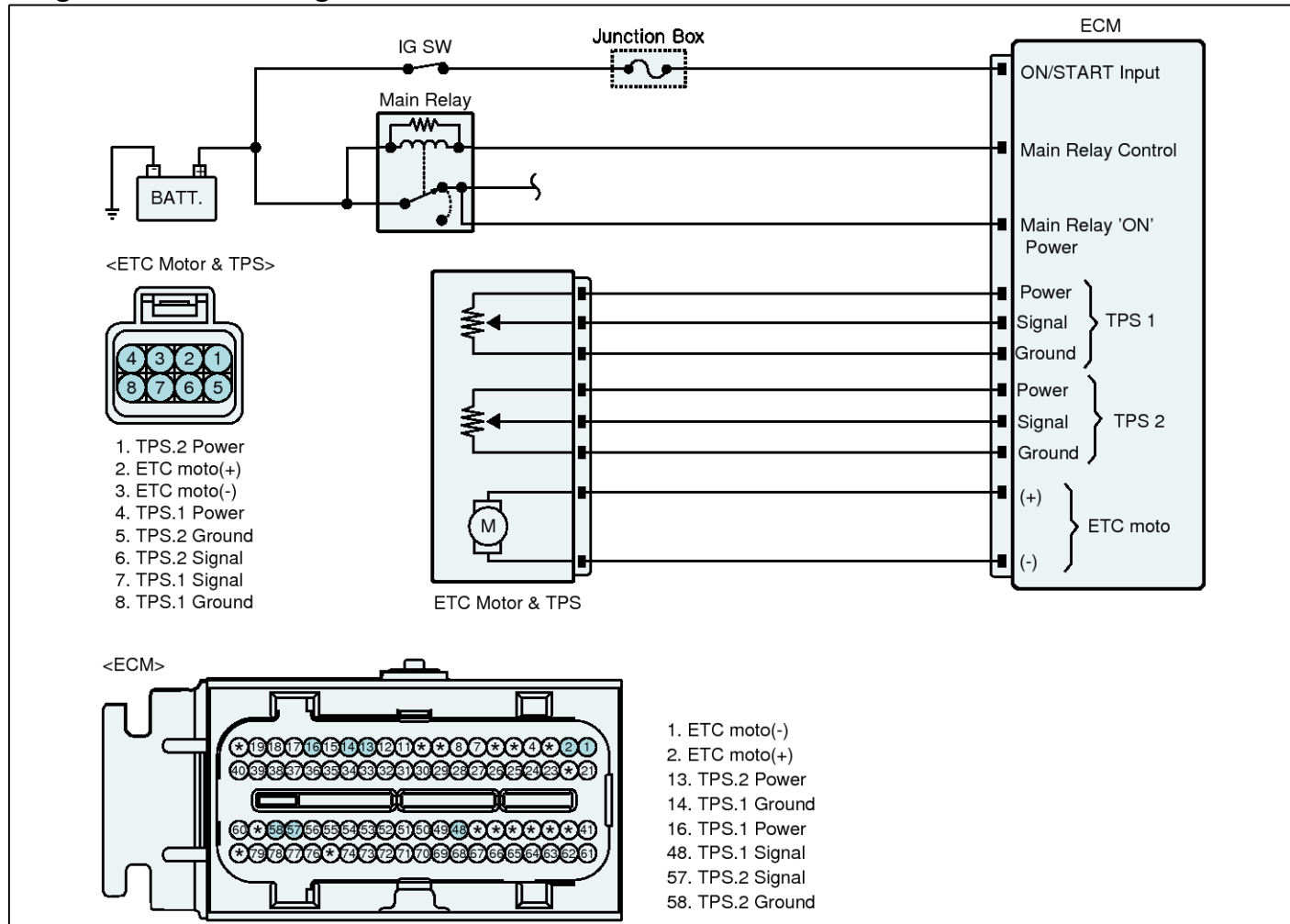
Fuel System

<DTC Name>

- P0638 Throttle Actuator Control Range/ Performance (Bank 1)
- P0685 ECM/ECM Power Relay Control Circuit /Open

- P1295 Throttle Actuator Control System - Power Management
- P2106 Throttle Actuator Control System - Forced Limited Power

Diagnostic Circuit Diagram



SBHFL9516L

Signal Waveform & Data

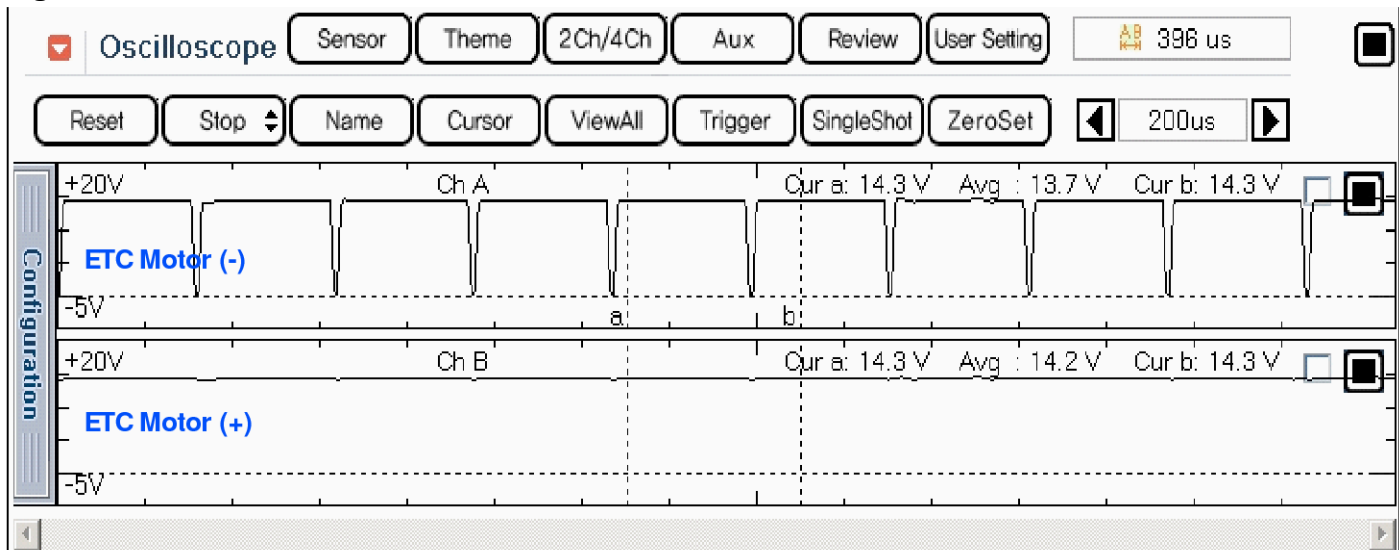


Fig.1

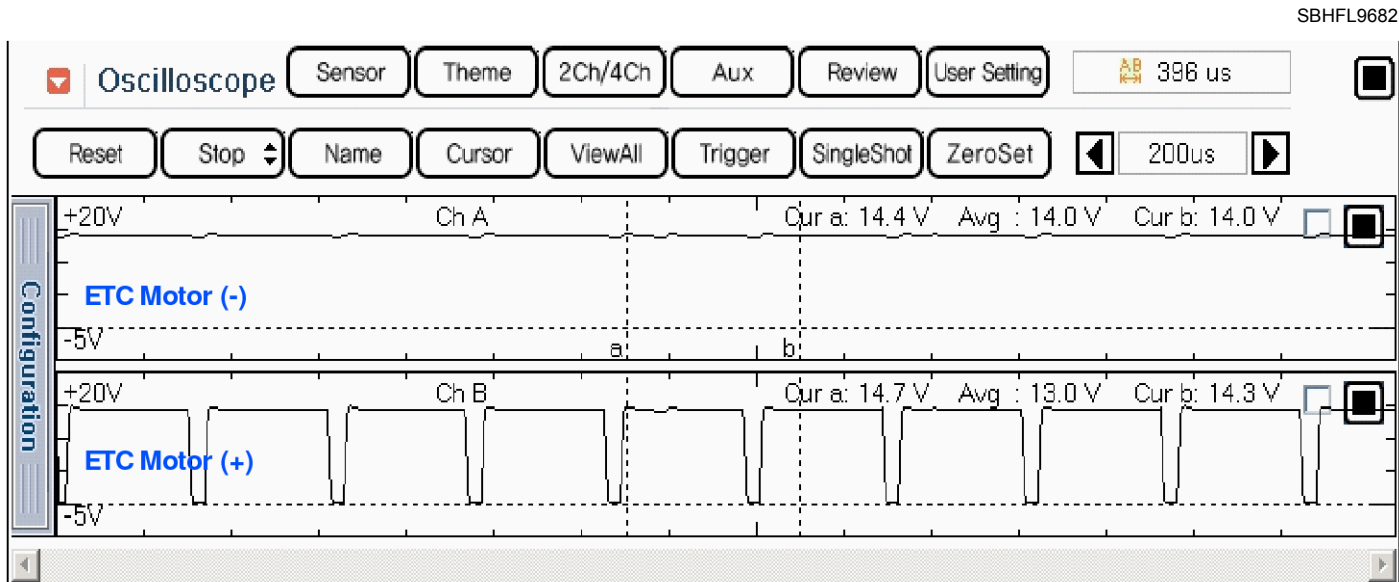


Fig.2

Fig 1) Normal waveform of ETC motor with acceleration

Fig 2) Normal waveform of ETC motor with deceleration

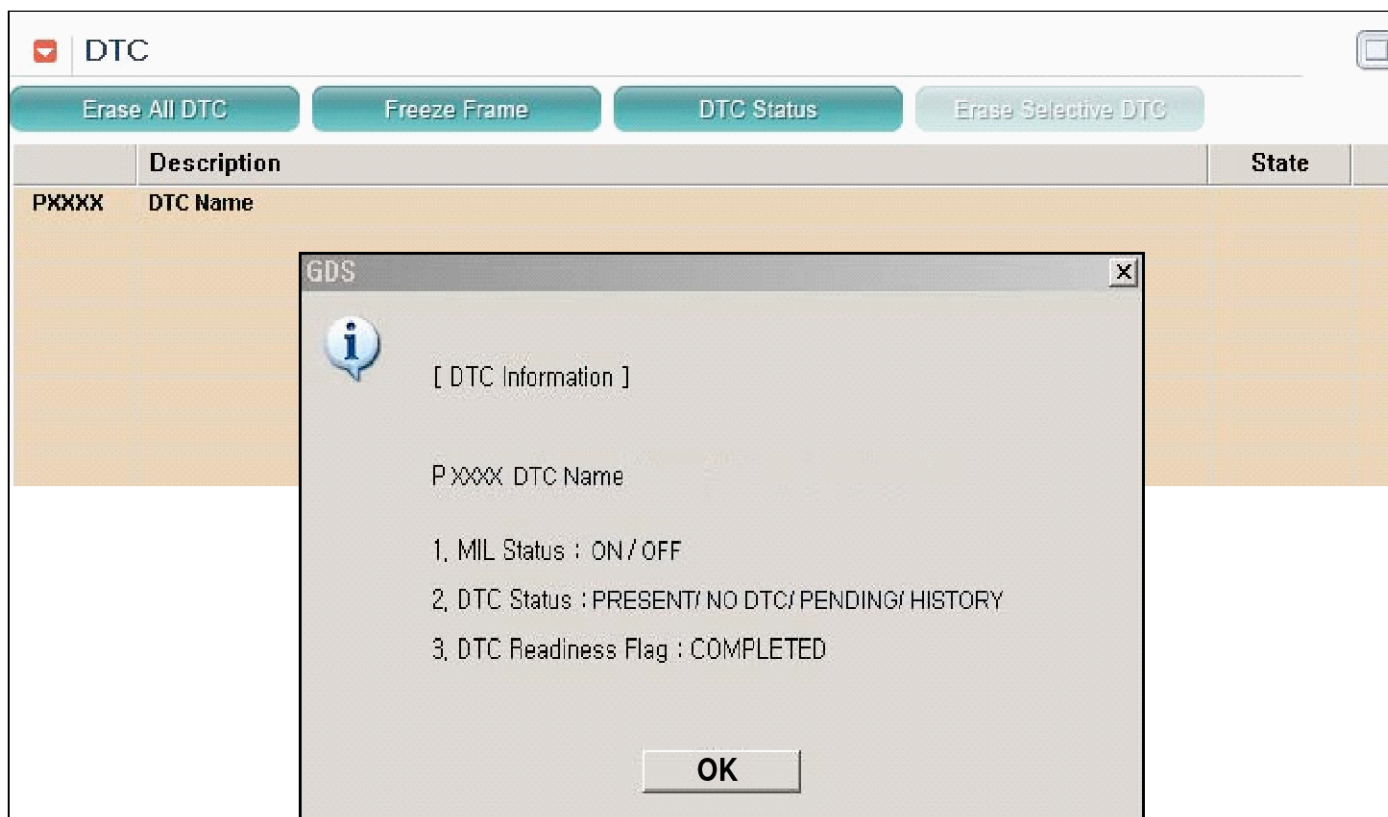
FL-596

Fuel System

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ▶ Go to "Terminal and Connector inspection" procedure.

NO ▶ Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage..
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ▶ Go to "Control Circuit Inspection" procedure.

Control Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect ETC Motor & TPS connector.
2. IG "ON"
3. Measure the voltage between ETC motor(+)/(-) of ETC Motor & TPS harness connector and chassis ground.

Specification : Approx. B+

4. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Go to "Check open in harness" as follows.

Engine Control System

FL-597

■ Check open in harness

1. IG "OFF" and disconnect ETC Motor & TPS connector and ECM connector.
2. Measure the resistance between ETC motor (+) terminal of ETC Motor & TPS harness connector and ETC motor (+) terminal of ECM harness connector.
3. Measure the resistance between ETC motor (-) terminal of ETC Motor & TPS harness connector and ETC motor (-) terminal of ECM harness connector.

Specification : Approx. below 1Ω

4. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in motor harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check throttle valve for stuck

1. IG "OFF" and disconnect the air hose between throttle body and air mass flow sensor.
2. Check stuck on throttle valve..
3. Is the throttle valve normal?

YES ▶ Go to "Check ETC motor resistance" as follows.

NO ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

■ Check ETC motor resistance

1. IG "OFF" and disconnect ETC Motor & TPS connector.
2. Measure the resistance between ETC motor(+) and (-) terminals of ETC Motor & TPS connector (component side).

Specification : Approx. 1.275 ~ 1.725Ω @ 23℃(73.4°F)

3. Is the throttle valve normal?

YES ▶ Is the measured resistance within specification ?

NO ▶ Substitute with a known - good ETC motor and check for proper operation. If the problem is corrected, replace ETC motor and go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will take 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

■ ETC motor actuation test

1. IG "OFF" and connect ETC Motor & TPS connector.
2. After IG "ON", execute the "ETC motor actuation test" by Scantool.

☒ **Actuation Test**

Test Items	
Injector-Cylinder 6	
Fan PWM	
ETC Motor	
Variable Intake Manifold 1	
Cam Phaser Intake Bank1	
Cam Phaser Intake Bank2	
Spark Advance/Retard	
CAM Phaser Exhaust Bank 1	
CAM Phaser Exhaust Bank 2	

● Duration

Until Stop Button

● Conditions

ENG. RUN

● Result

Success

Start

Stop

SBHFL9684L

3. Is the measured resistance within specification ?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

 NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Substitute with a known - good ETC motor and check for proper operation. If the problem is corrected, replace ETC motor and go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off. (It will take 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-599

P0641 Sensor Reference Voltage "A" Circuit/Open

General Description

The ECM provides a 5 volt reference voltage to Throttle Position Sensor 1(TPS1). The ECM monitors reference voltage deviation from the power supply circuit of the sensors.

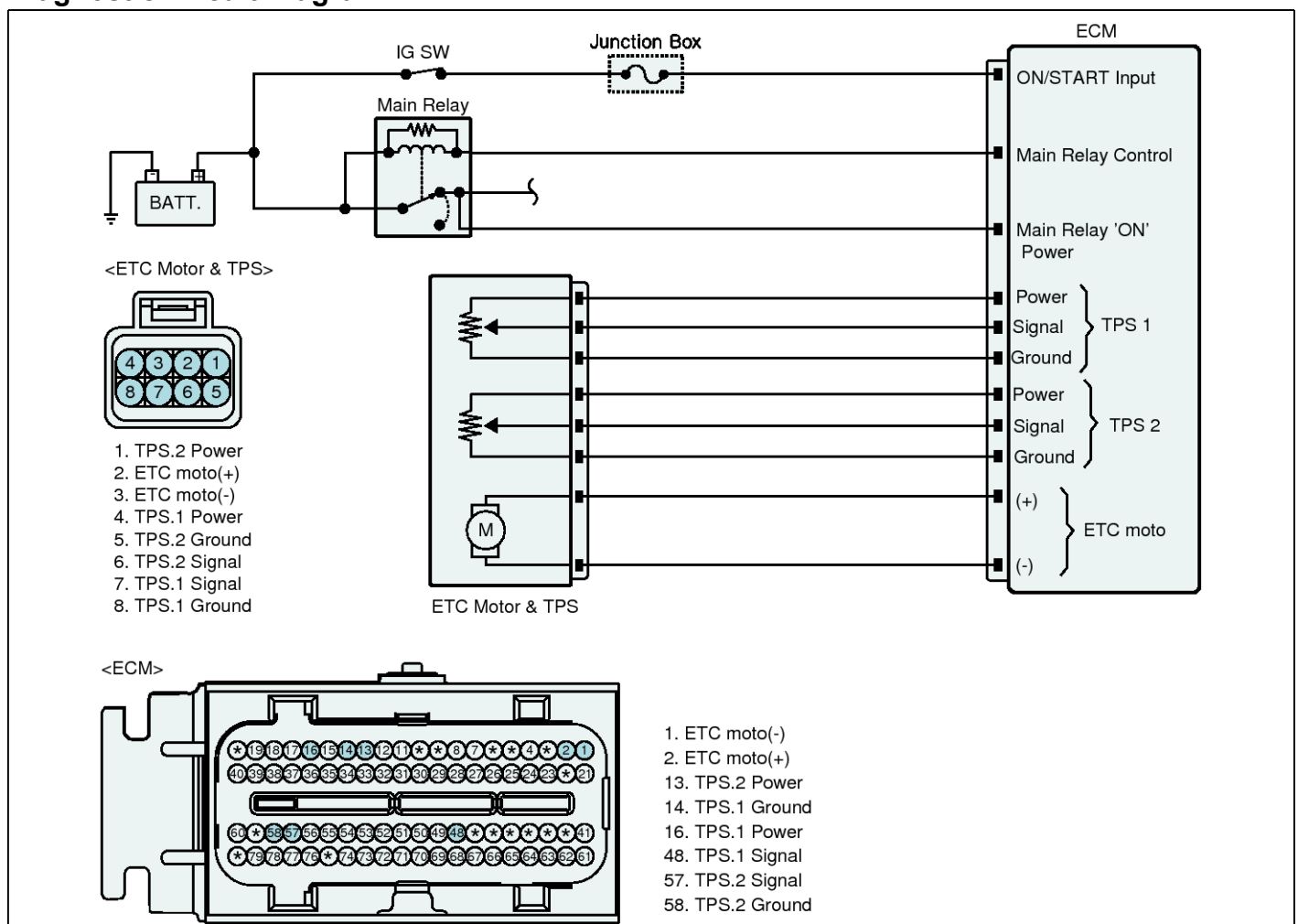
DTC Description

Checking the voltage from sensor power supply every 1.87 sec. under detecting condition, if the value within detecting condition lasts for more than 0.2 sec., ECM sets P0641. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Sensor reference voltage check	• Short in sensor power supply line • Faulty ECM
Enable Conditions	• IG "ON"	
Threshold value	• Sensor supply power < 4.5V or > 5.5V	
Diagnosis Time	• Continuous (More than 0.2 seconds failure for every 1.8 7 seconds test)	
MIL On Condition	• 2 driving cycle	

Diagnostic Circuit Diagram



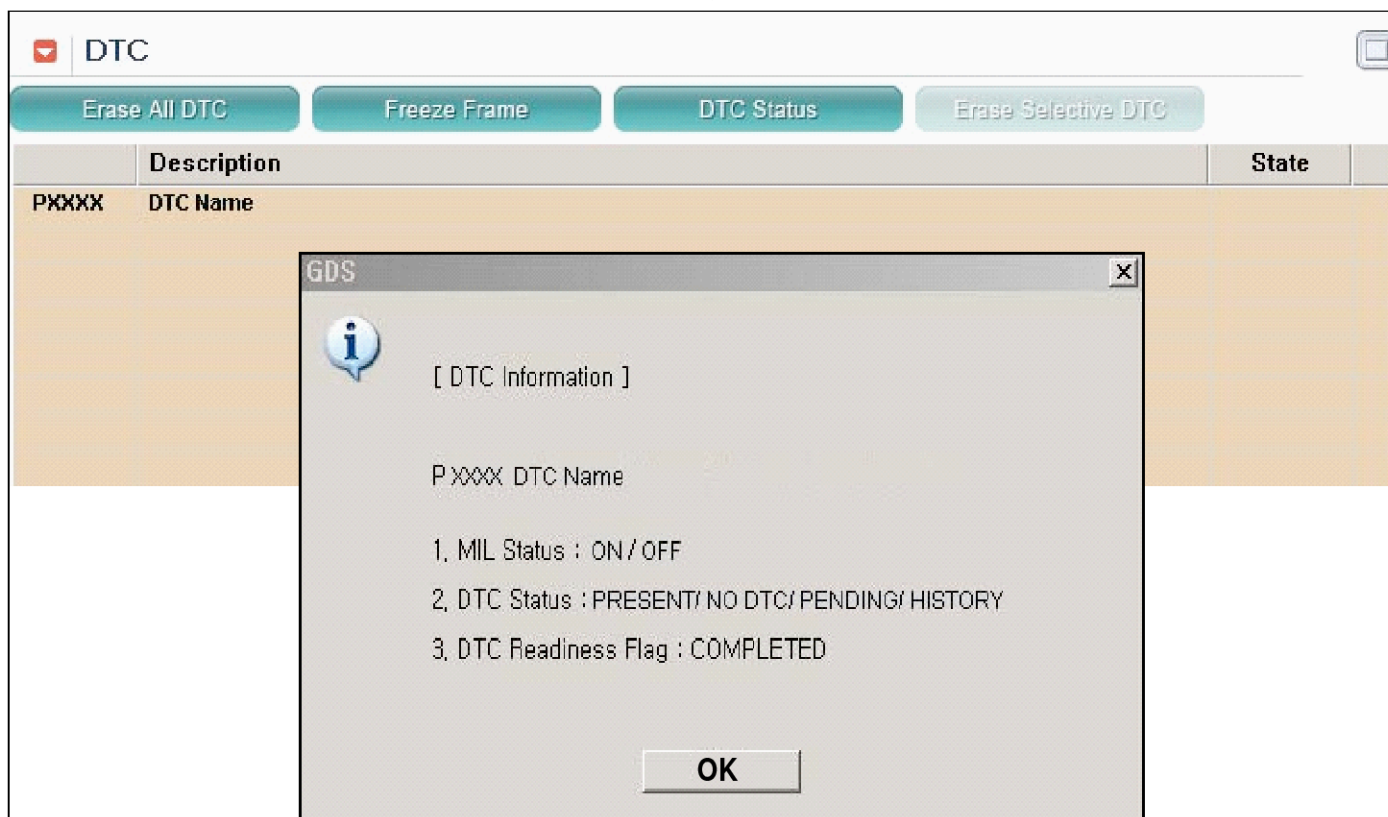
Engine Control System

FL-601

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to "Power Circuit Inspection" procedure

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect ETC Motor & TPS connector.
2. IG "ON"
3. Measure voltage between TPS1 power terminal of ETC Motor & TPS harness connector and chassis ground.

Specification : Approx. B+

FL-602

Fuel System

4. Is the measured voltage within specification ?

YES ► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Check short in power harness" as follows.

■ Check short in power harness

1. IG "OFF" and disconnect ETC Motor & TPS connector and ECM connector.
2. Measure the resistance between TPS1 power and ETC motor (+) terminals of ETC Motor & TPS harness connector.(Measurement "A")
3. Measure the resistance between TPS1 power and ETC motor (-) terminals of ETC Motor & TPS harness connector.(Measurement "A")
4. Measure the resistance between TPS1 power and TPS1 ground terminals of ETC Motor & TPS harness connector.(Measurement "B")
5. Measure the resistance between TPS1 power and TPS2 ground terminals of ETC Motor & TPS harness connector.(Measurement "B")

Specification : Infinite

6. Is the measured resistance within specification ?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Repair short in power harness and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-603

P0646 A/C Clutch Relay Control Circuit Low

General Description

The A/C clutch relay is activated if the A/C switch is operated while the blower is running and system operation is enabled by the ECM. When A/C is requested, the Engine Control Module(ECM) provides a ground path to the A/C clutch relay control circuit. When the relay circuit is grounded, the A/C clutch relay is energized. The ECM delays grounding the relay circuit for a short time, so the ECM can adjust the engine idle speed for the additional load. The ECM will temporarily de-energized the A/C clutch relay for one or more of the following conditions:

- Full acceleration when the throttle is at WOT.(Wide Open Throttle)
- Risk of overheating: Engine coolant temp. exceeds threshold value
- A/C system pressure exceeds threshold value
- Engine starting

DTC Description

ECM monitors inputted voltage through A/C compressor relay. Checking voltage every 10 sec. under detecting condition, if the voltage lower than the specified value is detected for more than 5 sec., ECM sets P0646.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects circuit short to low voltage	• Poor connection • Open or short to ground in A/C relay circuit • Faulty ECM
Enable Conditions	• After 0.5 sec under conditions below • No DTC exists • Engine works • $11V \leq \text{Battery voltage} \leq 16V$	
Threshold value	• Open or short to ground	
Diagnosis Time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	• DTC only (NO MIL ON)	

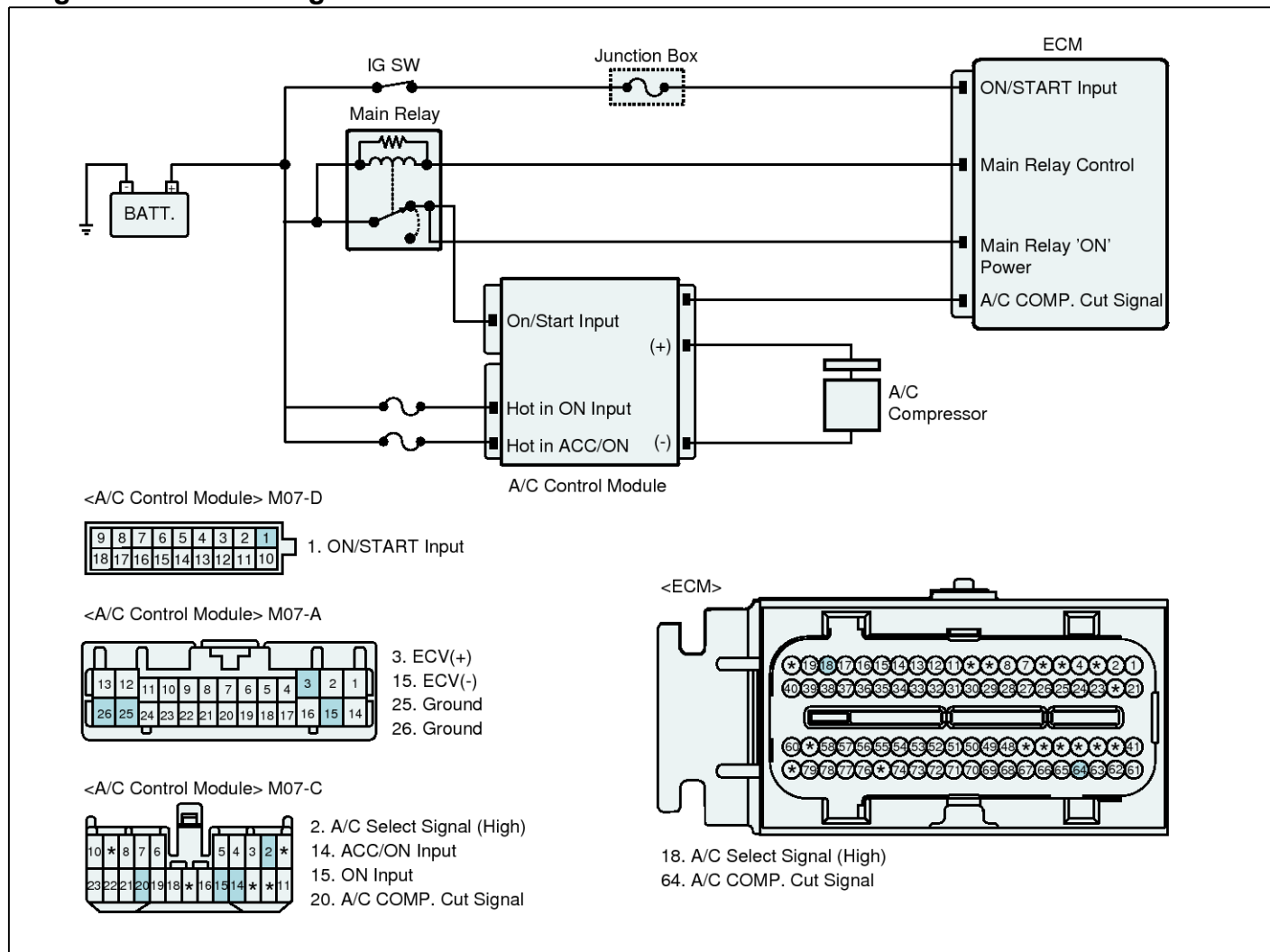
Specification

	A/C COMP. cut signal Voltage	A/C Compressor State
A/C COMP. cut signal On	0V	Off
A/C COMP. cut signal Off	12V	-

FL-604

Fuel System

Diagnostic Circuit Diagram



SBHFL9543L

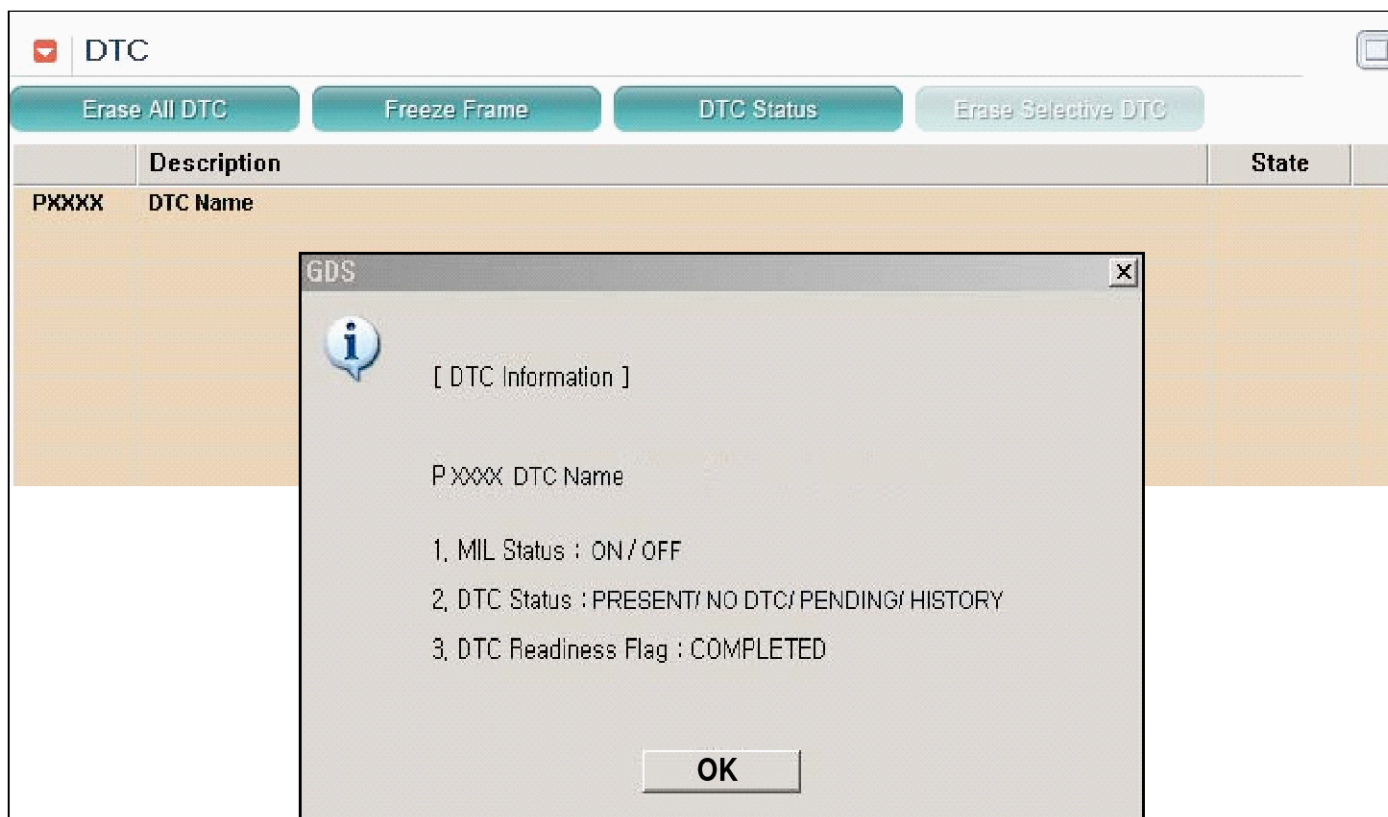
Engine Control System

FL-605

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to " Power Circuit Inspection " procedure

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect A/C Control Module connector.
2. IG "ON"
3. Measure voltage between battery power supply terminals of A/C Control Module harness connector and chassis ground.

Specification : Approx. B+

FL-606

Fuel System

4. Is the measured voltage within specification ?

YES ► Go to "Control Circuit Inspection" procedure

NO ► Check the fuse between Battery and A/C Control Module.
► Repair open or short to ground in power harness and go to "Verification of Vehicle Repair" procedure.

Control Circuit Inspection

■ Check Short to Ground in harness

1. IG "OFF" and disconnect A/C Control Module and ECM connector.
2. Measure the resistance between A/C COMP. cut signal terminal of A/C Control Module harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification ?

YES ► Go to "Check open in harness" as follows.

NO ► Repair short in A/C COMP. cut signal harness and go to "Verification of Vehicle Repair" procedure.

■ Check Open in harness

1. IG "OFF" and disconnect A/C Control Module and ECM connector..
2. Measure the resistance between A/C COMP. cut signal terminal of A/C Control Module harness connector and A/C COMP. cut signal terminal of ECM harness connector.

Specification : Approx. below 1Ω

3. Is the measured resistance within specification ?

YES ► Substitute with a known - good A/C Control Module and check for proper operation. If the problem is corrected, replace A/C Control Module and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Repair open in A/C COMP. cut signal harness and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-607

P0647 A/C Clutch Relay Control Circuit High

General Description

Refer to DTC P0646 : A/C Clutch Relay Control Circuit Low

DTC Description

ECM monitors inputted voltage through A/C compressor relay. Checking voltage every 10 sec. under detecting condition, if the voltage higher than the specified value is detected for more than 5 sec., ECM sets P0647.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects circuit short to low voltage	• Poor connection • Short to power in A/C relay circuit • Faulty A/C relay • Faulty PCM
Enable Conditions	• After 0.5 sec under conditions below • No DTC exists • Engine works • $11V \leq \text{Battery voltage} \leq 16V$	
Threshold value	• Short to power	
Diagnosis Time	• Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	• DTC only (NO MIL ON)	

Specification

Refer to DTC P0646 : A/C Clutch Relay Control Circuit Low

Diagnostic Circuit Diagram

Refer to DTC P0646 : A/C Clutch Relay Control Circuit Low

Monitor Scantool Data

Refer to DTC P0646 : A/C Clutch Relay Control Circuit Low

Terminal and Connector inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to "Power Circuit Inspection" procedure

Power Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect A/C Control Module connector.

- IG "ON"

- Measure voltage between battery power supply terminals of A/C Control Module harness connector and chassis ground.

Specification : Approx. B+

- Is the measured voltage within specification ?

YES ► Go to "Control Circuit Inspection" procedure

NO ► Check the fuse between Battery and A/C Control Module.
► Repair open or short to ground in power harness and go to "Verification of Vehicle Repair" procedure.

Control Circuit Inspection

■ Check Short to Battery in harness

- IG "OFF" and disconnect A/C Control Module and ECM connector.
- IG "ON"
- Measure voltage between battery A/C COMP. cut signal terminals of A/C Control Module harness connector and chassis ground.

Specification : Approx. 0V

4. Is the measured voltage within specification ?

YES ► Substitute with a known - good A/C Control Module and check for proper operation. If the problem is corrected, replace A/C Control Module and go to "Verification of Vehicle Repair" procedure.

NO ► If problem isn't fixed with replacing A/C Control Module, Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

 NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

► Repair short in A/C COMP. cut signal harness and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P0646 : A/C Clutch Relay Control Circuit Low

Engine Control System

FL-609

P0650 Malfunction Indicator Lamp (MIL) Control Circuit

General Description

The Malfunction Indicator Lamp (MIL), which is located in the instrument cluster, comes on to notify the driver that there may be a problem with the vehicle and that service is needed. Immediately after the ignition switch turns on, the malfunction indicator lamp is lit to indicate that the MIL operates normally and goes off after starting

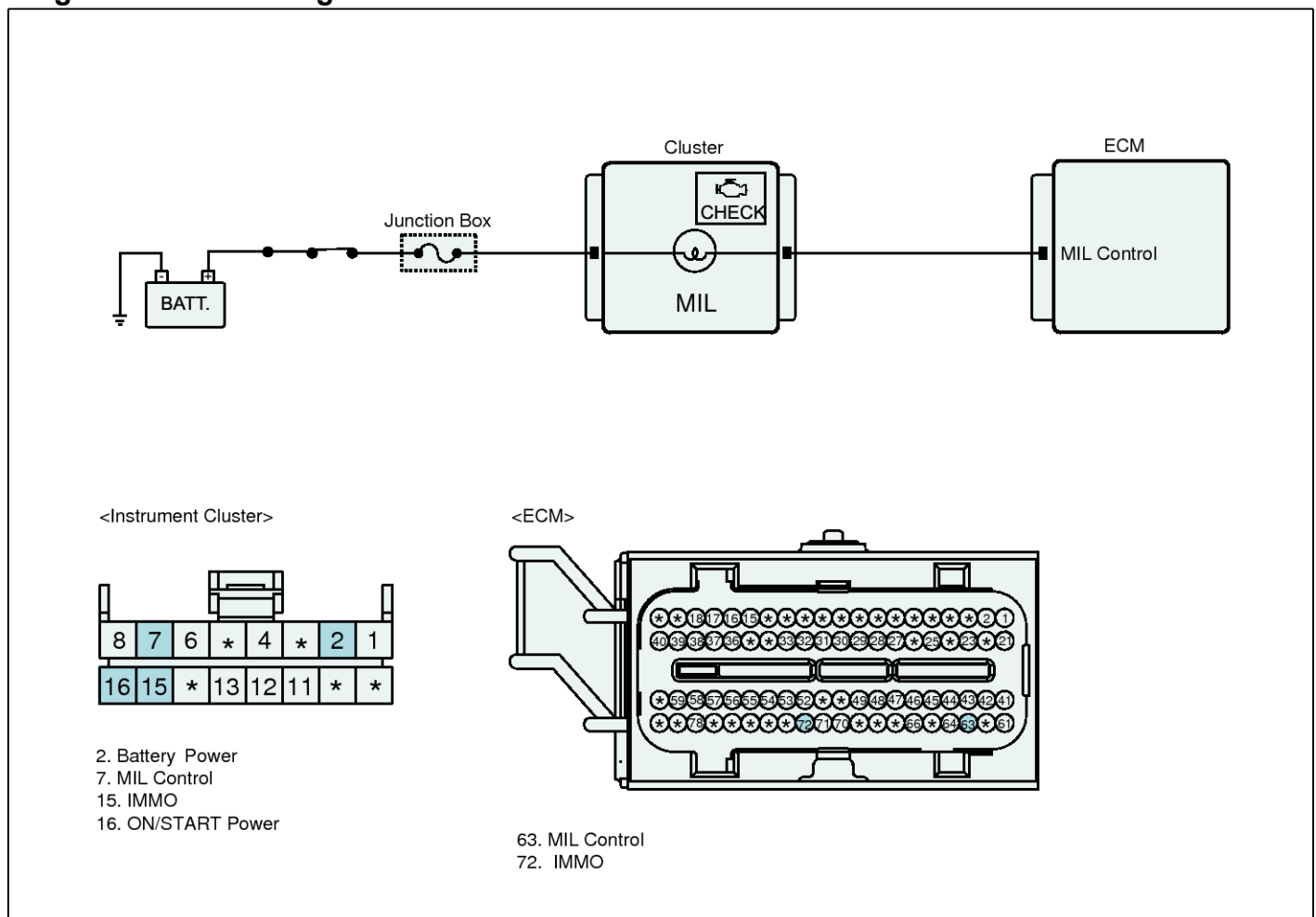
DTC Description

Checking input signal of engine check lamp every 10 sec. under detecting condition, if open, short to battery or ground is detected, ECM sets P0650.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Check the MIL	- Poor connection - Open or short in MIL circuit - Faulty MIL - Faulty ECM
Enable Conditions	- After 0.5 sec under conditions below - Engine works $11V \leq \text{Battery voltage} \leq 16V$	
Threshold value	Open or short	
Diagnosis Time	Continuous	
MIL On Condition	DTC only (NO MIL ON)	

Diagnostic Circuit Diagram



FL-610

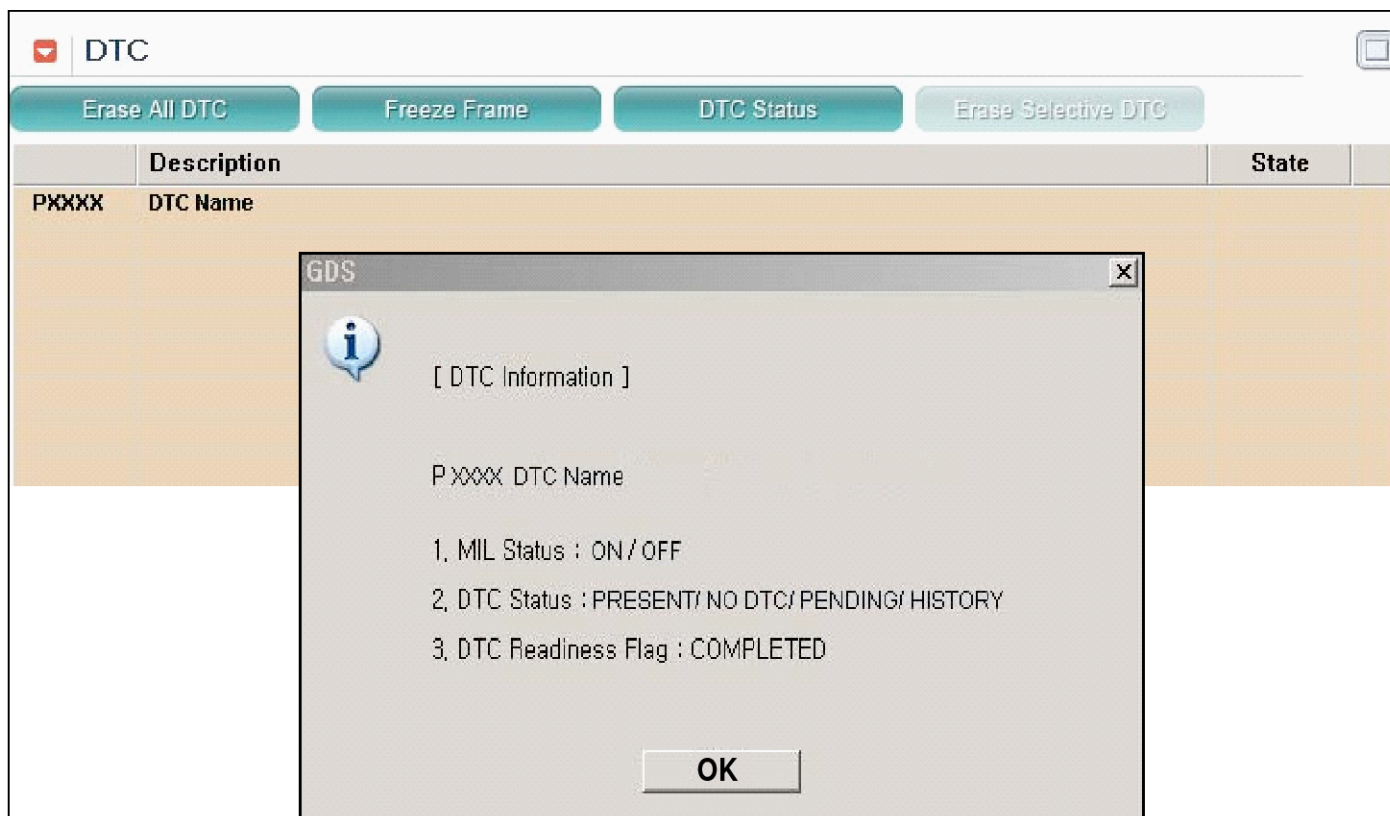
Fuel System

SBHFL9536L

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to "Power Circuit Inspection" procedure

Power Circuit Inspection

Check voltage

1. IG "OFF" and disconnect Instrument cluster connector.
2. IG "ON"
3. Measure voltage between power supply terminal of instrument cluster harness connector and chassis ground.

Specification : Approx. B+

Engine Control System

FL-611

4. Is the measured voltage within specification ?

YES ▶ Go to "Control Circuit Inspection" procedure.

NO ▶ Check fuse between battery and instrument cluster for open or blown-off.
▶ Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

Control Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect ECM connector.
2. IG "ON"
3. Measure voltage between MIL terminal of ECM harness connector and chassis ground.

Specification : Approx. B+

4. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Check open in Engine warning lamp's filament.
▶ Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check instrument cluster

1. IG "OFF"
2. Substitute with a known - good instrument cluster and check for proper operation.
3. Does it normally operate after replacement?

YES ▶ Replace instrument cluster and go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

FL-612

Fuel System

P0651 Sensor Reference Voltage "B" Circuit Open

General Description

The ECM provides a 5 volt reference voltage to Throttle Position Sensor 2 (TPS2). The ECM monitors reference voltage deviation from the power supply circuit of the sensors.

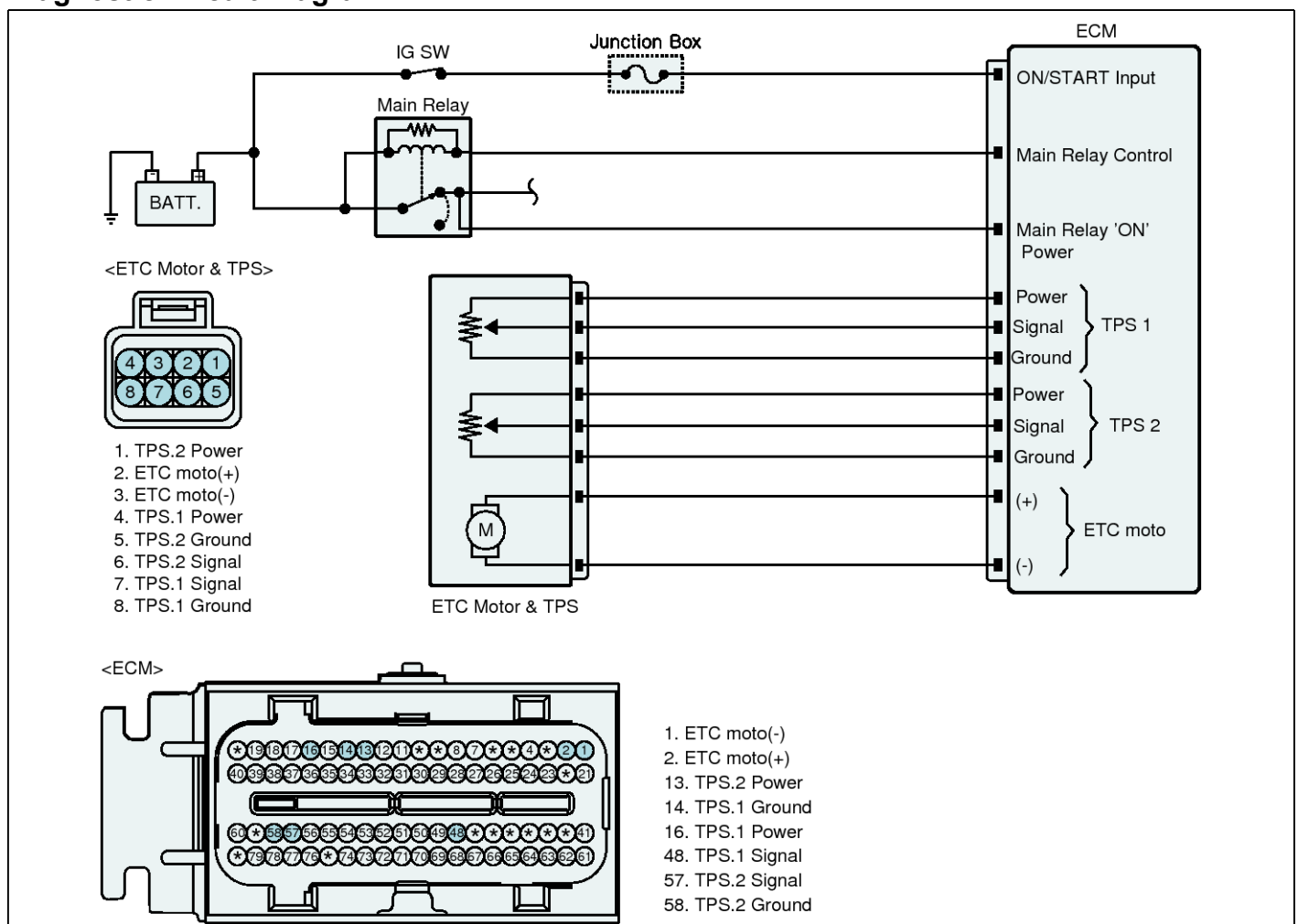
DTC Description

Checking the voltage from sensor power supply every 1.87 sec. under detecting condition, if the value within detecting condition lasts for more than 0.2 sec., ECM sets P0651. MIL (Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Sensor reference voltage check	• Short in sensor power supply line • Faulty ECM
Enable Conditions	• IG "ON"	
Threshold value	• Sensor supply power < 4.5V or > 5.5V	
Diagnosis Time	• Continuous (More than 0.2 seconds failure for every 1.8 7 seconds test)	
MIL On Condition	• 2 driving cycle	

Diagnostic Circuit Diagram



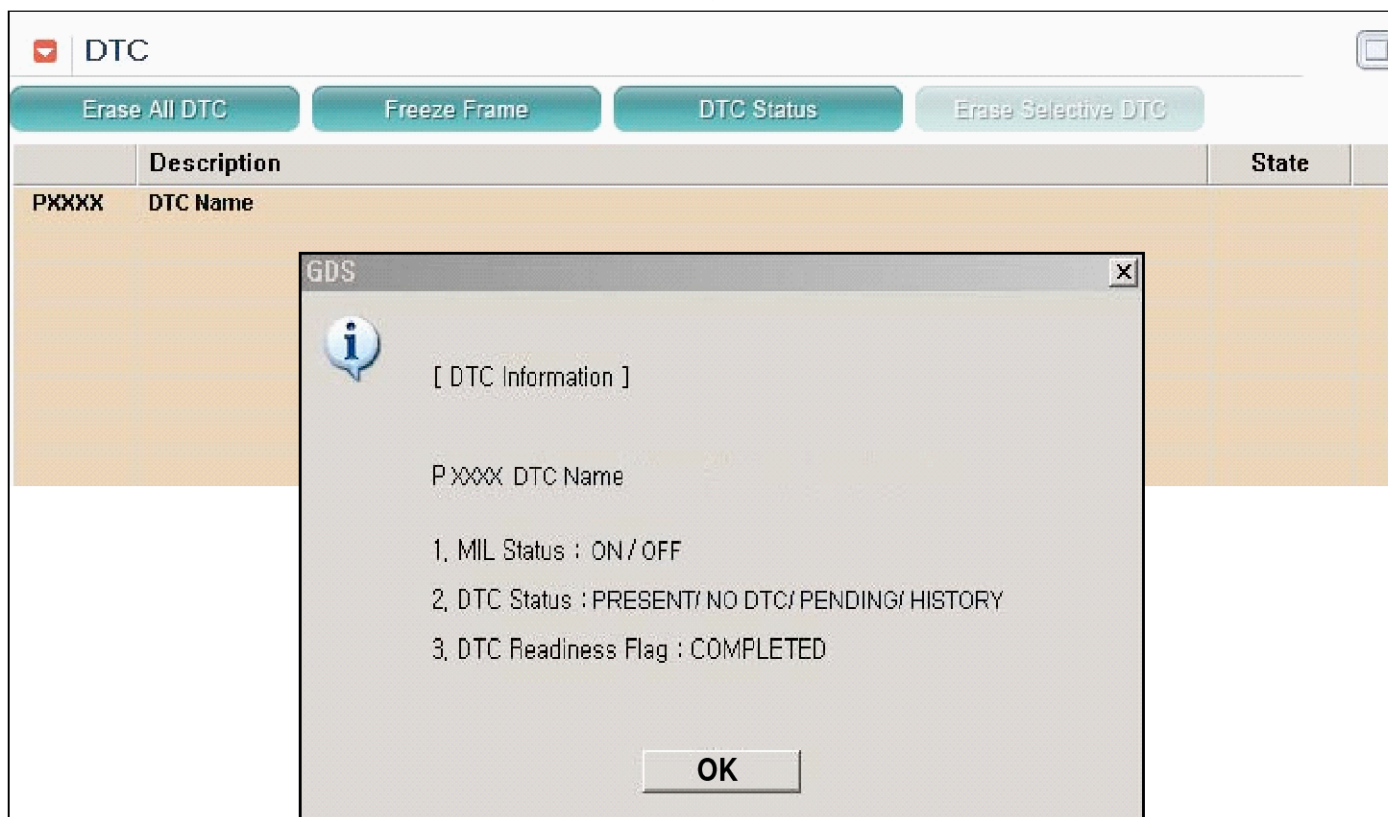
FL-614

Fuel System

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to "Power Circuit Inspection" procedure

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect ETC Motor & TPS connector.
2. IG "ON"
3. Measure voltage between TPS2 power terminal of ETC Motor & TPS harness connector and chassis ground.

Specification : Approx. B+

Engine Control System

FL-615

4. Is the measured voltage within specification ?

YES ► Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Check short in power harness" as follows.

■ Check short in power harness

1. IG "OFF" and disconnect ETC Motor & TPS connector and ECM connector.
2. Measure the resistance between TPS2 power and ETC motor (+) terminals of ETC Motor & TPS harness connector.(Measurement "A")
3. Measure the resistance between TPS2 power and ETC motor (-) terminals of ETC Motor & TPS harness connector.(Measurement "A")
4. Measure the resistance between TPS2 power and TPS1 ground terminals of ETC Motor & TPS harness connector.(Measurement "B")
5. Measure the resistance between TPS2 power and TPS2 ground terminals of ETC Motor & TPS harness connector.(Measurement "B")

Specification : Infinite

6. Is the measured resistance within specification ?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Repair short in power harness and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

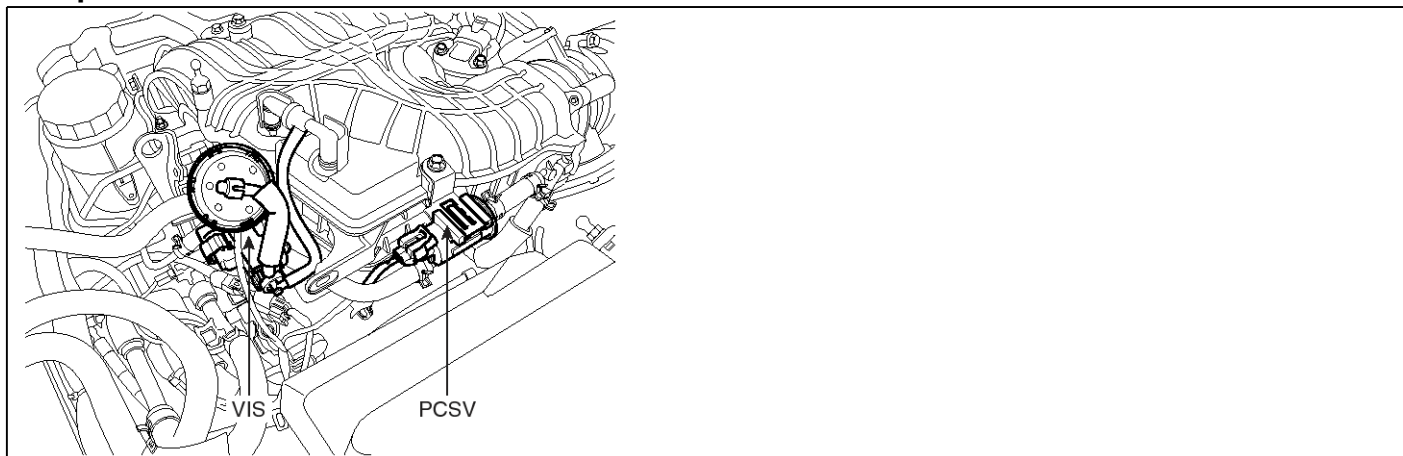
NO ► Go to the applicable troubleshooting procedure.

FL-616

Fuel System

P0660 Intake Manifold Tuning Valve Control Circuit/Open (Bank 1)

Component Location



SBHFL9319L

General Description

VIS(Variable intake system) is a device which varies the length of intake manifold to generate maximum power at certain RPM. VIS lengthens intake manifold to improve the torque at low RPM when vehicle speed is low while it shortens intake manifold to raise torque at high RPM when vehicle speed is high. PCU controls VIS using RPM signal.

DTC Description

Checking the output voltage from VIV(Variable Intake Manifold Valve) every 10 sec. under detecting condition, if the value within detecting condition lasts for more than 5 sec., ECM sets P0660. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycle.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Signal low, high	- Poor connection - Open or short in VIV circuit - Faulty VIV - Faulty ECM
Enable Conditions	- After 0.5 sec under conditions below - Engine works $11V \leq \text{Battery voltage} \leq 16V$	
Threshold value	Open or short	
Diagnosis Time	Continuous (More than 5 seconds failure for every 10 seconds test)	
MIL On Condition	2 driving cycle	

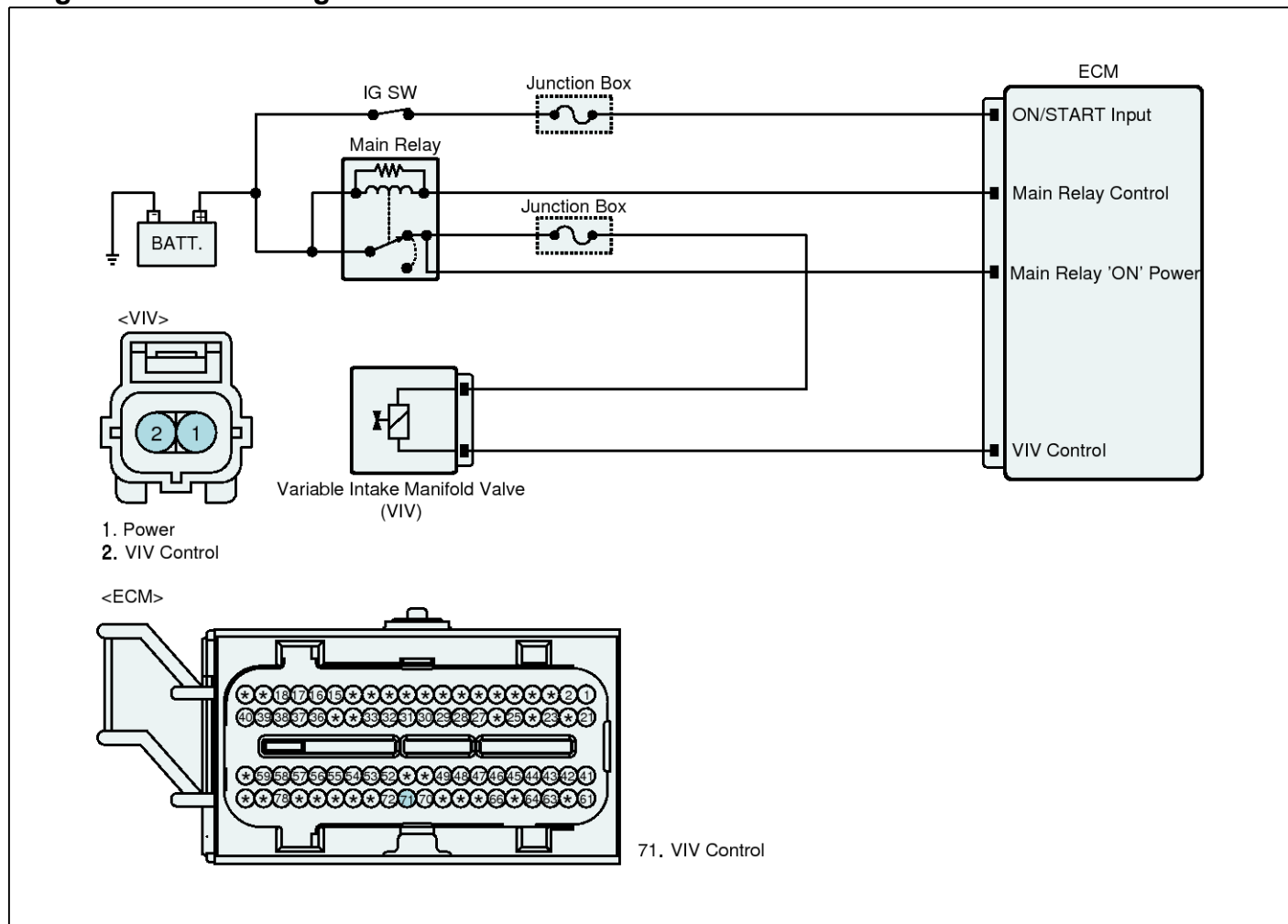
Specification

VIV	Specification(22 °C)
Resistance(Ω)	30 ~ 35

Engine Control System

FL-617

Diagnostic Circuit Diagram



SBHFL9537L

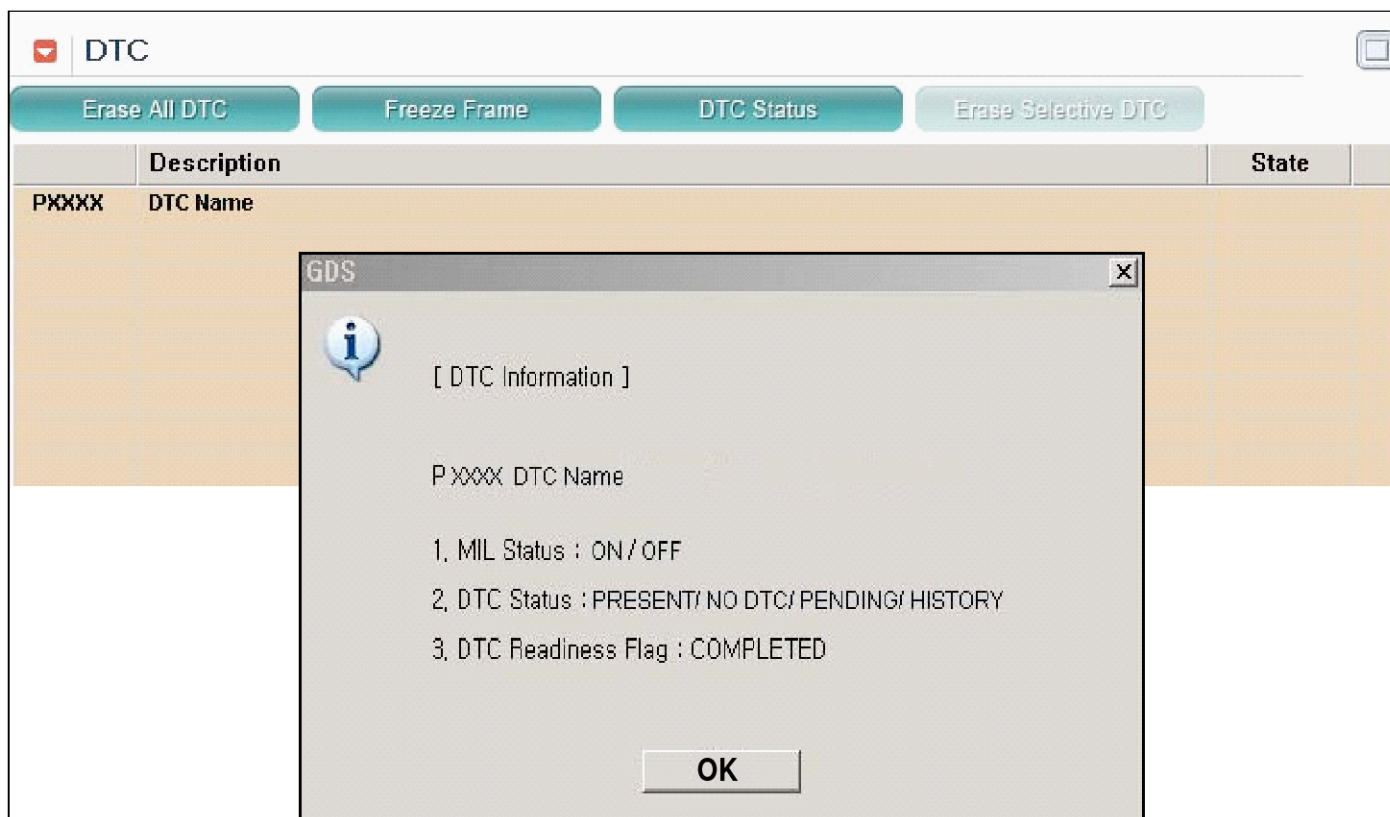
FL-618

Fuel System

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to "Power Circuit Inspection" procedure

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect VIV connector.
2. IG "ON"
3. Measure voltage between power terminal of VIV harness connector and chassis ground.

Specification : Approx. B+

Engine Control System

FL-619

4. Is the measured voltage within specification ?

YES ▶ Go to "Control Circuit Inspection" procedure

NO ▶ Check fuse connected to power of VIV for open or blown-off.
▶ Repair open or short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

Control Circuit Inspection

■ Check short to ground in harness

1. IG "OFF" and disconnect VIV connector and ECM connector.
2. Measure resistance between control terminal of VIV harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification ?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness, and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect VIV connector and ECM connector.
2. Measure resistance between control terminal of VIV harness connector and VIV control terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in harness, and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check VIV

1. IG "OFF" and disconnect VIV connector.
2. Measure resistance between power and control terminals of VIV connector.(Component side)

Specification : 30 ~ 35 Ω (22°C/71.6°F)

3. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good VIV and check for proper operation. If the problem is corrected, replace VIV and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

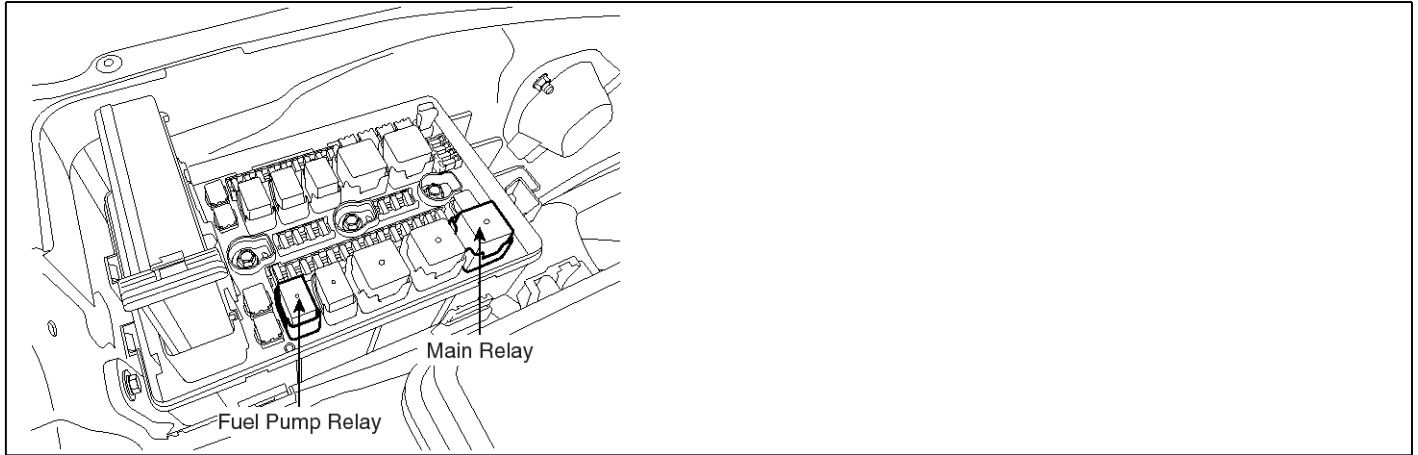
NO ▶ Go to the applicable troubleshooting procedure.

FL-620

Fuel System

P0685 ECM/PCM Power Relay Control Circuit /Open

Component Location



SBHFL9323L

General Description

The ECM provides ground to one side of the coil of the main relay and the other side is connected to the battery. The ECM monitors battery voltage and the voltage after the main relay.

DTC Description

Checking the controlling state of main relay every 10 sec. under detecting condition, if open or short in the circuit is detected for more than 5 sec., ECM sets P0685.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Detects a short to ground, to battery or open circuit on the main relay	• Poor Connection • Open or short in control circuit • Faulty Main Relay • Faulty ECM
Enable Conditions	• Engine Running • $11V \leq \text{Ignition Voltage} \leq 16V$	
Threshold value	• Open or Short in circuit	
Diagnosis Time	• Continuous (More than 5sec. failure for every 10 sec. test)	
MIL On Condition	• DTC only (NO MIL ON)	

※ If Main relay has a fault(ex. Open) under engine running,

the DTCs,P0638/P0685/P1295/P2106, can happen at the same time.

<DTC Name>

- P0638 Throttle Actuator Control Range/Performance(Bank 1)

- P0685 ECM/PCM Power Relay Control Circuit /Open

- P1295 Throttle Actuator Control System - Power Management

- P2106 Throttle Actuator Control System - Forced Limited Power

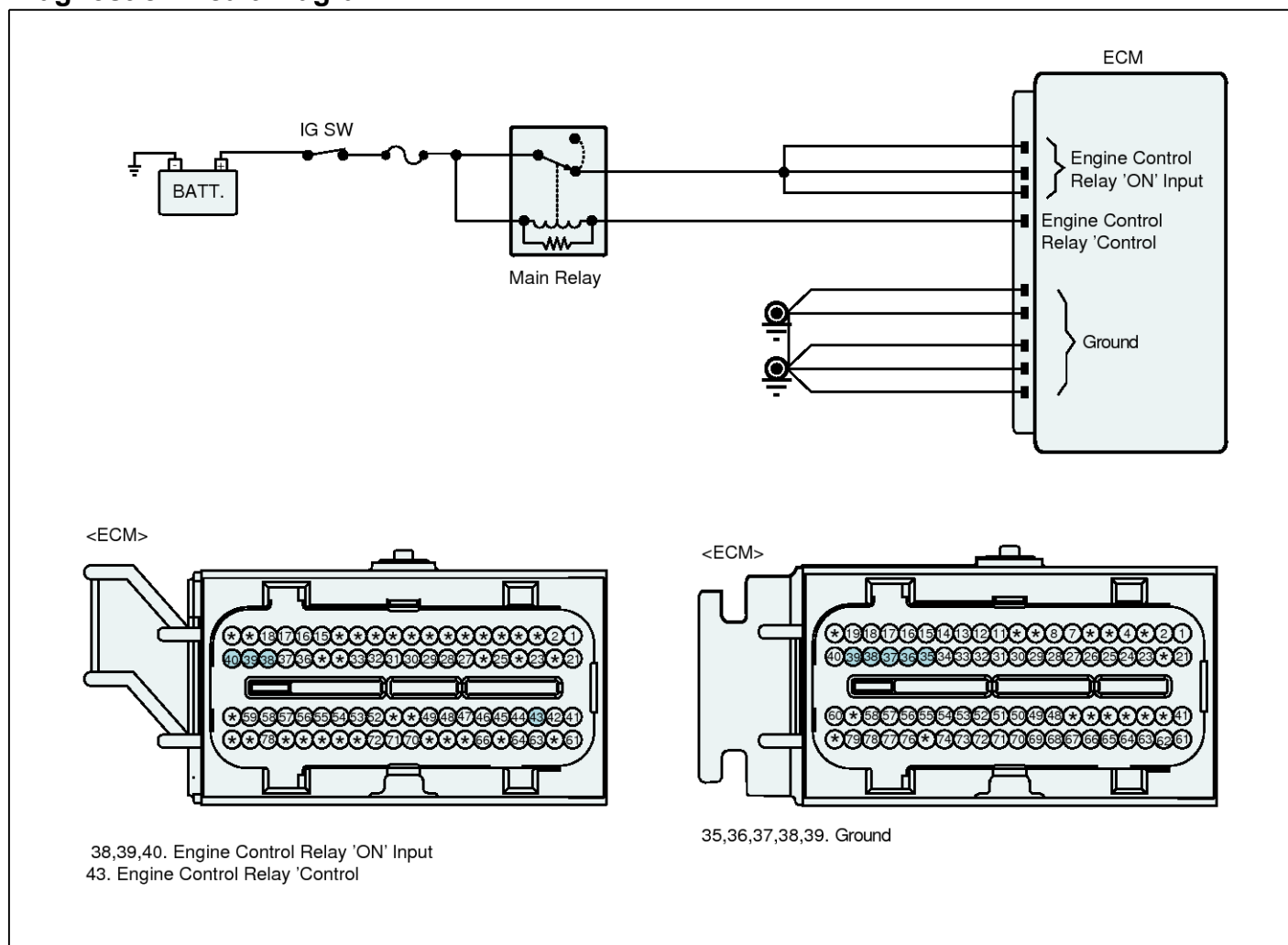
Engine Control System

FL-621

Specification

Coil Resistance	70Ω ~ 120Ω

Diagnostic Circuit Diagram



SBHFL9534L

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.

5. Is parameter displayed "Present fault"?

- YES** ► Go to "Terminal and Connector inspection" procedure.
- NO** ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. T- thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

FL-622

Fuel System

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ▶ Go to "Power Circuit Inspection" procedure

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect the main relay.
2. IG "ON"
3. Measure the voltage between power supply terminals of main relay harness connector and chassis ground.

Specification : Approx. B+

4. Is the measured voltage within specification ?

YES ▶ Go to "Control Circuit Inspection" procedure.

NO ▶ Check the fuse between battery and main relay.
▶ Repair open or short to ground in power harness and go to "Verification of Vehicle Repair" procedure.

Control Circuit Inspection

■ Check short in harness

1. IG "OFF" and disconnect the main relay and ECM connector.
2. Measure the resistance between control terminal of main relay harness connector and chassis ground.

Specification : Infinite

3. Is the measured resistance within specification ?

YES ▶ Go to "Check open in harness" procedure.

NO ▶ Repair short in control harness and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect the main relay and ECM connector.
2. Measure the resistance between control terminal of main relay harness connector and main relay control terminal of ECM harness connector.

Specification : Approx. below 1Ω

3. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in control harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check Main relay

1. IG "OFF" and disconnect main relay.
2. Measure the resistance between battery power supply and control terminals of main relay. (Measurement "A")
3. Measure the resistance between battery power supply and power supply to ECM terminals of main relay. (Measurement "B")

Specification :

Terminal	Continuity
Battery power supply - Power supply to ECM	NO
Battery power supply - Main relay control	YES (Approx. 70Ω ~ 120Ω)

4. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good Fuel Pump Relay and check for proper operation. If the problem is corrected, replace Fuel Pump Relay and go to "Verification of Vehicle Repair" procedure.

Engine Control System

FL-623

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

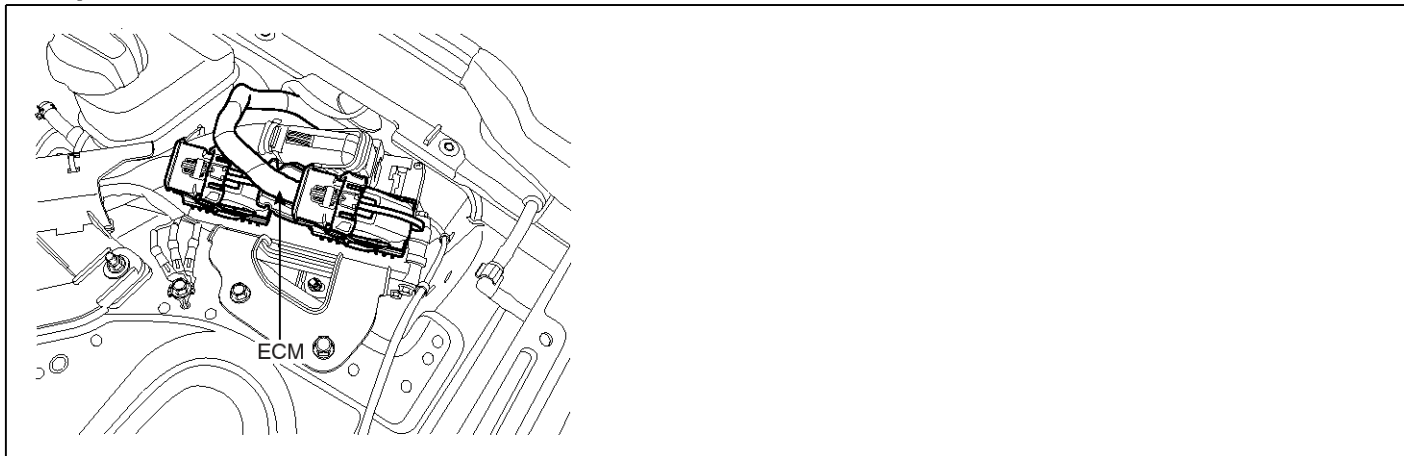
NO ► Go to the applicable troubleshooting procedure.

FL-624

Fuel System

P0700 Transmission Control System (MIL Request)

Component Location



SBHFL9300L

General Description

The TCM can request activation of the MIL lamp Via a communication line to the ECM. This is only a request from TCM to ECM to turn the MIL on. The fault code is stored in the TCM. Select Transaxle system on the Scantool and monitor DTC related automatic transaxle system.DO ALL REPAIRS associated malfunction with A/T.

DTC Description

The ECM sets this code when it receives MIL ON request from TCM .

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Freeze frame request via CAN	Transaxle system
Enable Conditions	Battery Voltage $\geq 10V$	
Threshold value	MIL is requested by TCM	
Diagnosis Time	Contineous	
MIL On Condition	1 driving cycle	

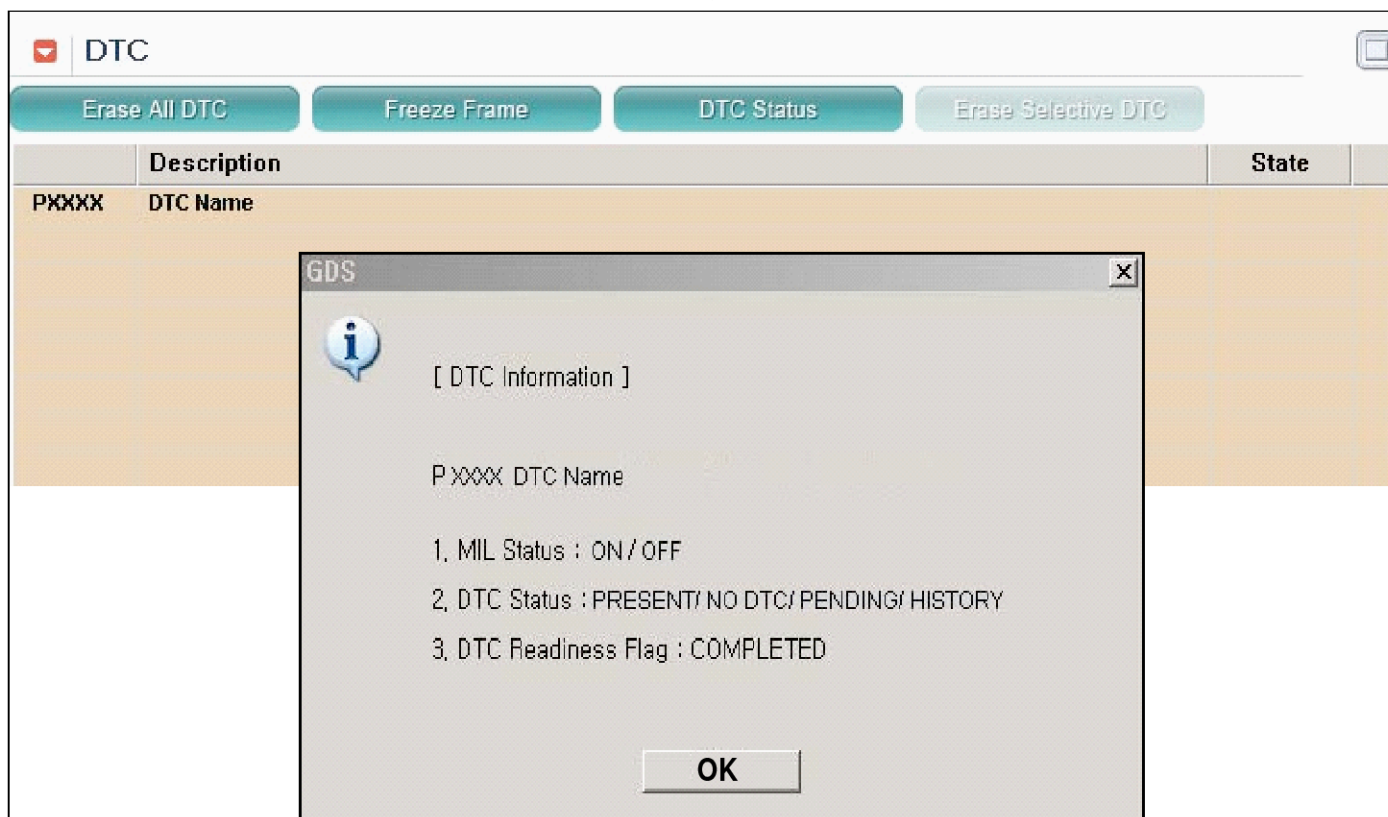
Engine Control System

FL-625

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ▶ This is only a request from TCM to ECM to turn the MIL on. The fault code is stored in the TCM. The Freeze Frame Data is stored in the ECM under the P0700 request code. Be sure to retrieve freeze frame data before clearing code P0700 from ECM.

▶ Check the transaxle system.

NO ▶ Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

P1106 Manifold Absolute Pressure Sensor Circuit Intermittent high

Component Location



SBHFL9302L

General Description

The amount of intake air flow must be inputted to ECM in order to determine the fuel injection quantity. To measure the pressure inside of intake manifold, MAFS is used at idle and MAPS is required at accelerating. MAPS(Manifold Absolute Pressure) calculates the amount of air indirectly as measuring the pressure inside of intake manifold. This mechanism is also called Speed-Density Type. MAPS transfers analog output signal which is proportional to the change of intake manifold pressure, then, with this signal and RPM, ECM calculates the amount of intake air flow. MAPS is mounted on surge tank to measure the pressure inside of intake manifold, and it consists of a piezo electric element and hybrid IC which amplifies output signal from the element. A piezo electric element is a sort of a diaphragm using piezo electric effect. One side of the diaphragm is surrounded with vacuum chamber while intake pressure is applied to the other side. Thus, signals are output by the transformation of diaphragm according to the change of pressure inside of intake manifold.

DTC Description

Checking output signals of MAPS under detecting condition, if an output signal is intermittently above 4.5V, ECM sets P1106.

Engine Control System

FL-627

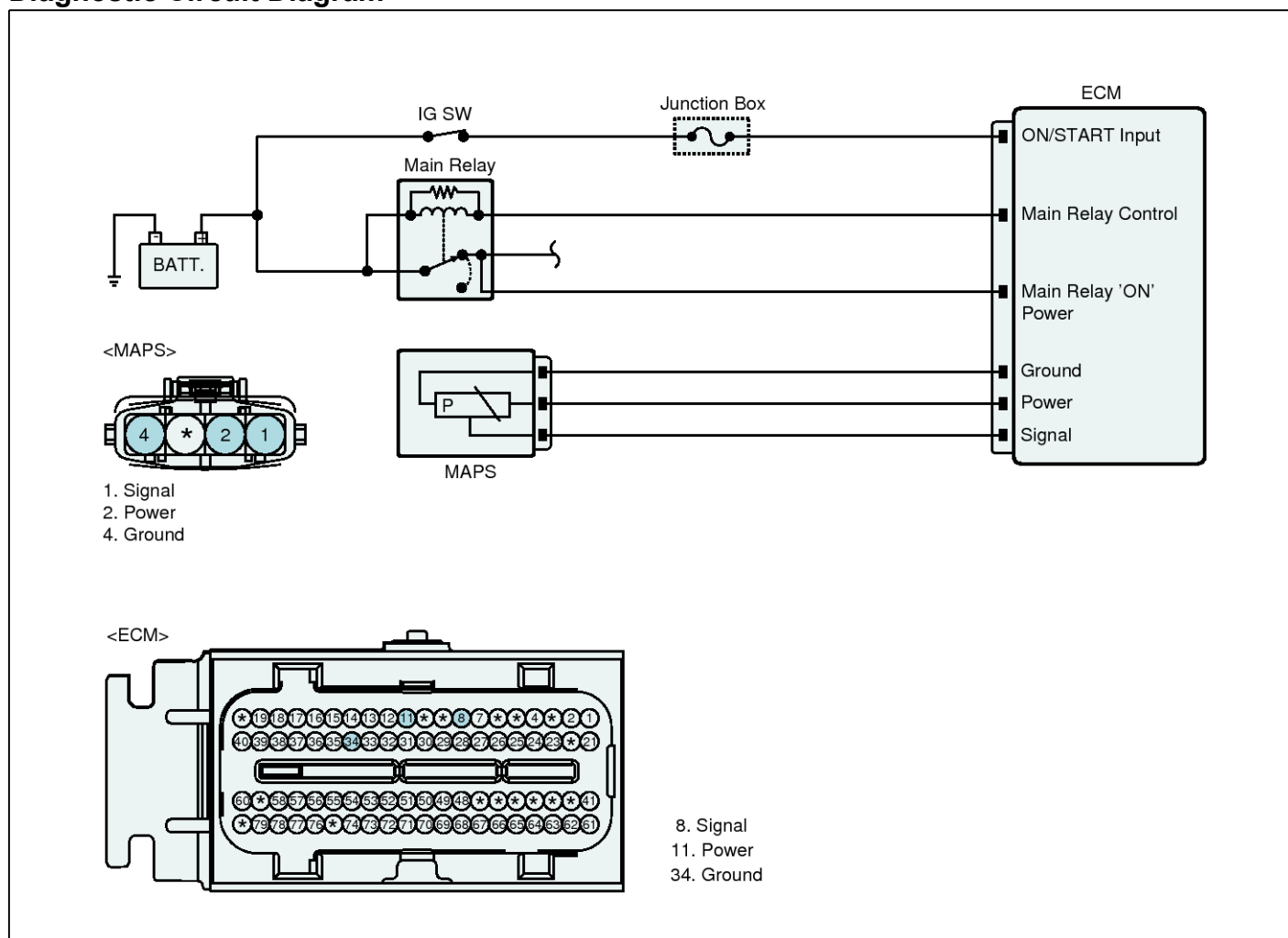
DTC Detecting Condition

Item		Detecting Condition	Possible cause
DTC Strategy		Monitor the signal of MAP sensor	- Poor Connecting - Short to battery in signal circuit - Open in ground circuit - Faulty MAPS - Faulty ECM
Enable Conditions	Case 1	- No TPS Active Fault Present - Engine Running Time > 10sec. - Engine Speed $\leq$ 2500rpm - Throttle Position $\leq$ 30%	
	Case 2	- No TPS Active Fault Present - Engine Running Time > 10sec. - Engine Speed > 2500rpm - Throttle Position $\leq$ 40%	
Threshold value		Intermittently MAP Signal > 4.5V	
Diagnosis Time		Continuous (More than 2sec. failure for every 4 sec. test)	
MIL On Condition		DTC only(NO MIL ON)	

Specification

Pressure(kPa)	Voltage(V)
20	0.79
46.66	1.84
101.32	4.0

Diagnostic Circuit Diagram



SBHFL9514L

Signal Waveform & Data

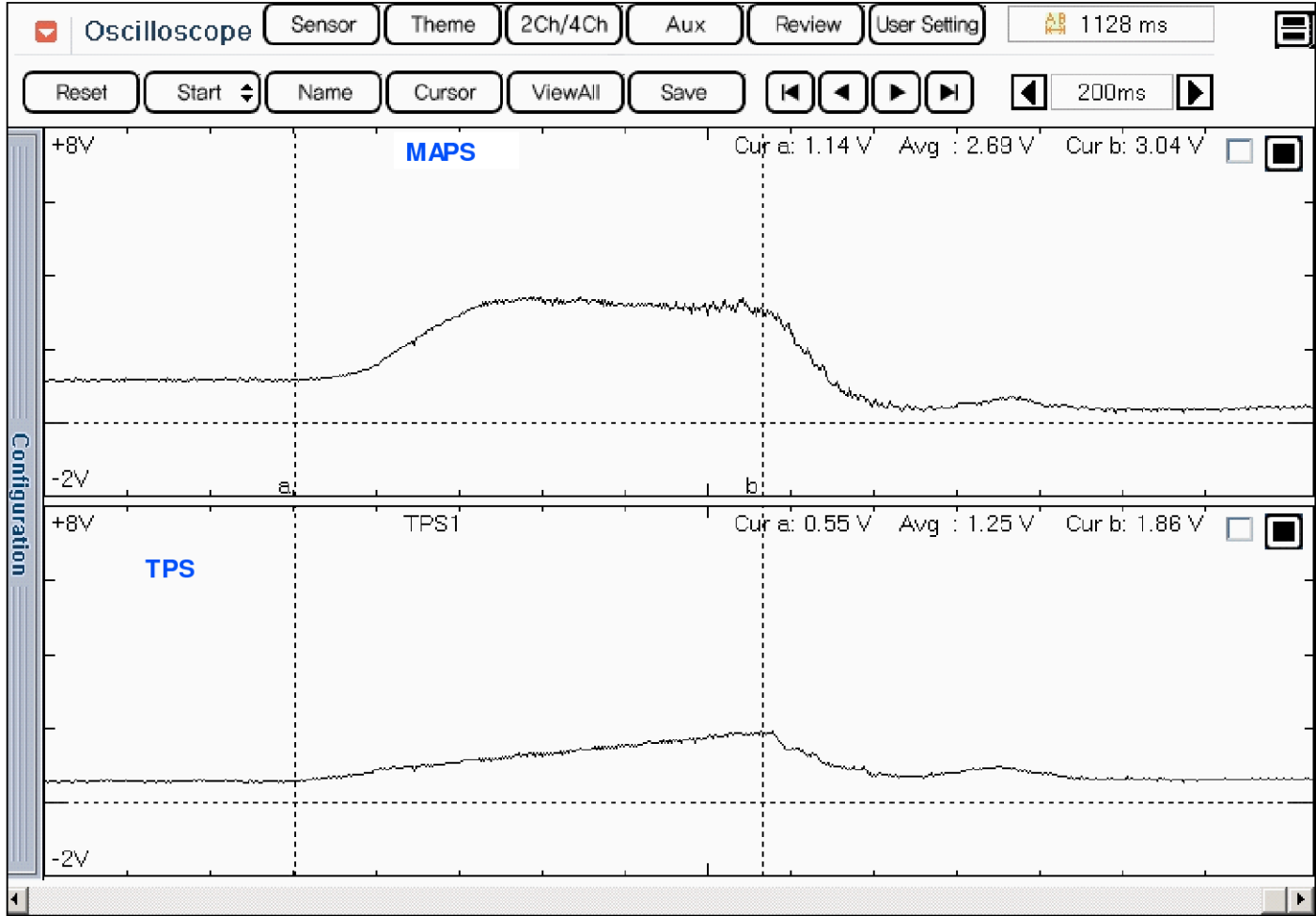


Fig.1

SBHFL9628L

Current Data		
Standard Display	Full List	Graph
Items List	Reset Min.Max.	Record
Stop	VSS	
Sensor Name	Value	Unit
☒ Air Flow Rate from Mass Air Flow Sensor	11	kg/h
☒ Manifold Absolute Pressure Sensor	285	hPa
☒ Engine Speed	600	RPM

Fig.2

SBHFL9629L

Fig 1) Normal waveform of MAPS & TPS with acceleration.

Fig 2) Normal data of MAPS at idle.

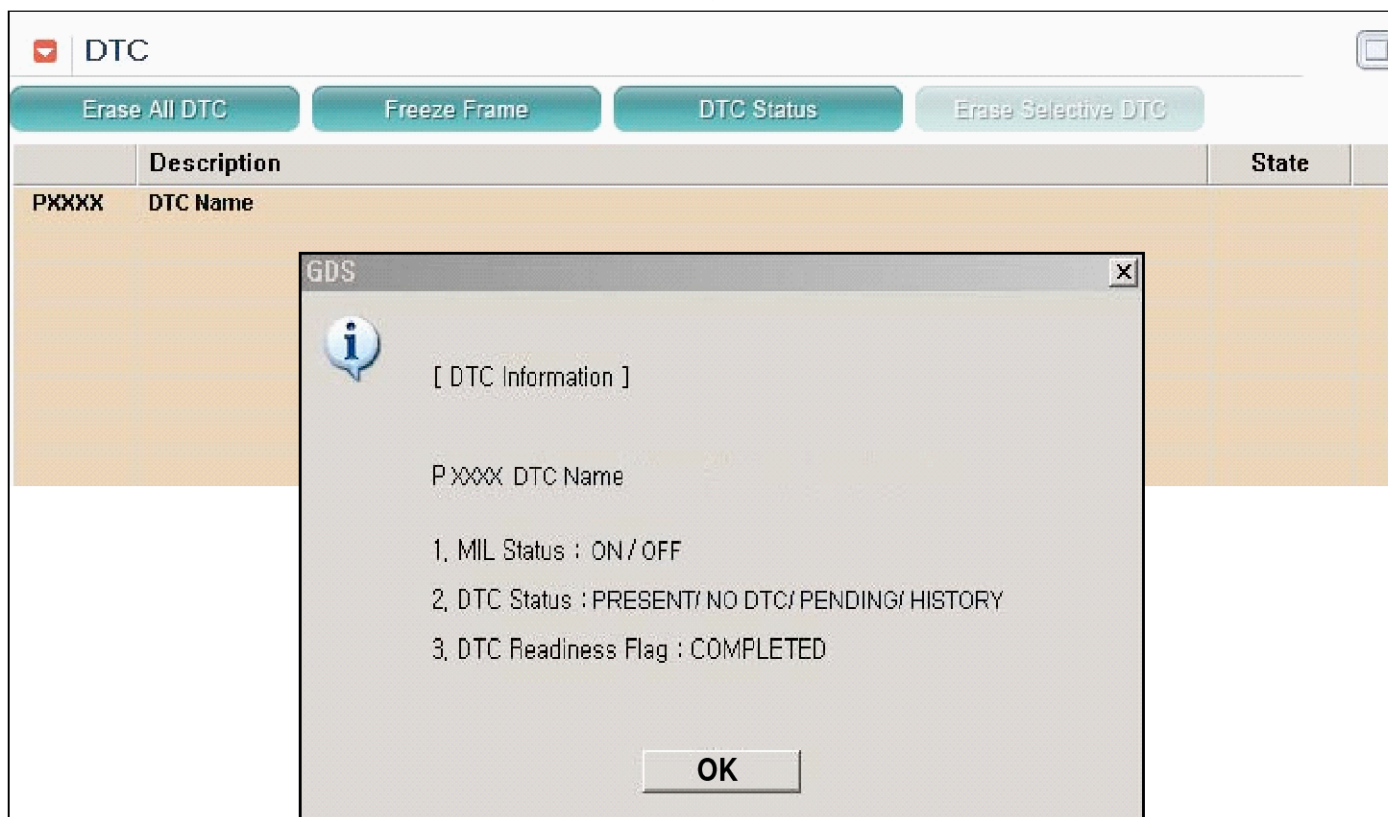
FL-630

Fuel System

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to " Power Circuit Inspection " procedure

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and Disconnect MAPS connector.
2. IG "ON"
3. Measure the voltage between power terminal of MAPS harness connector and ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ► Go to "Ground Circuit Inspection" Procedure.

NO ► Repair open or short in harness and go to " Verification of Vehicle Repair" procedure.

Engine Control System

FL-631

Ground Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect MAPS connector and then IG "ON".
2. Measure voltage between signal terminal of MAPS harness connector and chassis ground (Measurement "A")
3. Measure voltage between signal and ground terminals of MAPS harness connector (Measurement "B")

Specification : Voltage difference between Measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

YES ▶ Go to "Signal Circuit Inspection" procedure.

NO ▶ Repair contact resistance or open in harness and then go to "Verification of Vehicle Repair" procedure.

Signal Circuit Inspection

■ Check short to battery in harness

1. IG "OFF".
2. Disconnect MAPS and ECM connector.
3. Measure resistance between signal and power terminals of MAPS harness connector.

Specification : Infinite

4. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" as follows.

NO ▶ Repair short in harness and then go to "Verification of Vehicle Repair" procedure.

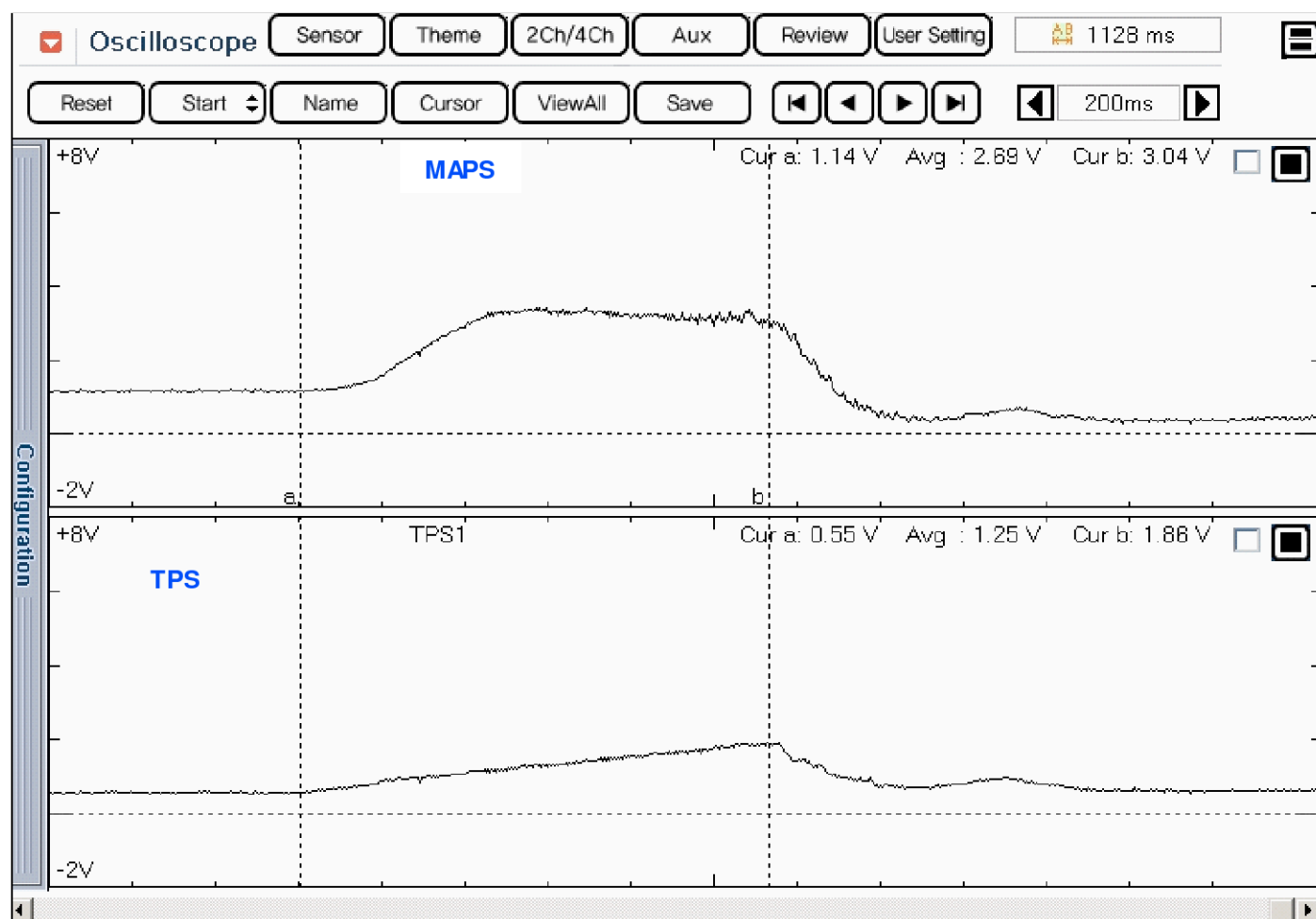
Component Inspection

■ Check MAPS Performance

1. IG "OFF" and install a scantool
2. Connect probe to MAPS and TPS to check signal waveform by using oscilloscope function.
3. ENG "ON" and monitor signal waveform during acceleration and deceleration.

Specification : Signal waveform will be displayed as follows.

Pressure(kPa)	Voltage(V)
20	0.79
46.66	1.84
101.32	4.0



SBHFL9627L

4. Is the measured signal waveform(MAP/TPS Rationality) O.K ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good MAPS and check for proper operation. If the problem is corrected, replace MAPS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-633

P1107 Manifold Absolute Pressure Sensor Circuit Intermittent low

Component Location

Refer to DTC P1106 : Manifold Absolute Pressure Sensor Circuit Intermittent High

General Description

Refer to DTC P1106 : Manifold Absolute Pressure Sensor Circuit Intermittent High

DTC Detecting Condition

Item		Detecting Condition	Possible cause
DTC Strategy		This code detects a continuous short to low or open in either the signal circuit or the MAP	- Connecting Condition - Open or short to ground in power circuit - Open or short to ground in signal circuit - MAPS - ECM
Enable Conditions	Case 1	- No TPS Active Fault Present - Ignition Voltage $\geq 11V$ - Engine Speed $\leq 1000rpm$ - Throttle Position $\geq 0\%$	
	Case 2	- No TPS Active Fault Present - Ignition Voltage $\geq 11V$ - Engine Speed $> 1000rpm$ - Throttle Position $\geq 30\%$	
Threshold value		MAP Signal $< 0.25V$	
Diagnosis Time		Continuous (More than 2.5 seconds failure for every 5 seconds test)	
MIL On Condition		NO MIL ON(DTC only)	

Specification

Refer to DTC P1106 : Manifold Absolute Pressure Sensor Circuit Intermittent High

Diagnostic Circuit Diagram

Refer to DTC P1106 : Manifold Absolute Pressure Sensor Circuit Intermittent High

Signal Waveform & Data

Refer to DTC P1106 : Manifold Absolute Pressure Sensor Circuit Intermittent High

Monitor Scantool Data

Refer to DTC P1106 : Manifold Absolute Pressure Sensor Circuit Intermittent High

Terminal and Connector inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

DTC Description

Checking output signals of MAPS under detecting condition, if an output signal is intermittently below 0.25V, ECM sets P1107.

3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ▶ Go to " Power Circuit Inspection " procedure

Power Circuit Inspection

■ Check voltage

- IG "OFF" and Disconnect MAPS connector.
- IG "ON"
- Measure the voltage between power terminal of MAPS harness connector and ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ▶ Go to "Signal Circuit Inspection" Procedure.

NO ▶ Repair open or short in harness and go to " Verification of Vehicle Repair" procedure.

FL-634

Fuel System

Signal Circuit Inspection

■ Check short to ground in harness

1. IG "OFF".
2. Disconnect MAPS and ECM connector.
3. Measure the resistance between signal terminal of MAPS harness connector and ground.

Specification : Infinite

4. Is the measured resistance within specification ?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect MAPS and ECM connector.
2. Measure resistance between signal terminal of MAPS harness connector and MAPS signal terminal of ECM harness connector.

Specification : Approx. below 1Ω.

3. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check MAPS Performance

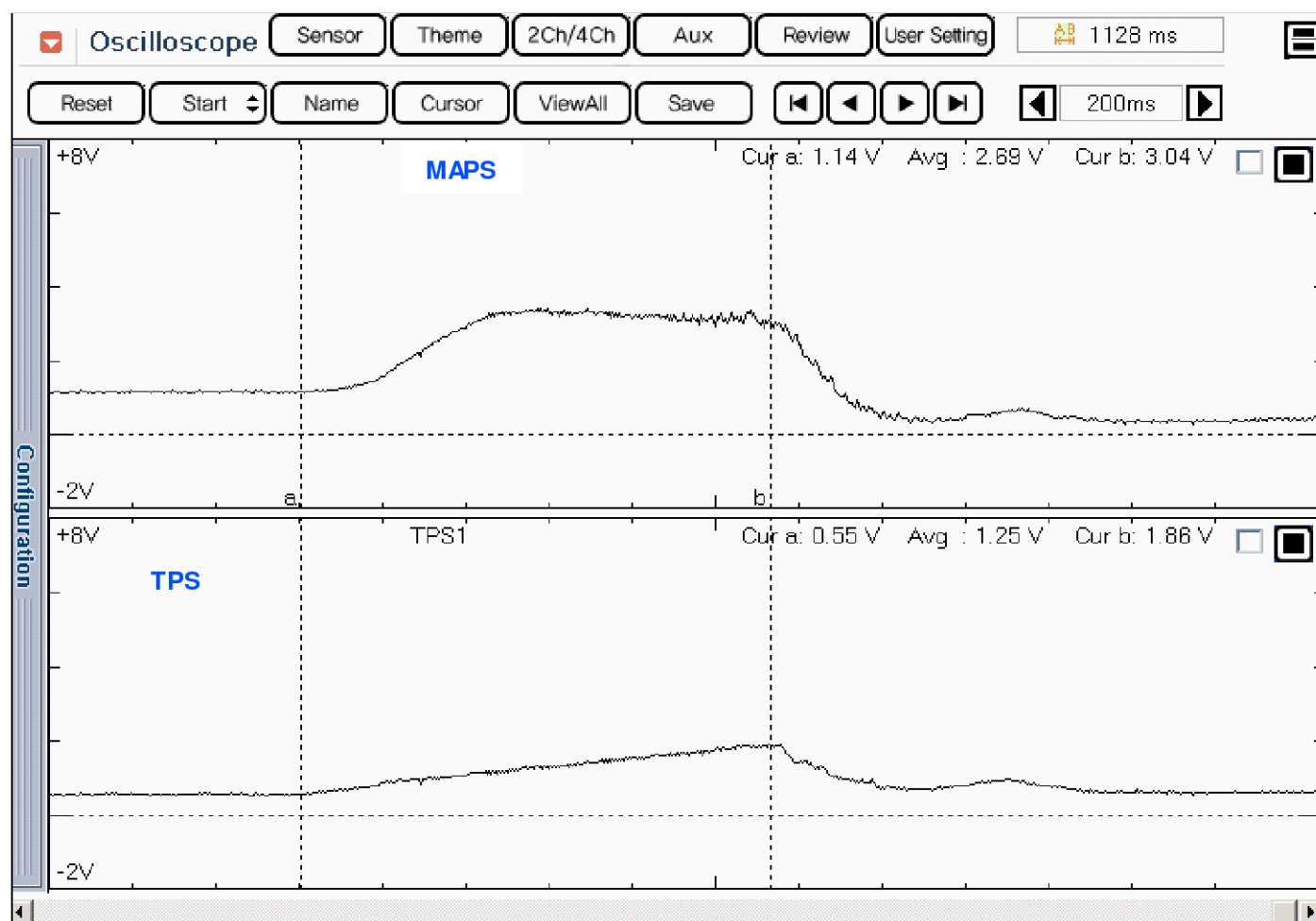
1. IG "OFF" and install a scantool
2. Connect probe to MAPS and TPS to check signal waveform by using oscilloscope function.
3. ENG "ON" and monitor signal waveform during acceleration and deceleration.

Specification : Signal waveform will be displayed as follows.

Pressure(kPa)	Voltage(V)
20	0.79
46.66	1.84
101.32	4.0

Engine Control System

FL-635



SBHFL9627L

4. Is the measured signal waveform(MAP/TPS Rationality) O.K ?

YES ▶ Substitute with a known - good ECM and c-check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good MAPS and c-check for proper operation. If the problem is corrected, replace MAPS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P1106 : Manifold Absolute Pressure Sensor Circuit Intermittent High

P1111 Intake Air Temperature Sensor Circuit Intermittent high

Component Location



SBHFL9301L

General Description

The Intake Air Temperature Sensor (IATS) is installed into the Mass Air Flow Sensor (MAFS). The IATS uses a thermistor whose resistance changes with the temperature. The electrical resistance of the IATS decreases as the temperature increases, and increases as the temperature decreases. The 5 V power source in the ECM is supplied to the IATS via a resistor in the ECM. That is, the resistor in the ECM and the thermistor in the IATS are connected in series. When the resistance value of the thermistor in IATS changes according to the intake air temperature, the signal voltage also changes. Using this signal, the information of the intake air temperature, the ECM corrects basic fuel injection duration and ignition timing.

DTC Description

Checking output signals of IATS under detecting condition, if an output signal is intermittently over 4.9V, ECM sets P1111.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	This code detects a continuous short to high in either the signal circuit or the sensor	- Poor connection - Open or short to battery in harness - Open in ground harness - IATS - ECM
Enable Conditions	- Engine running state - No Vehicle speed sensor fault - No ECTS fault - No MAFS fault - Intake airflow < 15 g/s - Vehicle speed < 25kph(9.3mph) - Engine coolant temperature > 50°C(122°F)	
Threshold value	Intake air temperature sensor's voltage > 4.9V	
Diagnosis Time	Continuous (More than 10 seconds failure for every 20 seconds test)	
MIL On Condition	NO MIL ON(DTC only)	

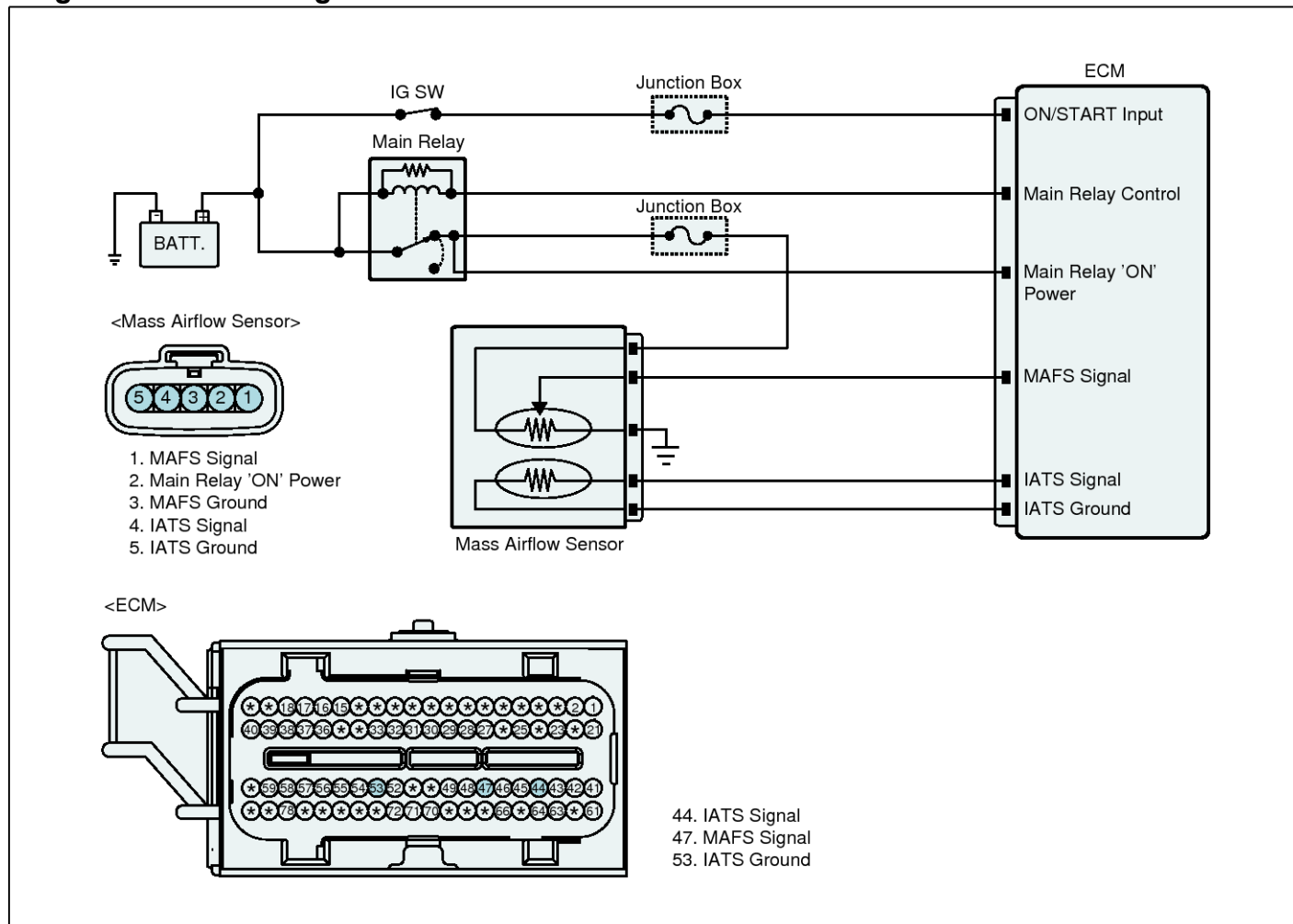
Engine Control System

FL-637

Specification

Temp. (°C)	Resistance (kΩ)	Temp. (°C)	Resistance (kΩ)
-40	95.95 ~ 105.78	20	3.42 ~ 3.61
-20	27.4 ~ 29.77	40	1.43 ~ 1.5
0	9.08 ~ 9.72	60	0.66 ~ 0.69
10	5.49 ~ 5.83	80	0.33 ~ 0.34

Diagnostic Circuit Diagram



SBHFL9513L

FL-638

Fuel System

Signal Waveform & Data

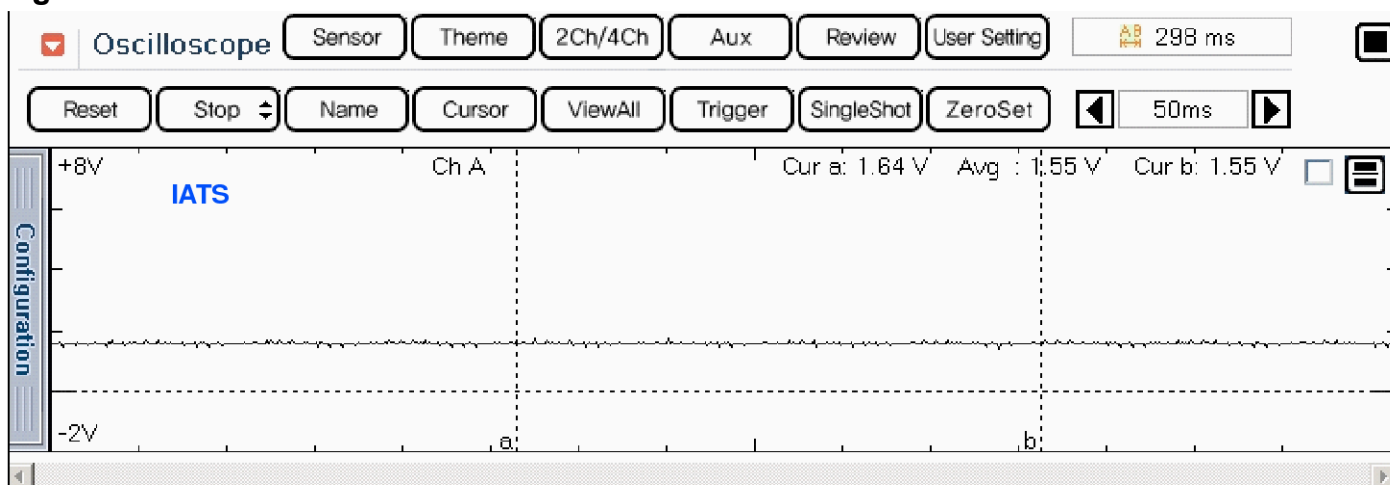


Fig.1

SBHFL9630L

Current Data		
Standard Display	Full List	Graph
Items List	Reset Min.Max.	Record
Stop	VSS	
Sensor Name	Value	Unit
☐ Engine Coolant Temperature Sensor	10.5	'C
☐ Intake Air Temperature Sensor	12.0	'C
☐ Oil Temperature Sensor	10.5	'C

Fig.2

SBHFL9631L

Sensor Name	Value	Unit
☒ Engine Speed	640	RPM
☒ Engine Coolant Temperature Sensor	90.8	'C
☒ Intake Air Temperature Sensor	27.8	'C
☒ Oil Temperature Sensor	88.5	'C

Fig.3

SBHFL9632L

Fig 1) Normal waveform of IATS at 43°C (109°F)

Fig 2) Normal data of IATS(53°F) & ECTS & EOTS at ig on

Fig 3) Normal data of IATS(82°F) & ECTS & EOTS after warming up.

The output signals of IATS & ECTS change smoothly without any rapid changes. Those have almost same characteristic signal during the early period after start. It means that the temperatures of intake air and engine coolant are depended on the temperature of atmosphere.

Meanwhile, during the warming up, the output signal of ECTS is going up increasingly. but, the output signal of IATS changes a little bit. even it may not change almost. It means that the heat of engine does not affect on the temperature of intake air. Meanwhile, during the warming up, the output signal of ECTS is going up increasingly. but, the output signal of IATS changes a little bit. even it may not change almost. It means that the heat of engine does not affect on the temperature of intake air.

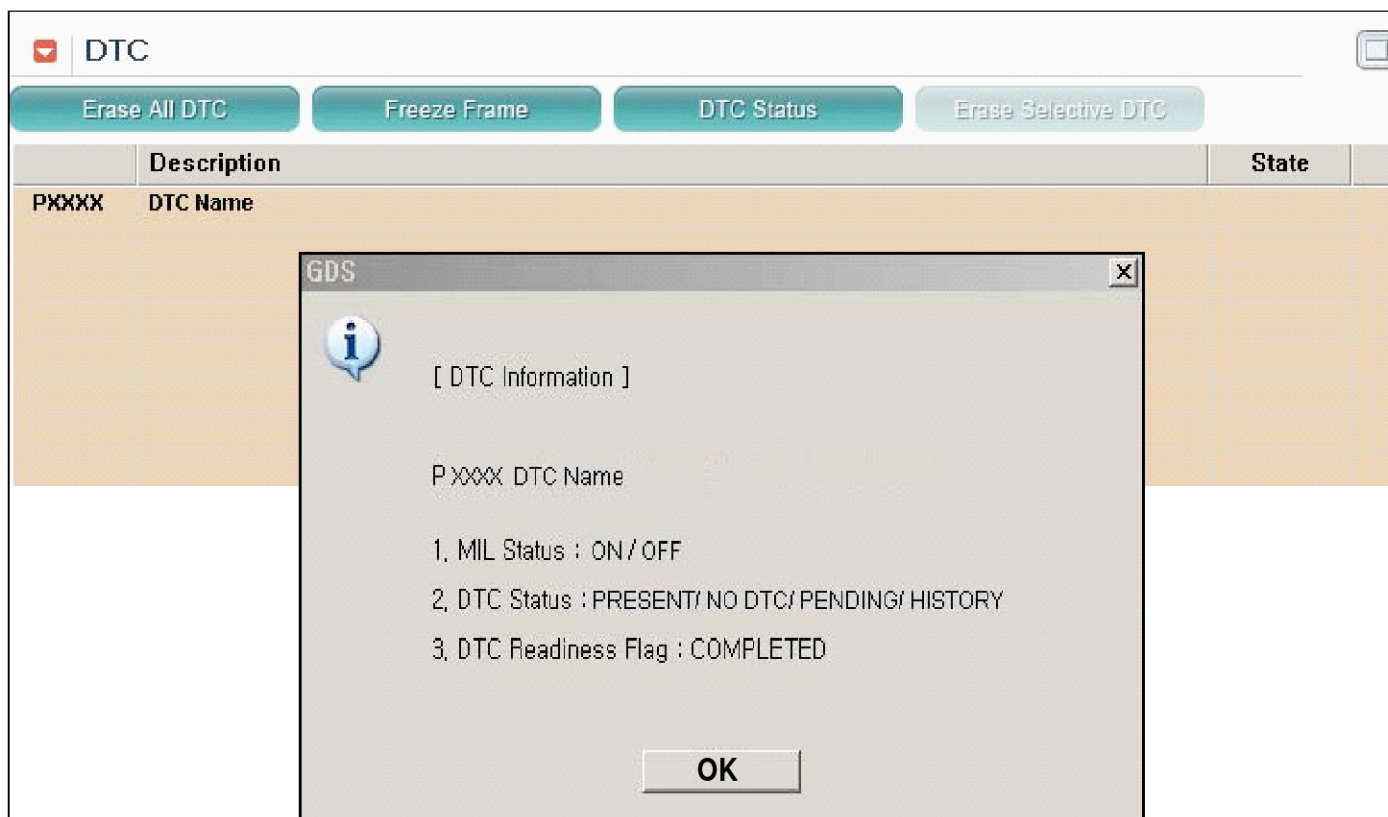
Engine Control System

FL-639

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to "Signal Circuit Inspection" procedure

Signal Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect IATS connector.
2. IG "ON"
3. Measure voltage between signal terminal of IATS harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ► Go to "Ground Circuit Inspection" procedure.

NO ► If the voltage is 0V, go to "Check open in harness" as follows. If the voltage is more than 5 .1V, go to "Check short to battery in harness" as follows.

FL-640

Fuel System

■ Check short to battery in harness

1. IG "OFF" and disconnect IATS connector and ECM connector.
2. Measure resistance between signal terminal of IATS harness connector and power terminal of MAFS harness connector.
3. Measure resistance between signal terminal of IATS harness connector and signal terminal of MAFS harness connector.

Specification : Infinite

4. Is the measured resistance within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Repair short to battery in harness and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect IATS connector and ECM connector.
2. Measure resistance between signal terminal of IATS harness connector and IATS signal terminal of ECM harness connector.

Specification : below 1Ω

3. Is the measured resistance within specification ?

YES ► Go to "Ground Circuit Inspection" procedure.

NO ► Repair open in harness and go to "Verification of Vehicle Repair" procedure.

Ground Circuit Inspection

■ Check open in harness

1. IG "OFF" and disconnect IATS connector and then IG "ON".
2. Measure voltage between signal terminal of IATS harness connector and chassis ground.(Measurement "A")
3. Measure voltage between signal and ground terminals of IATS harness connector.(Measurement "B")

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Repair contact resistance or open in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check IATS resistance

1. IG "OFF" and disconnect IATS connector.
2. Measure resistance between signal and ground terminals of IATS connector after checking out the temperature of IATS with scantool (Component Side)

Specification :

Temp. (°C)	Resistance (kΩ)
-40	95.95 ~ 105.78
-20	27.4 ~ 29.77
0	9.08 ~ 9.72
10	5.49 ~ 5.83
20	3.42 ~ 3.61
40	1.43 ~ 1.5
60	0.66 ~ 0.69
80	0.33 ~ 0.34

3. Is the measured resistance within specification ?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Substitute with a known - good IATS and check for proper operation. If the problem is corrected, replace IATS and go to "Verification of Vehicle Repair" procedure.

Engine Control System

FL-641

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

FL-642

Fuel System

P1112 Intak Air Temperature Sensor Circuit Intermittent low

Component Location

Refer to DTC P1111 : Intake Air Temperature Sensor Circuit Intermittent High

General Description

Refer to DTC P1111 : Intake Air Temperature Sensor Circuit Intermittent High

DTC Description

Checking output signals of IATS under detecting condition, if an output signal is intermittently below 0.1V, ECM sets P1112.

DTC Detecting Condition

Item		Detecting Condition	Possible cause
DTC Strategy		This code detects a continuous short to ground in either the signal circuit or the sensor	- Poor connection - Short to ground in harness - IATS - ECM
Enable Conditions	Case 1	- Engine running state - No Vehicle speed sensor fault - Vehicle speed > 50kph(30mph)	
	Case 2	- Engine running time >120 sec. - Time from IG "OFF" to IG "ON" > 360 min.	
Threshold value		Intake air temperature sensor's voltage < 0.1V	
Diagnosis Time		Continuous (More than 10 seconds failure for every 20 seconds test)	
MIL On Condition		NO MIL ON(DTC only)	

Specification

Refer to DTC P1111 : Intake Air Temperature Sensor Circuit Intermittent High

Diagnostic Circuit Diagram

Refer to DTC P1111 : Intake Air Temperature Sensor Circuit Intermittent High

Signal Waveform & Data

Refer to DTC P1111 : Intake Air Temperature Sensor Circuit Intermittent High

Monitor Scantool Data

Refer to DTC P1111 : Intake Air Temperature Sensor Circuit Intermittent High

Terminal and Connector inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to "Signal Circuit Inspection" procedure

Signal Circuit Inspection

■ Check voltage

- IG "OFF" and disconnect IATS connector.
- IG "ON"
- Measure voltage between signal terminal of IATS harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Go to "Check short to ground in harness" procedure.

Engine Control System

FL-643

■ Check short to ground in harness

1. IG "OFF" and disconnect IATS connector and ECM connector.
2. Measure resistance between signal terminal of IATS harness connector and chassis ground.(Measurement "A")
3. Measure resistance between signal and ground terminals of IATS harness connector.(Measurement "B")
4. Measure resistance between signal terminal of IATS harness connector and ground terminal of MAFS harness connector.(Measurement "B")

Specification : Infinite

5. Is the measured resistance within specification ?

YES ▶ Go to "Component inspection" procedure.

NO ▶ Repair short to ground in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check IATS resistance

1. IG "OFF" and disconnect IATS connector.
2. Measure resistance between signal and ground terminals of IATS connector after checking out the temperature of IATS with scantool (Component Side)

Specification :

Temp. (°C)	Resistance (kΩ)
-40	95.95 ~ 105.78
-20	27.4 ~ 29.77
0	9.08 ~ 9.72
10	5.49 ~ 5.83
20	3.42 ~ 3.61
40	1.43 ~ 1.5
60	0.66 ~ 0.69
80	0.33 ~ 0.34

3. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good IATS and check for proper operation. If the problem is corrected, replace IATS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

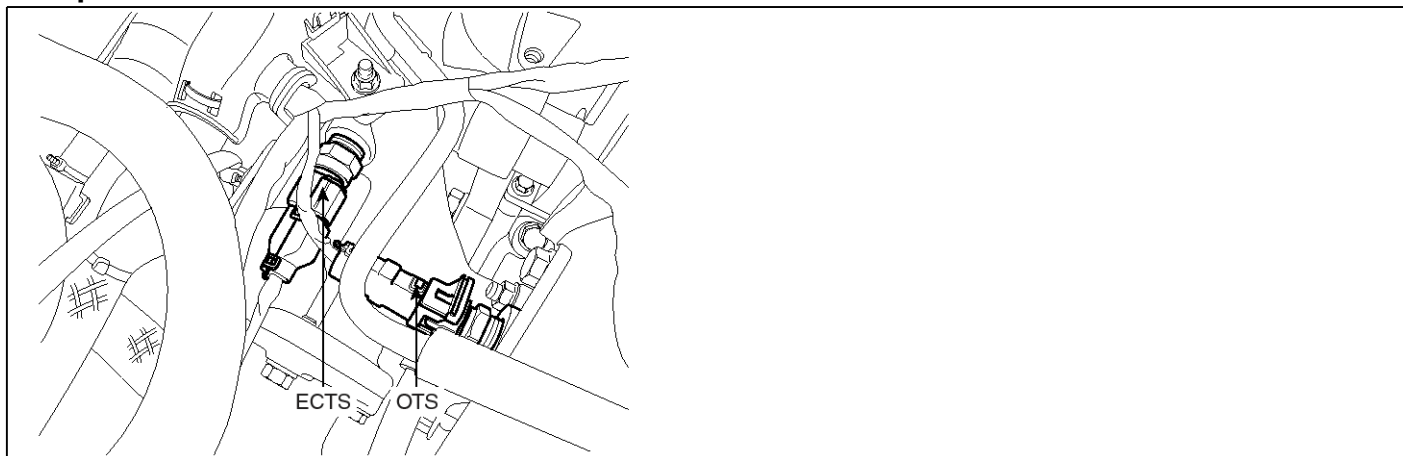
Refer to DTC P1111 : Intake Air Temperature Sensor Circuit Intermittent High

FL-644

Fuel System

P1114 Engine Coolant Temperature Sensor Circuit Intermittent low

Component Location



SBHFL9303L

General Description

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

DTC Description

Checking output signals from ECTS under detecting condition, if an output signal is intermittently below 0.1V, ECM sets P1114.

DTC Detecting Condition

Item		Detecting Condition	Possible cause
DTC Strategy		• Signal low	• Poor connection • Short to ground in harness • ECTS • ECM
Enable Conditions	Case 1	• Time after start-up > 120 sec.	
	Case 2	• Time from IG "OFF" to IG "ON" > 360 min. • Engine running state	
Threshold value		• Engine coolant temperature sensor's voltage < 0.1V	
Diagnosis Time		• Continuous (More than 40 seconds failure for every 80 second test)	
MIL On Condition		• NO MIL ON(DTC only)	

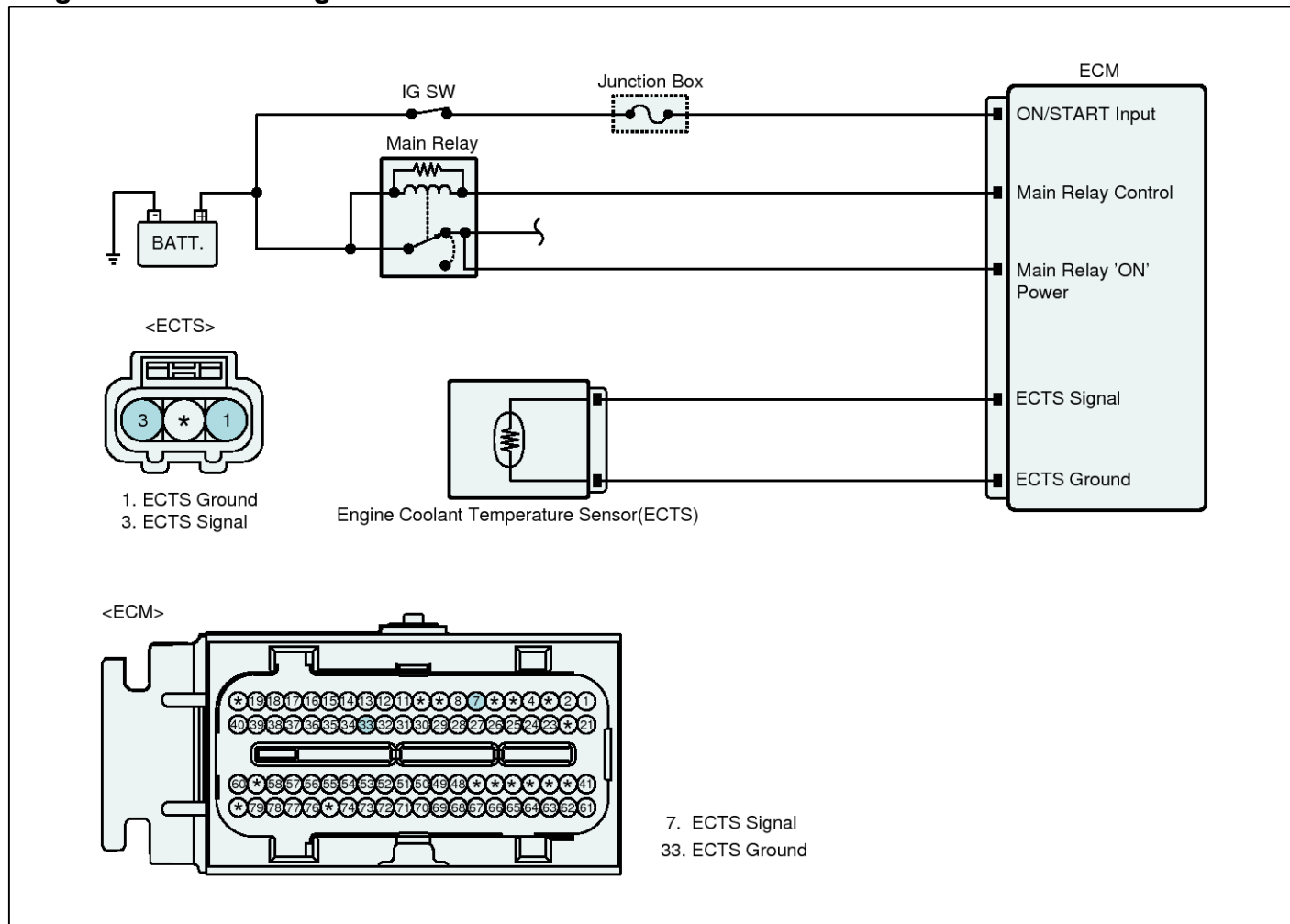
Engine Control System

FL-645

Specification

Temp. (°C)	Resistance (kΩ)	Temp. (°C)	Resistance (kΩ)
-40	48.14	40	1.15
-20	14.13 ~ 16.83	60	0.59
0	5.79	80	0.32
20	2.31 ~ 2.59	-	-

Diagnostic Circuit Diagram



SBHFL9515L

Signal Waveform & Data

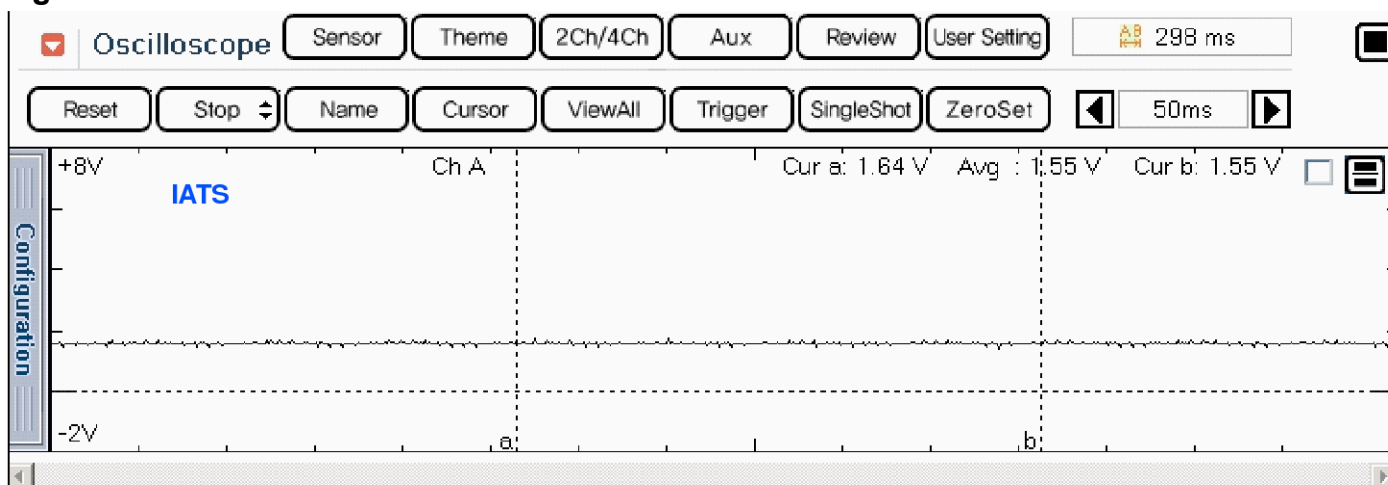


Fig.1

SBHFL9630L

Current Data		
Standard Display	Full List	Graph
Items List	Reset Min.Max.	Record
Stop	VSS	
Sensor Name	Value	Unit
☐ Engine Coolant Temperature Sensor	10.5	'C
☐ Intake Air Temperature Sensor	12.0	'C
☐ Oil Temperature Sensor	10.5	'C

Fig.2

SBHFL9631L

Sensor Name	Value	Unit
☒ Engine Speed	640	RPM
☒ Engine Coolant Temperature Sensor	90.8	'C
☒ Intake Air Temperature Sensor	27.8	'C
☒ Oil Temperature Sensor	88.5	'C

Fig.3

SBHFL9632L

Fig 1) Normal waveform of IATS at 43°C (109°F)

Fig 2) Normal data of IATS(53°F) & ECTS & EOTS at ig on

Fig 3) Normal data of IATS(82°F) & ECTS & EOTS after warming up.

The output signals of IATS & ECTS change smoothly without any rapid changes. Those have almost same characteristic signal during the early period after start. It means that the temperatures of intake air and engine coolant are depended on the temperature of atmosphere.

Meanwhile, during the warming up, the output signal of ECTS is going up increasingly. but, the output signal of IATS changes a little bit. even it may not change almost. It means that the heat of engine does not affect on the temperature of intake air. Meanwhile, during the warming up, the output signal of ECTS is going up increasingly. but, the output signal of IATS changes a little bit. even it may not change almost. It means that the heat of engine does not affect on the temperature of intake air.

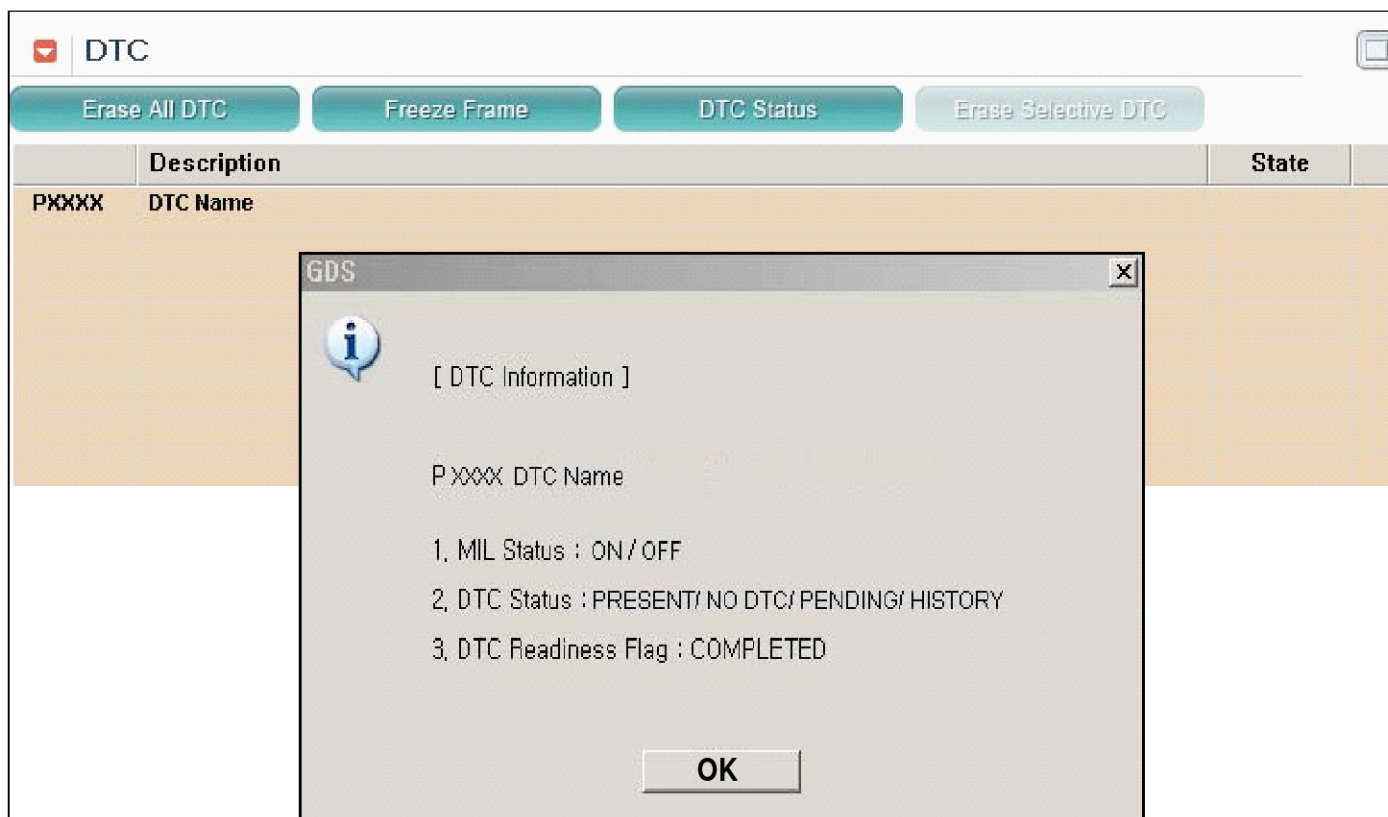
Engine Control System

FL-647

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to "Signal Circuit Inspection" procedure

Signal Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect ECTS connector.
2. IG "ON"
3. Measure voltage between signal terminal of ECTS harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ► Go to "Component Inspection" procedure.

NO ► Go to "Check short to ground in harness" as follows.

FL-648

Fuel System

■ Check short to ground in harness

1. IG "OFF" and disconnect ECTS connector and ECM connector.
2. Measure resistance between signal terminal of ECTS harness connector and chassis ground.(Measurement "A")
3. Measure resistance between signal and ground terminals of ECTS harness connector.(Measurement "B")

Specification : Infinite

4. Is the measured resistance within specification ?

YES ► Go to "Component inspection" procedure.

NO ► Repair short to ground in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check ECTS resistance

1. IG "OFF" and disconnect ECTS connector.
2. Measure resistance between signal and ground terminals of ECTS connector after checking out the temperature of ECTS with scantool (Component Side)

Specification :

Temp. (°C)	Resistance (kΩ)
-40	48.14
-20	14.13 ~ 16.83
0	5.79
20	2.31 ~ 2.59
40	1.15
60	0.59
80	0.32

3. Is the measured resistance within specification ?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Substitute with a known - good EOTS and check for proper operation. If the problem is corrected, replace EOTS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-649

P1115 Engine Coolant Temperature Sensor Circuit Intermittent high

Component Location

Refer to DTC P1114 : Engine Coolant Temperature Sensor Circuit Intermittent Low

General Description

Refer to DTC P1114 : Engine Coolant Temperature Sensor Circuit Intermittent Low

DTC Description

Checking output signals from ECTS under detecting condition, if an output signal is intermittently above 4.9V, ECM sets P1115.

DTC Detecting Condition

Item		Detecting Condition	Possible cause
DTC Strategy		• Open, Signal high	• Poor connection • Open or short to battery in signal harness • Open in ground harness • ECTS • ECM
Enable Conditions	Case 1	• Time after start-up > 120 sec.	
	Case 2	• Time from IG "OFF" to IG "ON" > 360 min. • Intake air temperature $\geq -10^{\circ}\text{C}$ (14°F) • Engine running state	
Threshold value		• Engine coolant temperature sensor's voltage > 4.9V	
Diagnosis Time		• Continuous (More than 10 sec. failure for every 20 sec. test)	
MIL On Condition		• NO MIL ON(DTC only)	

Specification

Refer to DTC P1114 : Engine Coolant Temperature Sensor Circuit Intermittent Low

Diagnostic Circuit Diagram

Refer to DTC P1114 : Engine Coolant Temperature Sensor Circuit Intermittent Low

Signal Waveform & Data

Refer to DTC P1114 : Engine Coolant Temperature Sensor Circuit Intermittent Low

Monitor Scantool Data

Refer to DTC P1114 : Engine Coolant Temperature Sensor Circuit Intermittent Low

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to "Signal Circuit Inspection" procedure

Signal Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect EOTS connector.
2. IG "ON"
3. Measure voltage between signal terminal of EOTS harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ► Go to "Ground Circuit Inspection" procedure.

NO ► If the voltage is 0V, go to "Check open in harness" as follows. If the voltage is more than 5.1V, repair short to battery in harness and go to "Verification of Vehicle Repair" procedure.

FL-650

Fuel System

■ Check open in harness

1. IG "OFF" and disconnect ECTS connector and ECM connector.
2. Measure resistance between signal terminal of ECTS harness connector and ECTS signal terminal of ECM harness connector.

Specification : Below 1Ω

3. Is the measured resistance within specification ?

YES ▶ Go to "Ground Circuit Inspection" procedure.

NO ▶ Repair open in harness and go to "Verification of Vehicle Repair" procedure.

Ground Circuit Inspection

■ Check open in harness

1. IG "OFF" and disconnect ECTS connector and then IG "ON".
2. Measure voltage between signal terminal of ECTS harness connector and chassis ground.(Measurement "A")
3. Measure voltage between signal and ground terminals of ECTS harness connector.(Measurement "B")

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

4. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair contact resistance or open in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check ECTS resistance

1. IG "OFF" and disconnect ECTS connector.
2. Measure resistance between signal and ground terminals of ECTS connector after checking out the temperature of ECTS with scantool (Component Side)

Specification :

Temp. (°C)	Resistance (kΩ)
-40	48.14
-20	14.13 ~ 16.83
0	5.79
20	2.31 ~ 2.59
40	1.15
60	0.59
80	0.32

3. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good EOTS and check for proper operation. If the problem is corrected, replace EOTS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P1114 : Engine Coolant Temperature Sensor Circuit Intermittent Low

Engine Control System

FL-651

P1295 Throttle Actuator Control System - Power Management

General Description

The Electronic Throttle Control(ETC) system is made of the components throttle body, Throttle Position Sensor(TPS)1&2 and Accelerator Position Sensor(APS) 1&2. The throttle body contains the actuator, the throttle plate and the throttle position sensor (potentiometer), which are integrated in one housing. The actuator consists of a DC motor with a two-stage gear. The opening angle of the throttle valve is detected by the throttle position sensor which is mounted on the throttle body. And it provides feedback to the ECM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC Description

If power management mode is recognized under detecting condition, ECM sets P1295. And MIL(Malfunction Indication Lamp) turns on.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	This code detects if the system is in Power Management Mode	- TPS Malfunction - TPS Malfunction + MAFSMalfunction - MAP Malfunction + TPS Malfunction - Faulty ECM
Enable Conditions	Ignition On	
Threshold value	Power Management Mode is active	
Diagnosis Time	-	
MIL On Condition	1 driving Cycle	

※ If Main relay has a fault(ex. Open) under engine running, the DTCs,P0638/P0685/P1295/P2106, can happen at the same time.

<DTC Name>

- P0638 Throttle Actuator Control Range/Performance (Bank 1)
- P0685 ECM/ECM Power Relay Control Circuit /Open
- P1295 Throttle Actuator Control System - Power Management
- P2106 Throttle Actuator Control System - Forced Limited Power

Monitor Scantool Data

1. Connect scantool to DLC(Data Link Connector)
2. IG "ON" & Monitor that any different DTC(Diagnostic Trouble Code) is existed.
(There will be at least one more DTC which causes this DTC P1295 to retrieve)
3. Repair the DTCs cause DTC P1295 first according to the designated trouble shooting guide.
(After repairing the DTCs cause DTC P1295, don't forget to do "ETC Initialization" as follows.)

4. Is the same DTC occurred ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

 NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off. (It will take 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

Engine Control System

FL-653

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

FL-654

Fuel System

P1501 Battery Temperature Too High Diagnostic

General Description

Many control units have applied to vehicle as it becomes more eletrolnical. These units control their own system based on information from diverse sensors. Therefore necessity of common use of diverse sensor information and importance of stable power supply are gathering strength. Battery sensor is mounted on battery (-) terminal. It transmits battery voltage, current, temperature information to ECM. ECM controls generating voltage by duty cycle based on these signals.

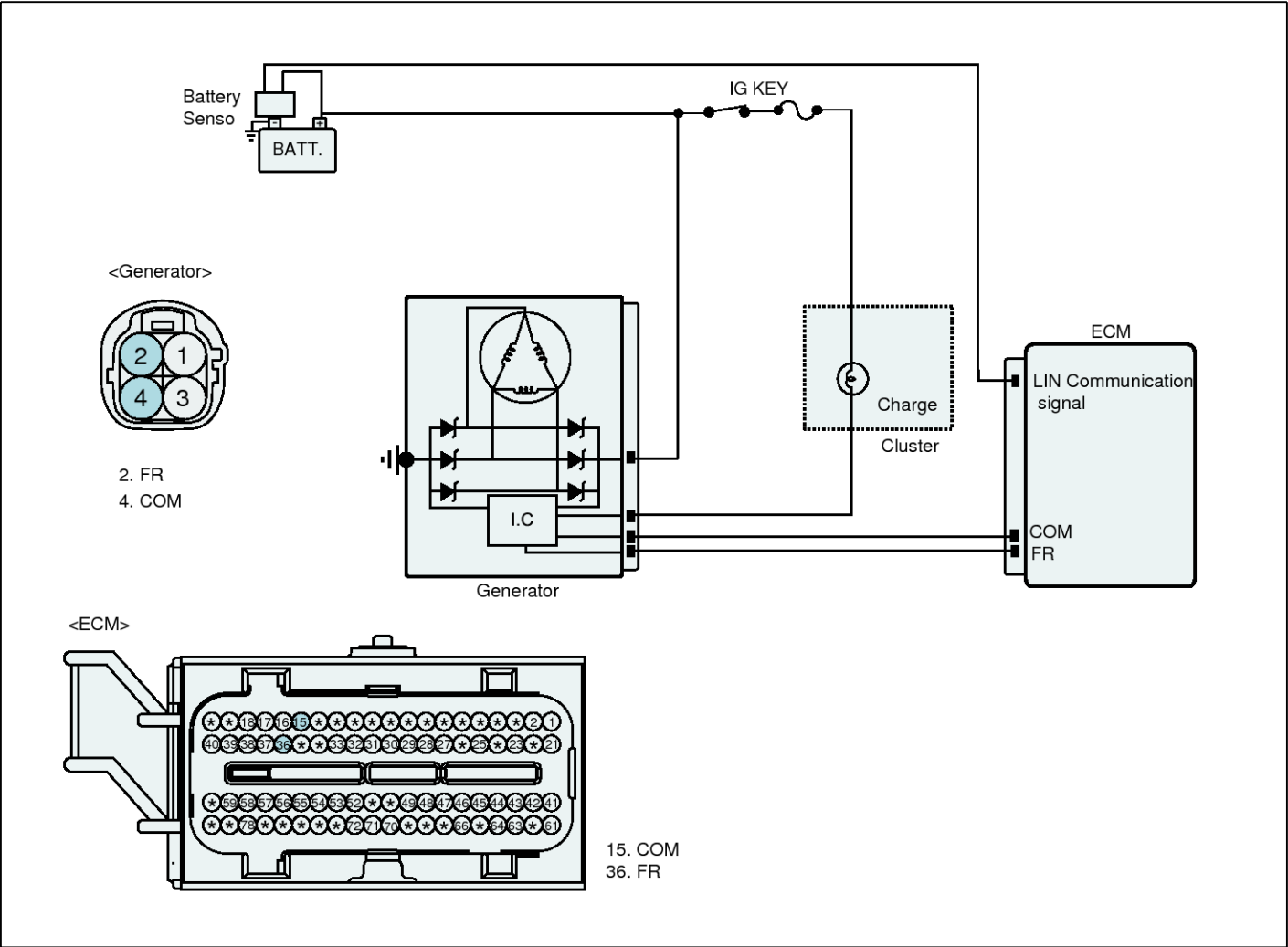
DTC Description

ECM sets this code when the battery temperature from battery sensor is too high.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Signal Monitoring	Battery temperature high
Enable Conditions	- Engine running state - No error related to LIN communication	
Threshold value	Battery temperature from battery sensor > 70℃	
Diagnosis Time	Continuous	
MIL On Condition	NO MIL ON(DTC only)	

Diagnostic Circuit Diagram



SBHFL9538L

Signal Waveform & Data

Current Data		
Standard Display	Full List	Graph
Items List	Reset Min.Max.	Record
Stop	VSS	
Sensor Name	Value	Unit
☒ Battery Positive Voltage	12.4	V
☒ Battery Sensor Current	-10.5	A
☒ Battery Sensor Temperature	10.5	°C
☒ Battery Sensor State of Charge	93	%

Fig.1

SBHFL9686L

FL-656

Fuel System

Sensor Name	Value	Unit
☒ Battery Positive Voltage	13.0	V
☒ Battery Sensor Current	0.0	A
☒ Battery Sensor Temperature	125.0	'C
☒ Battery Sensor State of Charge	86	%

Fig.2

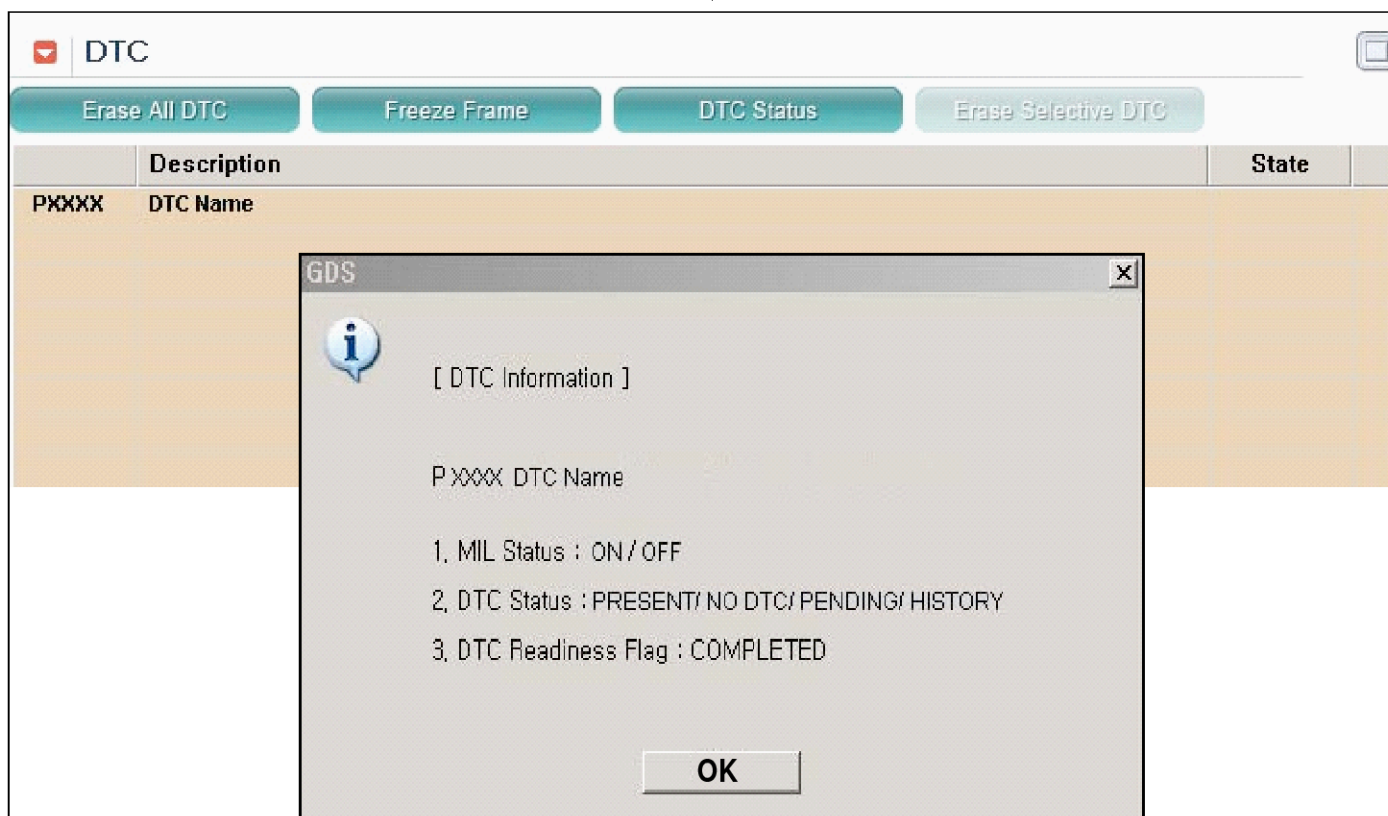
SBHFL9687L

Fig 1) Normal data of battery sensor temperature at 10.5°C (51°F)

Fig 2) Abnormal data of battery sensor temperature when battery sensor circuit open.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Engine Control System

FL-657

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Check for battery charging condition and visually check whether is there cause can make battery temperature increased, repair as necessary and go to "Verification of Vehicle Repair" procedure after cooling down the vehicle.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

FL-658

Fuel System

P1502 Battery Not Charging Diagnostic

General Description

Many control units have applied to vehicle as it becomes more eletrolnical. These units control their own system based on information from diverse sensors. Therefore necessity of common use of diverse sensor information and importance of stable power supply are gathering strength. Battery sensor is mounted on battery (-) terminal. It transmits battery voltage, current, temperature information to ECM. ECM controls generating voltage by duty cycle based on these signals.

DTC Description

ECM sets this code when the battery charging current from battery sensor is too low.

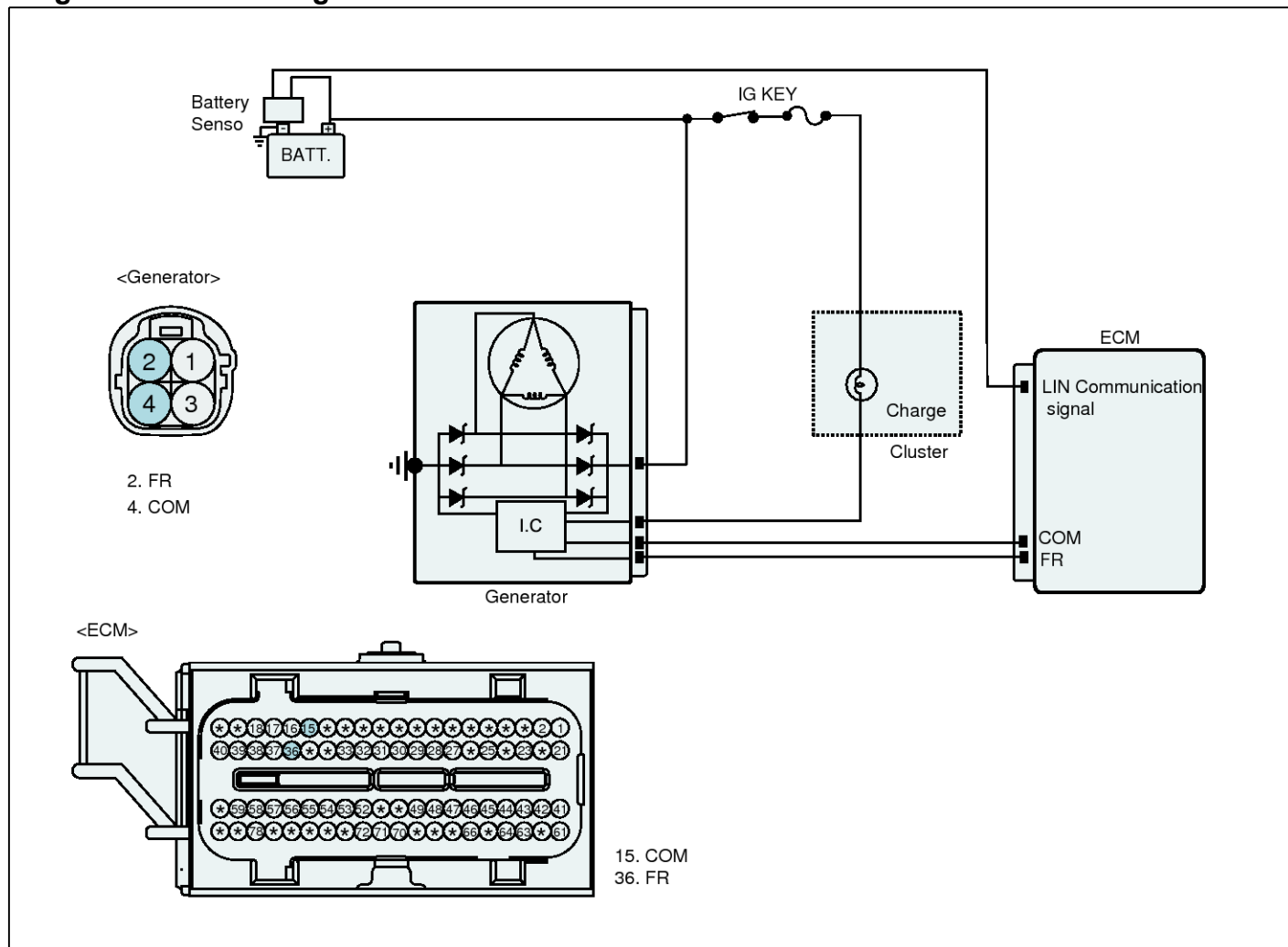
DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Signal Monitoring	- Poor connection - Open or short in charging system - Faulty charging system - Faulty ECM
Enable Conditions	- Engine running state - No error related to LIN communication	
Threshold value	Battery charging current < 10A	
Diagnosis Time	Continuous	
MIL On Condition	NO MIL ON(DTC only)	

Engine Control System

FL-659

Diagnostic Circuit Diagram



SBHFL9538L

Signal Waveform & Data

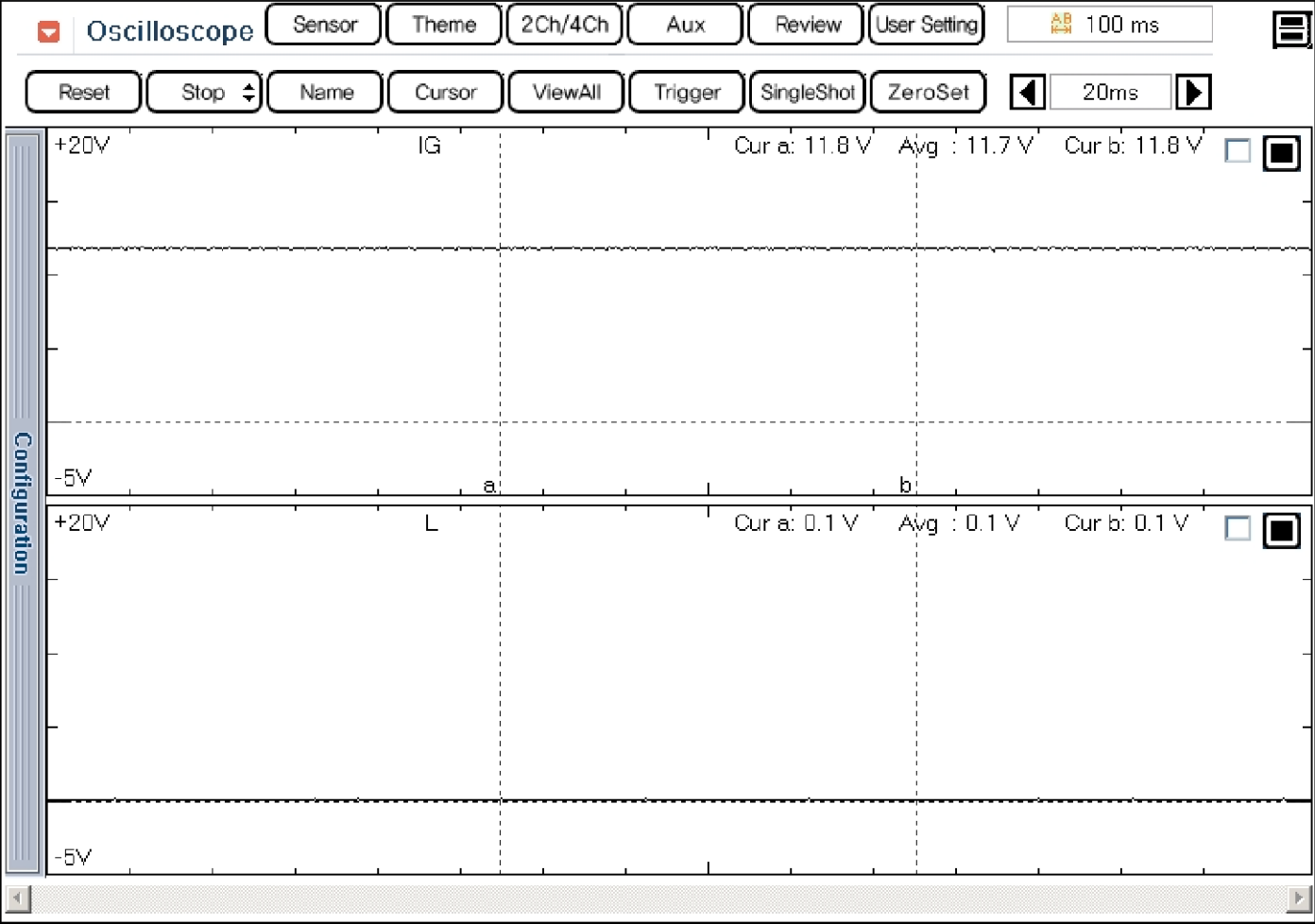


Fig.1

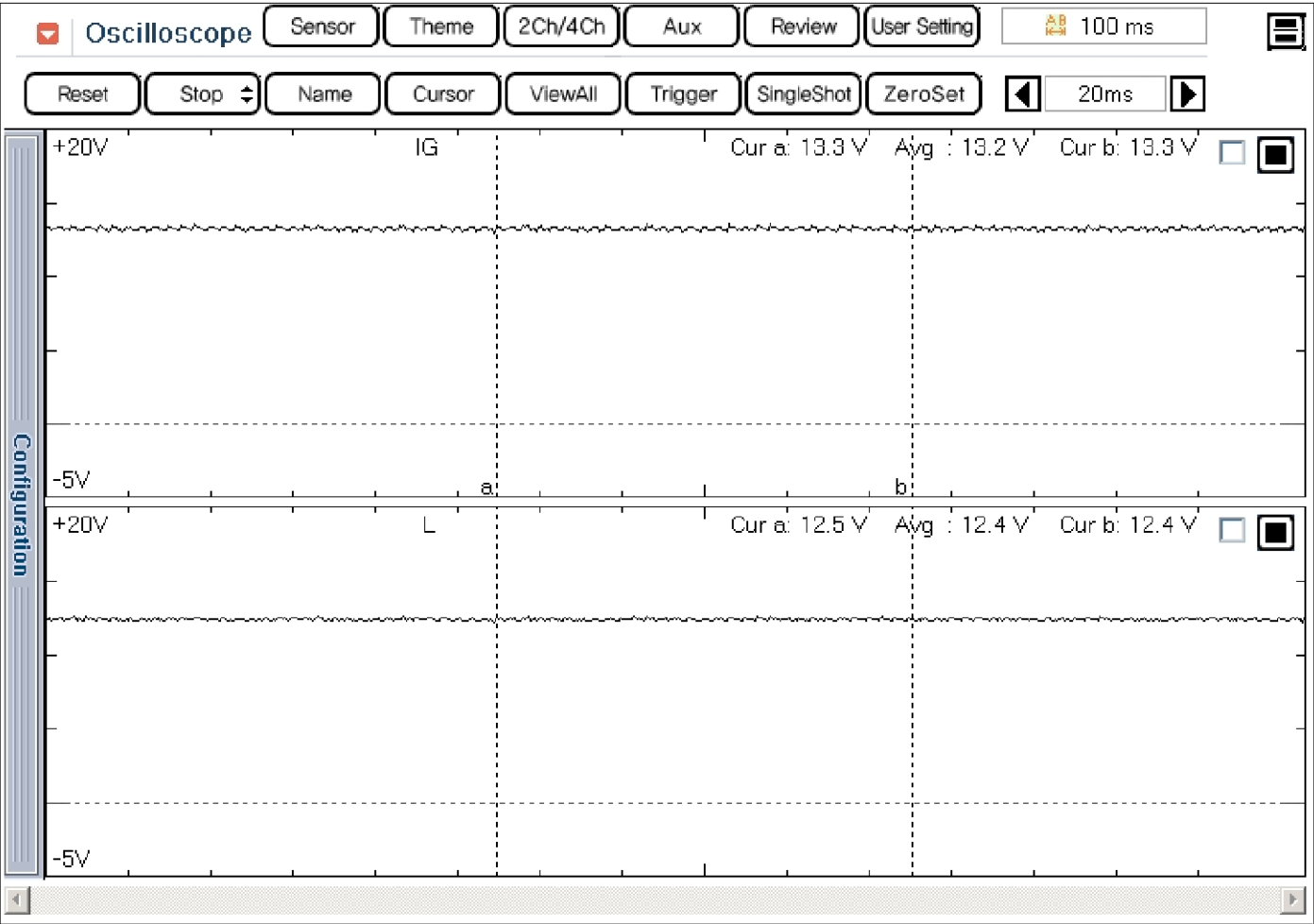


Fig.2

SBHFL9678L

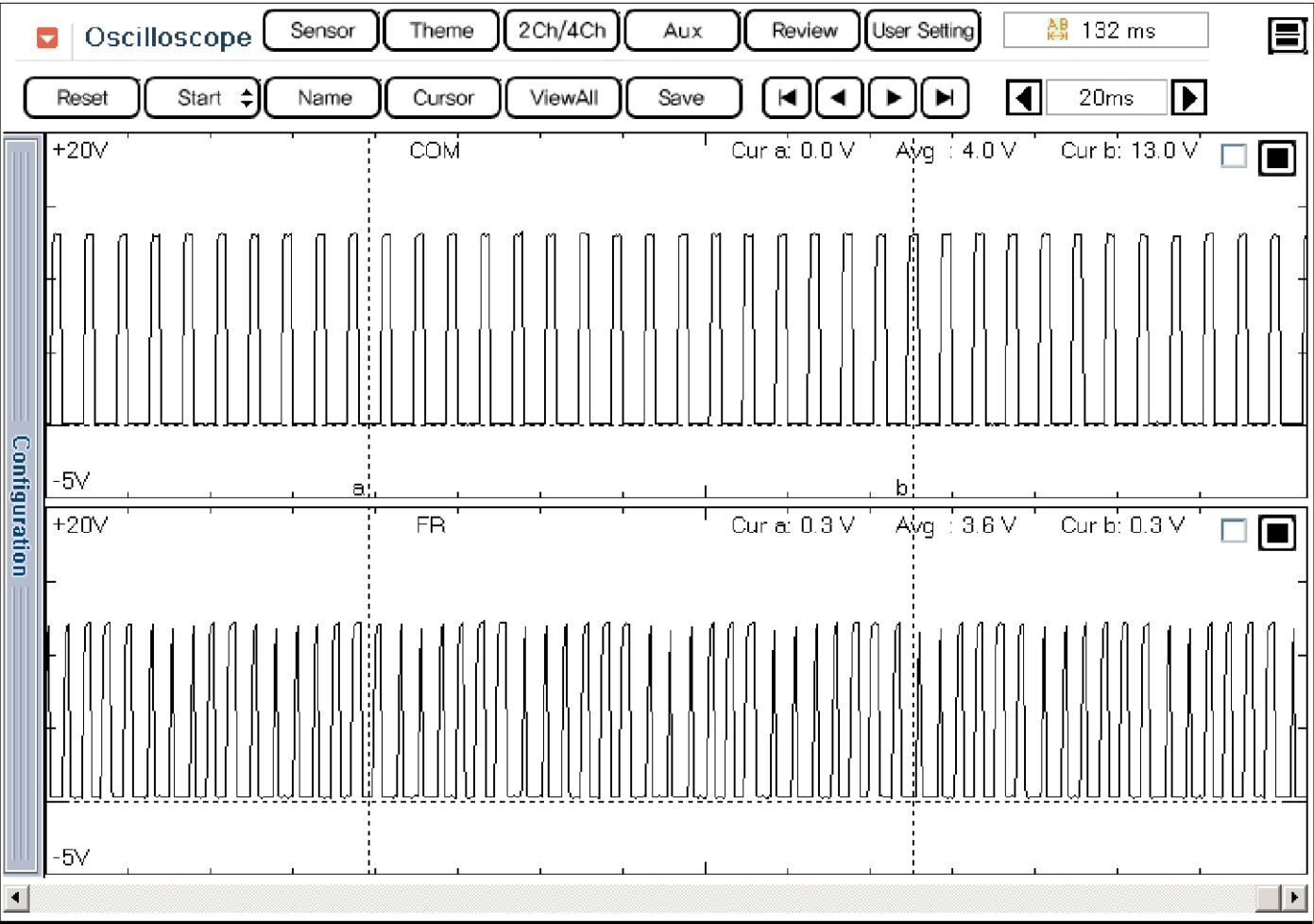


Fig.3

SBHFL9679L

Engine Control System

FL-663

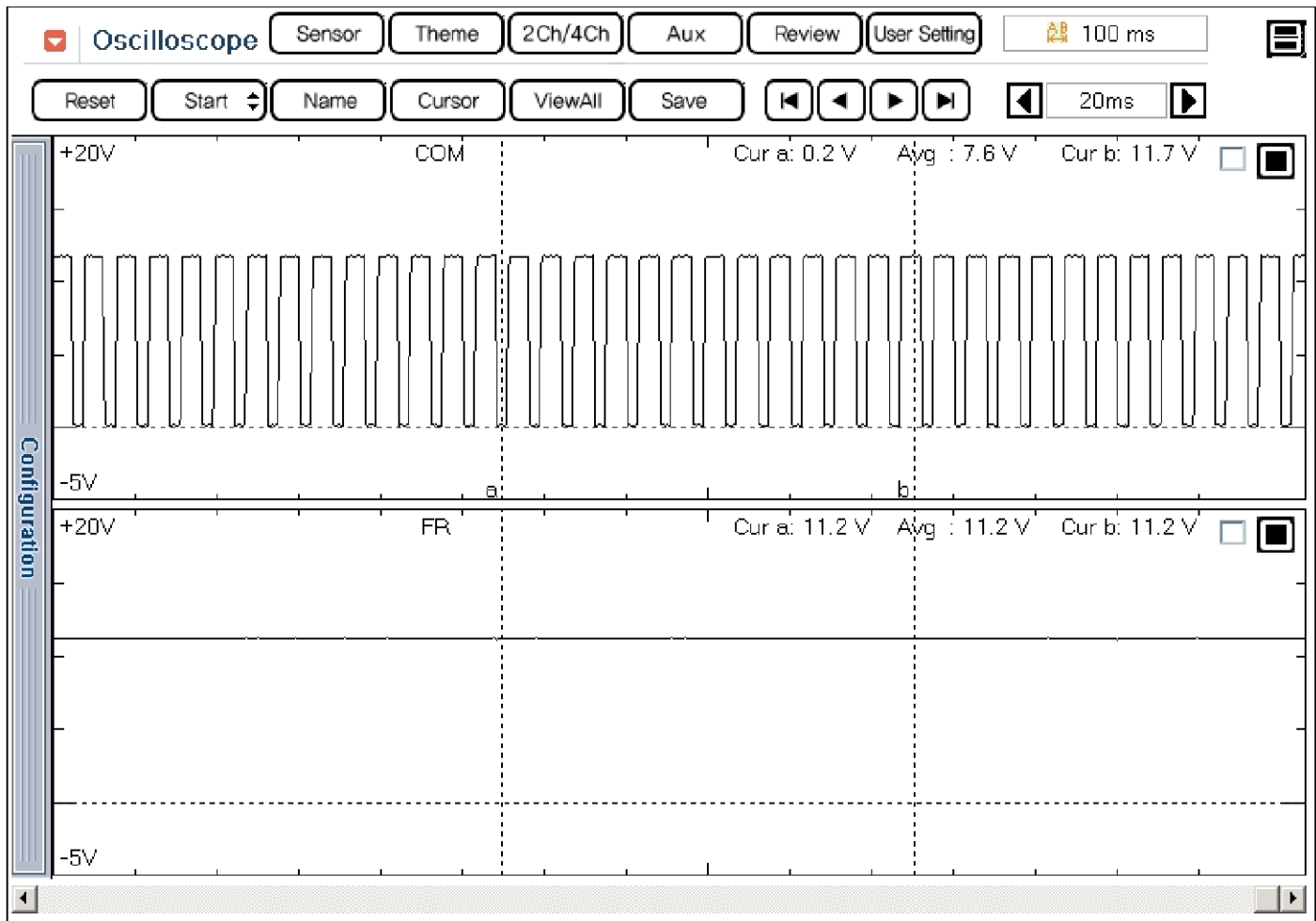


Fig.4

SBHFL9680L

Fig 1) Normal waveforms of IG, L terminal of alternator during charge warning lamp is ON

Fig 2) Normal waveforms of IG, L terminal of alternator during charge warning lamp is OFF

Fig 3) Normal waveforms of COM, FR terminal of alternator at idle

Fig 4) Normal waveforms of COM, FR terminal of alternator under connector disconnected condition

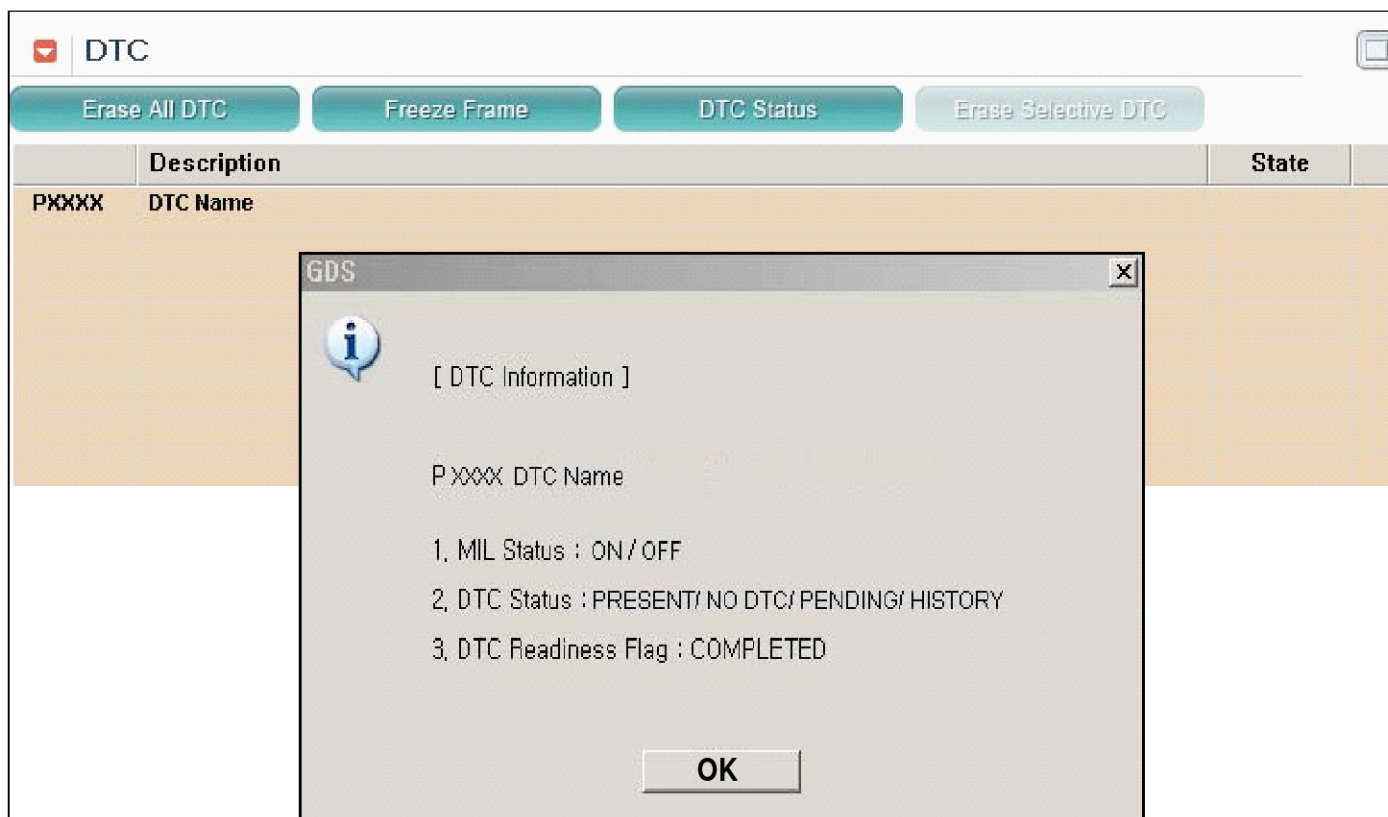
FL-664

Fuel System

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to "System Inspection" procedure.

System Inspection

■ Check Generator circuit

1. Engine starts.
2. Maintain ENG RPM 2,500RPM over 2 minutes.
3. Measure voltage between the battery terminal(+) and the battery terminal(-).

Specification : Approx. 12.5 ~ 14.7V

Engine Control System

FL-665

4. Is the measured voltage within specification?

YES ► Check for Battery State, repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO ► Check that the tension of drive belt, ENG RPM, fuse, terminal of battery, all terminals of generator are in good condition and Check for damaged harness and poor connection between generator and battery. If OK repair or replace generator and then go to "Verification of vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

FL-666

Fuel System

P1523 Throttle Actuator Control System - Throttle Valve Stuck

Component Location



SBHFL9302L

General Description

The Electronic Throttle Control(ETC) system is made of the components throttle body, Throttle Position Sensor(TPS)1&2 and Accelerator Position Sensor(APS) 1&2. The throttle body contains the actuator, the throttle plate and the throttle position sensor (potentiometer), which are integrated in one housing. The actuator consists of a DC motor with a two-stage gear. The opening angle of the throttle valve is detected by the throttle position sensor which is mounted on the throttle body. And it provides feedback to the ECM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC Description

Checking throttle valve return state under detecting condition, if an output signal is within the threshold value for more than designated time, ECM sets P1523.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor throttle valve return state	- Carbon in throttle - Broken Throttle return spring - throttle sticky - throttle icy
Enable Conditions	- ETC Power Control Mode - TPS 1 & 2 = normal - Sensor Supply voltage = Normal	
Threshold value	The throttle did not return to default range within 1 to 4 seconds of turning off. That is, (TPS1's signal > 0.9V AND TPS1's signal < 1.85V) or (TPS2's signal < 1.85 V AND TPS2's signal > 0.9V) when the power to the ETC motor is turned off.	
Diagnosis Time	Continuous	
MIL On Condition	DTC only (NO MIL ON)	

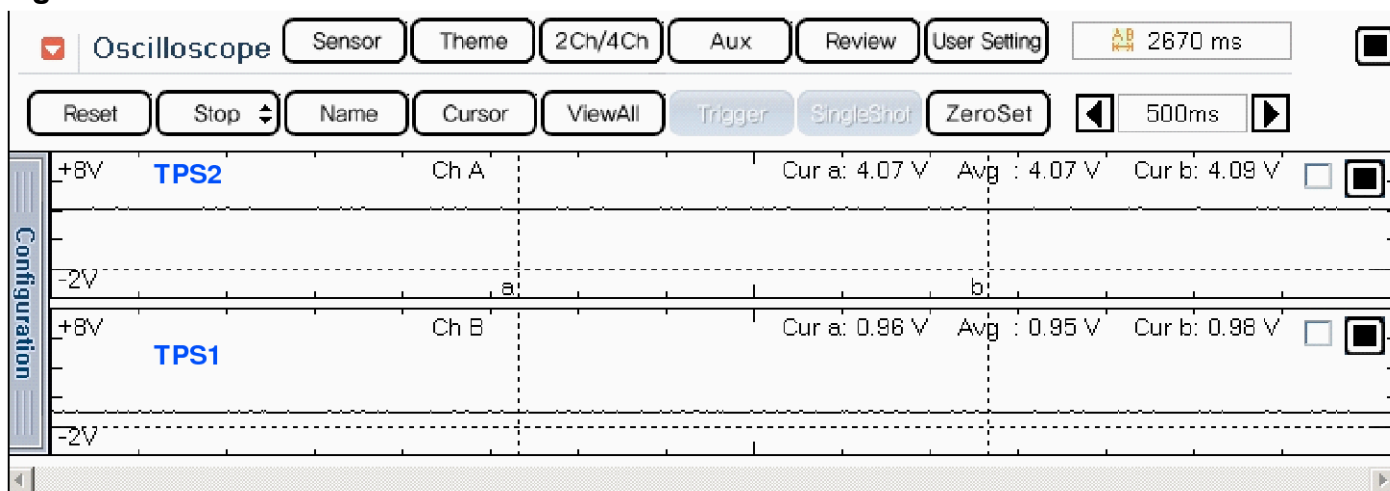
Engine Control System

FL-667

Specification

Throttle Opening (°)	Output Voltage (V) [Vref=5.0]	
	TPS1	TPS2
0°	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	0.0V

Signal Waveform & Data



SBHFL9634L

FL-668

Fuel System

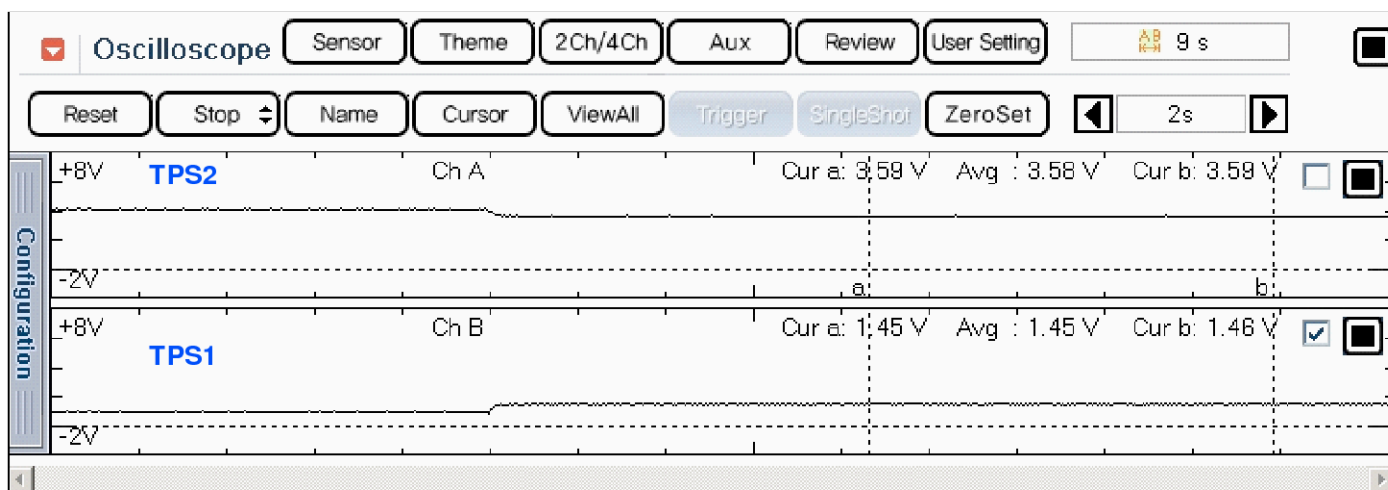


Fig.2

SBHFL9635L

Sensor Name	Value	Unit
☒ ETC Throttle Position	4.1	DEG
☒ Throttle Position1 Duty	5.1	DEG
☒ Throttle Position2 Duty	5.2	DEG
☒ Throttle Position1 Voltage	0.7	V
☒ Throttle Position2 Voltage	4.3	V
☒ ETC Motor Duty	-12	%

Fig.3

SBHFL9636L

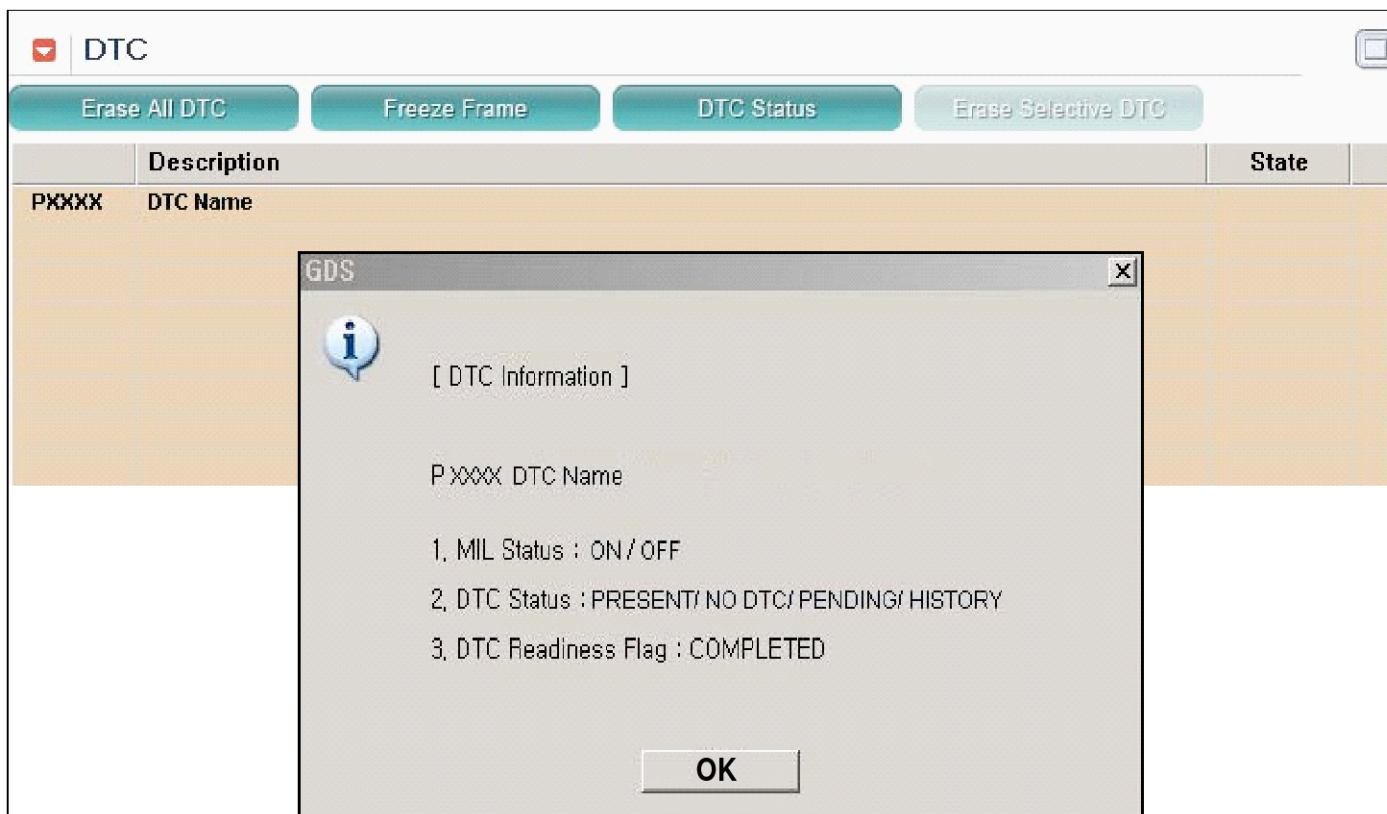
Fig 1) Normal waveform of TPS1 & TPS2 with no accel pedal depressed under IG ON condition

Fig 2) Normal waveform of TPS1 & TPS2 with accel pedal depressed under IG ON condition

Fig 3) Normal data of TPS1 & TPS2 under IG ON condition

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu..
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ▶ Go to "System Inspection" procedure.

NO ▶ Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

System Inspection

■ Visual Inspection

1. IG "OFF".
2. Check throttle valve after removing air duct.
 - ▶ Carbon deposit.
 - ▶ Throttle icy
 - ▶ Broken return spring.
 - ▶ Throttle sticky

3. Is the throttle valve return O.K ?

YES ▶ Thoroughly check that something interferes throttle movement and perform ETS Initialization as follows and then, go to "Verification of Vehicle Repair" procedure.

NO ▶ Repair or replace as necessary and then, do ETS Initialization as follows. then, go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will take 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-671

P2096 Post Catalyst Fuel Trim System too Lean (Bank 1)

Component Location



SBHFL9330L

General Description

In order to provide the best possible combination of drivability, fuel economy and emission control, the ECM uses a closed loop air/fuel metering system. The ECM monitors the HO₂S signal voltage and adjusts fuel delivery based on it in closed loop fuel control. Changes in fuel delivery will be indicated by the long-term and the short-term fuel trim values. The ideal fuel trim value is around 0%. The ECM will add fuel when the HO₂S signal is indicating a lean condition. Additional fuel is indicated by fuel trim values that are above 0%. The ECM will reduce fuel when the HO₂S signal is indicating a rich condition. Reduction in fuel is indicated by fuel trim values that are below 0%. The DTC relevant to fuel trim will be set when the amount reaches excessive levels because of a lean or rich condition.

DTC Description

If the lambda controller reaches the maximum or minimum threshold, then feedback control is no longer possible and emissions will be increased. The ECM sets DTC P2096 if no proportional post catalyst fuel trim adaptation occurs for a defined time after the lambda controller has reached its maximum threshold.

FL-672

Fuel System

DTC Detecting Condition

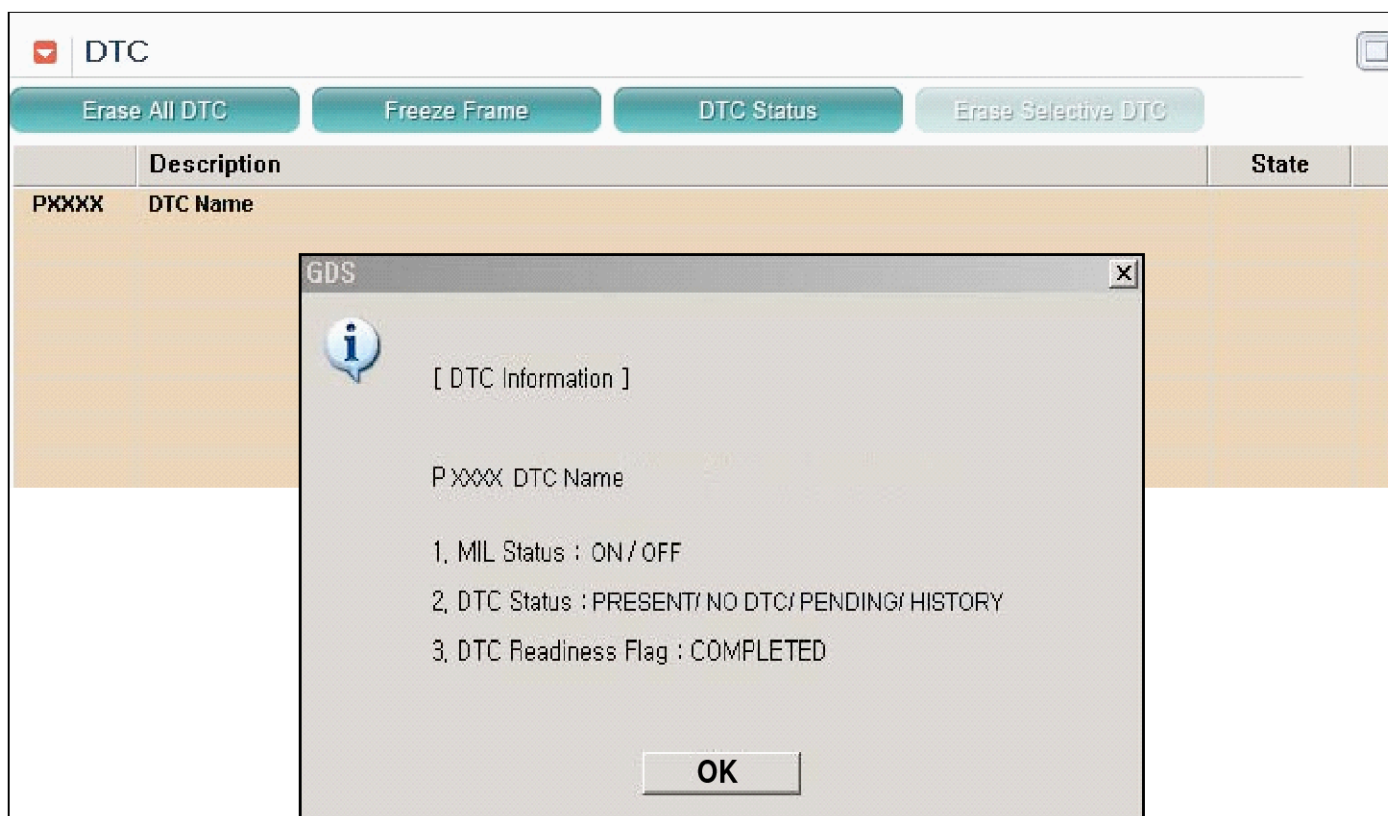
Item	Detecting Condition	Possible cause
DTC Strategy	Fuel Trim Rear Sensor Control Limits Exceeded	- Air leakage in exhaust System - HO2S - TWC
Enable Conditions	- Cell Enabled - Barometric Pressure ≥ 74 kPa - Intake Air Temperature ≥ -10 °C - System Voltage ≥ 10.9936 V - Closed Loop Active - BLM learn Allowed - Disabling Fault not present	
Threshold value	- Front O2 Sensor switch point ≥ 0.6V - Rear O2 Sensor Voltage < 0.25V	
Diagnosis Time	Fail count > 60 within 80 samples 250ms continuous loop	
MIL On Condition	2 Driving Cycles	

Monitor Scantool Data

NOTICE

If any codes relating to Rear HO2S or TWC(ThreeWay Catalyst Converter) are stored, do ALL REPAIRS associated with those codes before proceeding with this troubleshooting tree.

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu..
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check Exhaust system

1. Visually/physically inspect the following conditions:
 - ▶ Exhaust system between HO2S and Three way catalyst for air leakage, restriction and damage.
 - ▶ Damage, and for loose or missing hardware
2. Was a problem found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure

NO ▶ Go to next step as below

■ Check TWC

1. Visually/physically inspect the three-way catalyst(TWC) converter for the following damage:
 - ▶ Severe discoloration caused by excessive temperature
 - ▶ Dents and holes
 - ▶ Internal rattle caused by a damaged catalyst
2. Also, ensure that the TWC is a proper original equipment manufacturer part.
3. Was a problem found in any of the above areas?

YES ▶ Replace TWC and go to "Verification of Vehicle Repair" procedure

NO ▶ Go to next step as below

■ Check HO2S

1. Visually/physically inspect the HO2S for the following conditions:
 - ▶ Ensure that the HO2S is securely installed.(Pigtail and wiring harness not making contact with the exhaust pipe)
 - ▶ Check for corrosion on terminals and terminal tension (at the HO2S and at the ECM)

FL-674

Fuel System

- ▶ Front HO2S for silicon contamination. This contamination will be indicated by a white powdery coating on the portion of the sensor exposed to the exhaust stream and this will result in a but false(high) voltage signal
 - ▶ Fuel, engine coolant or oil contamination
 - ▶ Use of improper sealant
 - ▶ If contamination is evident on the HO2S, Fix the source of the sensor contamination before replacing the sensor to prevent future contamination. Go to "Verification of Vehicle Repair" procedure.
2. Warm up the engine to normal operating temperature and let it idle.
 3. Connect Scantool and monitor the "O2 SNSR VOL.-B1/S1" and "O2 SNSR VOL.-B1/S2" parameters on the Scantool data list.

Specification : - Front HO2S(O2 SNSR VOL.-B1/S1) :
Approx. 0~1V with idle after warm up

Sensor voltage increase during engine acceleration and decrease during engine deceleration

Approx. 0V ~ 0.4 V when fuel cut

- Rear HO2S(O2 SNSR VOL.-B1/S2) : Above 0.4V at idle

4. Was a problem found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure

NO ▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-675

P2097 Post Catalyst Fuel Trim System too Rich (Bank 1)

Component Location

Refer to DTC P2096 : Post Catalyst Fuel Trim System Too Lean (Bank 1)

General Description

Refer to DTC P2096 : Post Catalyst Fuel Trim System Too Lean (Bank 1)

DTC Description

If the lambda controller reaches the maximum or minimum threshold, then feedback control is no longer possible and emissions will be increased. The ECM sets DTC P2097 if no proportional post catalyst fuel trim adaptation occurs for a defined time after the lambda controller has reached its minimum threshold.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Fuel Trim Rear Sensor Control Limits Exceeded	- Air leakage in exhaust System - HO2S - TWC
Enable Conditions	- Cell Enabled - Barometric Pressure ≥ 74 kPa - Intake Air Temperature ≥ -10 °C - System Voltage ≥ 10.9936 V - Closed Loop Active - BLM learn Allowed - Disabling Fault not present	
Threshold value	- Front O2 Sensor switch point ≤ 0.4V - Rear O2 Sensor Voltage > 0.82V	
Diagnosis Time	Fail count > 30 within 80 samples 250ms continuous loop	
MIL On Condition	2 Driving Cycles	

Monitor Scantool Data

Refer to DTC P2096 : Post Catalyst Fuel Trim System Too Lean (Bank 1)

Component Inspection

■ Check Exhaust system

1. Visually/physically inspect the following conditions:
 - ▶ Exhaust system between HO2S and Three way catalyst for air leakage, restriction and damage.
 - ▶ Damage, and for loose or missing hardware

2. Was a problem found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure

NO ▶ Go to next step as below

■ Check TWC

1. Visually/physically inspect the three-way catalyst(TWC) converter for the following damage:
 - ▶ Severe discoloration caused by excessive temperature

▶ Dents and holes

▶ Internal rattle caused by a damaged catalyst

2. Also, ensure that the TWC is a proper original equipment manufacturer part.

3. Was a problem found in any of the above areas?

YES ▶ Replace TWC and go to "Verification of Vehicle Repair" procedure

NO ▶ Go to next step as below

■ Check HO2S

1. Visually/physically inspect the HO2S for the following conditions:

▶ Ensure that the HO2S is securely installed.(Pigtail and wiring harness not making contact with the exhaust pipe)

▶ Check for corrosion on terminals and terminal tension (at the HO2S and at the ECM)

FL-676

Fuel System

► Front HO2S for silicon contamination. This contamination will be indicated by a white powdery coating on the portion of the sensor exposed to the exhaust stream and this will result in a but false(high) voltage signal

► Fuel, engine coolant or oil contamination

► Use of improper sealant

► If contamination is evident on the HO2S, Fix the source of the sensor contamination before replacing the sensor to prevent future contamination. Go to "Verification of Vehicle Repair" procedure.

2. Warm up the engine to normal operating temperature and let it idle.

3. Connect Scantool and monitor the "O2 SNSR VOL.-B1/S1" and "O2 SNSR VOL.-B1/S2" parameters on the Scantool data list.

Specification : - Front HO2S(O2 SNSR VOL.-B1/S1) :
Approx. 0~1V with idle after warm up

Sensor voltage increase during engine acceleration and decrease during engine deceleration

Approx. 0V ~ 0.4 V when fuel cut

- Rear HO2S(O2 SNSR VOL.-B1/S2) : Above 0.4V at idle

4. Was a problem found in any of the above areas?

YES ► Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

Verification of Vehicle Repair

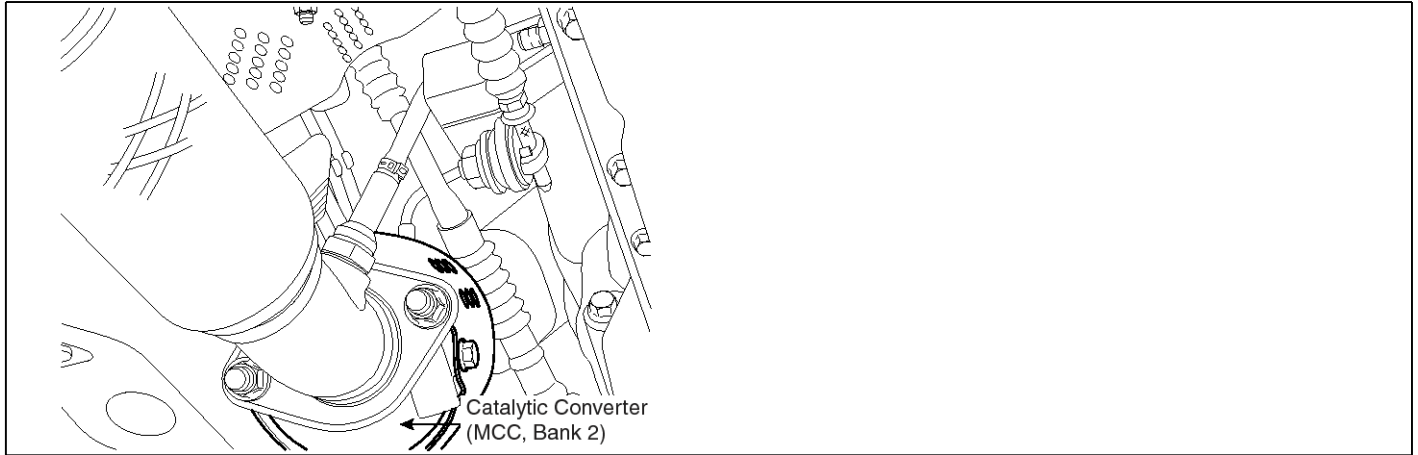
Refer to DTC P2096 : Post Catalyst Fuel Trim System Too Lean (Bank 1)

Engine Control System

FL-677

P2098 Post Catalyst Fuel Trim System Too Lean (Bank 2)

Component Location



SBHFL9331L

General Description

In order to provide the best possible combination of drivability, fuel economy and emission control, the ECM uses a closed loop air/fuel metering system. The ECM monitors the HO₂S signal voltage and adjusts fuel delivery based on it in closed loop fuel control. Changes in fuel delivery will be indicated by the long-term and the short-term fuel trim values. The ideal fuel trim value is around 0%. The ECM will add fuel when the HO₂S signal is indicating a lean condition. Additional fuel is indicated by fuel trim values that are above 0%. The ECM will reduce fuel when the HO₂S signal is indicating a rich condition. Reduction in fuel is indicated by fuel trim values that are below 0%. The DTC relevant to fuel trim will be set when the amount reaches excessive levels because of a lean or rich condition.

DTC Description

If the lambda controller reaches the maximum or minimum threshold, then feedback control is no longer possible and emissions will be increased. The ECM sets DTC P2098 if no proportional post catalyst fuel trim adaptation occurs for a defined time after the lambda controller has reached its maximum threshold.

FL-678

Fuel System

DTC Detecting Condition

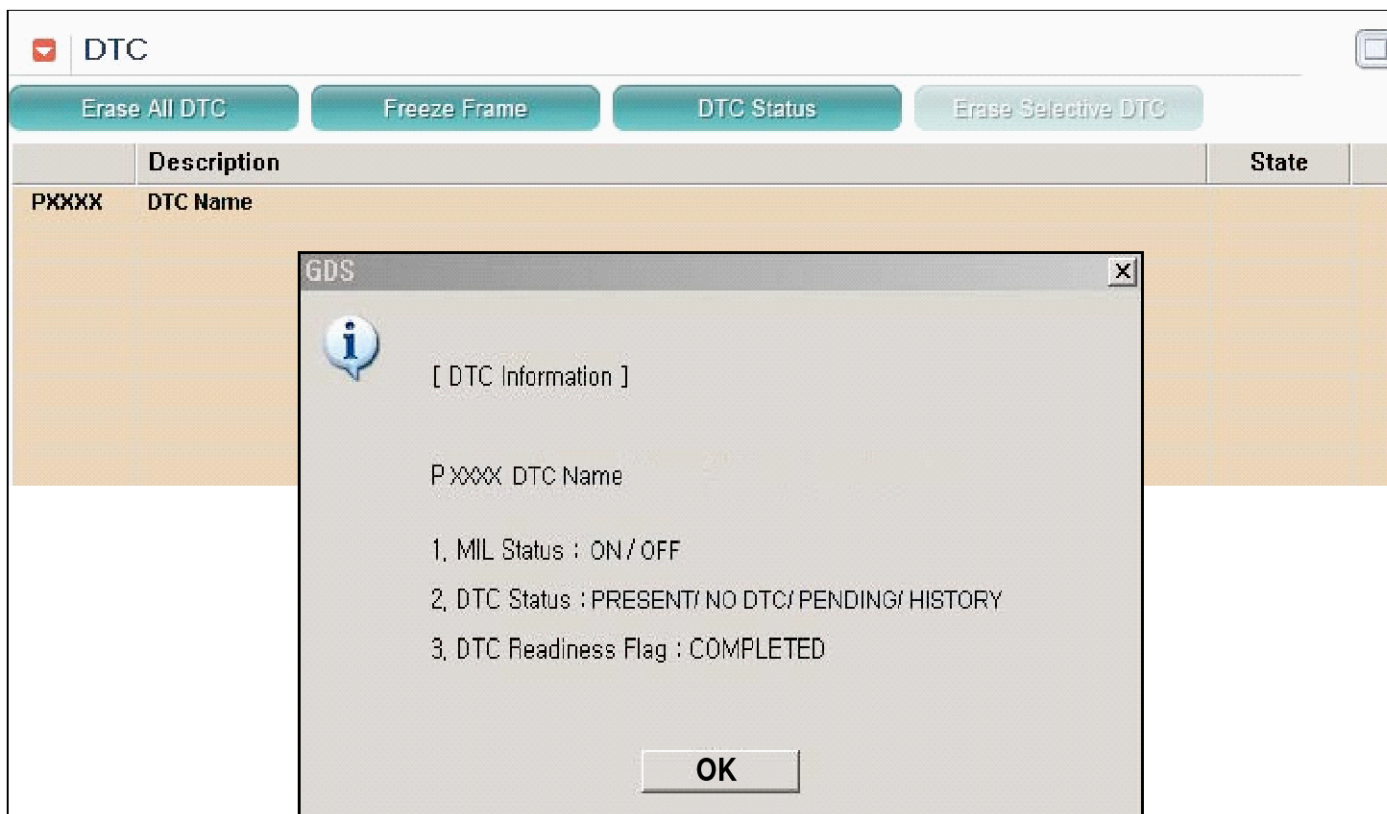
Item	Detecting Condition	Possible cause
DTC Strategy	Fuel Trim Rear Sensor Control Limits Exceeded	- Air leakage in exhaust System - HO2S - TWC
Enable Conditions	- Cell Enabled - Barometric Pressure ≥ 74 kPa - Intake Air Temperature ≥ -10 °C - System Voltage ≥ 10.9936 V - Closed Loop Active - BLM learn Allowed - Disabling Fault not present	
Threshold value	- Front O2 Sensor switch point ≥ 0.6V - Rear O2 Sensor Voltage < 0.25V	
Diagnosis Time	Fail count > 30 within 80 samples 250ms continuous loop	
MIL On Condition	2 Driving Cycles	

Monitor Scantool Data

NOTICE

If any codes relating to Rear HO2S or TWC(ThreeWay Catalyst Converter) are stored, do ALL REPAIRS associated with those codes before proceeding with this troubleshooting tree.

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu..
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check Exhaust system

1. Visually/physically inspect the following conditions:
 - ▶ Exhaust system between HO2S and Three way catalyst for air leakage, restriction and damage.
 - ▶ Damage, and for loose or missing hardware
2. Was a problem found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure

NO ▶ Go to next step as below

■ Check TWC

1. Visually/physically inspect the three-way catalyst(TWC) converter for the following damage:
 - ▶ Severe discoloration caused by excessive temperature
 - ▶ Dents and holes
 - ▶ Internal rattle caused by a damaged catalyst
2. Also, ensure that the TWC is a proper original equipment manufacturer part.
3. Was a problem found in any of the above areas?

YES ▶ Replace TWC and go to "Verification of Vehicle Repair" procedure

NO ▶ Go to next step as below

■ Check HO2S

1. Visually/physically inspect the HO2S for the following conditions:
 - ▶ Ensure that the HO2S is securely installed.(Pigtail and wiring harness not making contact with the exhaust pipe)
 - ▶ Check for corrosion on terminals and terminal tension (at the HO2S and at the ECM)

FL-680

Fuel System

- ▶ Front HO2S for silicon contamination. This contamination will be indicated by a white powdery coating on the portion of the sensor exposed to the exhaust stream and this will result in a but false(high) voltage signal
 - ▶ Fuel, engine coolant or oil contamination
 - ▶ Use of improper sealant
 - ▶ If contamination is evident on the HO2S, Fix the source of the sensor contamination before replacing the sensor to prevent future contamination. Go to "Verification of Vehicle Repair" procedure.
2. Warm up the engine to normal operating temperature and let it idle.
 3. Connect Scantool and monitor the "O2 SNSR VOL.-B1/S1" and "O2 SNSR VOL.-B1/S2" parameters on the Scantool data list.

Specification : - Front HO2S(O2 SNSR VOL.-B1/S1) :
Approx. 0~1V with idle after warm up

Sensor voltage increase during engine acceleration and decrease during engine deceleration

Approx. 0V ~ 0.4 V when fuel cut

- Rear HO2S(O2 SNSR VOL.-B1/S2) : Above 0.4V at idle

4. Was a problem found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure

NO ▶ Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-681

P2099 Post Catalyst Fuel Trim System Too Rich (Bank 2)

Component Location

Refer to DTC P2098 : Post Catalyst Fuel Trim System Too Lean (Bank 2)

General Description

Refer to DTC P2098 : Post Catalyst Fuel Trim System Too Lean (Bank 2)

DTC Description

If the lambda controller reaches the maximum or minimum threshold, then feedback control is no longer possible and emissions will be increased. The ECM sets DTC P2099 if no proportional post catalyst fuel trim adaptation occurs for a defined time after the lambda controller has reached its minimum threshold.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Fuel Trim Rear Sensor Control Limits Exceeded	- Air leakage in exhaust System - HO2S - TWC
Enable Conditions	- Cell Enabled - Barometric Pressure ≥ 74 kPa - Intake Air Temperature ≥ -10 °C - System Voltage ≥ 10.9936 V - Closed Loop Active - BLM learn Allowed - Disabling Fault not present	
Threshold value	- Front O2 Sensor switch point ≤ 0.4V - Rear O2 Sensor Voltage > 0.82V	
Diagnosis Time	Fail count > 30 within 80 samples 250ms continuous loop	
MIL On Condition	2 Driving Cycles	

Monitor Scantool Data

Refer to DTC P2098 : Post Catalyst Fuel Trim System Too Lean (Bank 2)

Component Inspection

■ Check Exhaust system

1. Visually/physically inspect the following conditions:
 - ▶ Exhaust system between HO2S and Three way catalyst for air leakage, restriction and damage.
 - ▶ Damage, and for loose or missing hardware
2. Was a problem found in any of the above areas?

YES ▶ Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure

NO ▶ Go to next step as below

■ Check TWC

1. Visually/physically inspect the three-way catalyst(TWC) converter for the following damage:
 - ▶ Severe discoloration caused by excessive temperature

▶ Dents and holes

▶ Internal rattle caused by a damaged catalyst

2. Also, ensure that the TWC is a proper original equipment manufacturer part.

3. Was a problem found in any of the above areas?

YES ▶ Replace TWC and go to "Verification of Vehicle Repair" procedure

NO ▶ Go to next step as below

■ Check HO2S

1. Visually/physically inspect the HO2S for the following conditions:
 - ▶ Ensure that the HO2S is securely installed.(Pigtail and wiring harness not making contact with the exhaust pipe)
 - ▶ Check for corrosion on terminals and terminal tension (at the HO2S and at the ECM)

FL-682

Fuel System

► Front HO2S for silicon contamination. This contamination will be indicated by a white powdery coating on the portion of the sensor exposed to the exhaust stream and this will result in a but false(high) voltage signal

► Fuel, engine coolant or oil contamination

► Use of improper sealant

► If contamination is evident on the HO2S, Fix the source of the sensor contamination before replacing the sensor to prevent future contamination. Go to "Verification of Vehicle Repair" procedure.

2. Warm up the engine to normal operating temperature and let it idle.

3. Connect Scantool and monitor the "O2 SNSR VOL.-B1/S1" and "O2 SNSR VOL.-B1/S2" parameters on the Scantool data list.

Specification : - Front HO2S(O2 SNSR VOL.-B1/S1) :
Approx. 0~1V with idle after warm up

Sensor voltage increase during engine acceleration and decrease during engine deceleration

Approx. 0V ~ 0.4 V when fuel cut

- Rear HO2S(O2 SNSR VOL.-B1/S2) : Above 0.4V at idle

4. Was a problem found in any of the above areas?

YES ► Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Check for poor connection between ECM and component: backed out terminal, improper mating, broken locks or poor terminal to wire connection. Repair as necessary and go to "Verification of Vehicle Repair" procedure

Verification of Vehicle Repair

Refer to DTC P2098 : Post Catalyst Fuel Trim System Too Lean (Bank 2)

Engine Control System

FL-683

P2104 Throttle Actuator Control System - Forced Idle

General Description

The Electronic Throttle Control(ETC) system is made of the components throttle body, Throttle Position Sensor(TPS)1&2 and Accelerator Position Sensor(APS) 1&2. The throttle body contains the actuator, the throttle plate and the throttle position sensor (potentiometer), which are integrated in one housing. The actuator consists of a DC motor with a two-stage gear. The opening angle of the thr

ottle valve is detected by the throttle position sensor which is mounted on the throttle body. And it provides feedback to the ECM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC Description

If ECM recognizes vehicle state as forced idle under detecting condition, it sets P2104 and MIL(Malfunction Indication Lamp) turns on.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• This code detects if the system is in Forced Idle Mode	• Faulty APS • Faulty APS+Brake • Faulty APS + Vehicle speed sensor • Faulty APS + Vehicle speed sensor + Brake • Faulty ECM
Enable Conditions	• Ignition "ON"	
Threshold value	• Forced Idle Mode is active	
Diagnosis Time	• -	
MIL On Condition	• 1 Driving Cycle	

Monitor Scantool Data

1. Connect scantool to DLC(Data Link Connector)
2. IG "ON" & Monitor that any different DTC(Diagnostic Trouble Code) is existed.
(There will be at least one more DTC which causes this DTC P2104 to retrieve)
3. Repair the DTCs cause DTC P2104 first according to the designated trouble shooting guide.
(After repairing the DTCs cause DTC P2104 , don't forget to do "ETC Initialization" as follows.)
4. Is the same DTC occurred ?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will take 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

FL-684

Fuel System

P2105 Throttle Actuator Control System-Force Engine Shutdown

General Description

Refer to DTC P2104 : Throttle Actuator Control System-Forced Idle

DTC Description

If ECM recognizes vehicle state as forced engine shutdown under detecting condition, it sets P2105 and then MIL(Malfunction Indication Lamp) turns on.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• This code detects if the system is in Forced Engine Shutdown Mode	• Faulty AFS+MAPS+ETS • Faulty ECM
Enable Conditions	• Ignition "ON"	
Threshold value	• Forced Engine Shutdown Mode Active	
Diagnosis Time	• -	
MIL On Condition	• 1 Driving Cycle	

Monitor Scantool Data

1. Connect scantool to DLC(Data Link Connector)
2. IG "ON" & Monitor that any different DTC(Diagnostic Trouble Code) is existed.
(There will be at least one more DTC which causes this DTC P2105 to retrieve)
3. Repair the DTCs cause DTC P2105 first according to the designated trouble shooting guide.
(After repairing the DTCs cause DTC P2105 , don't forget to do "ETC Initialization" as follows.)
4. Is the same DTC occurred ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will take 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

Engine Control System

FL-685

Verification of Vehicle Repair

Refer to DTC P2104 : Throttle Actuator Control
System-Forced Idle

FL-686

Fuel System

P2106 Throttle Actuator Control System-Force Limited Power

General Description

Refer to DTC P2104 : Throttle Actuator Control System-Forced Idle

DTC Description

If ECM recognizes vehicle state as forced limited power mode under detecting condition, it sets P2106 and then MIL(Malfunction Indication Lamp) turns on.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• This code detects if the system is in Limit Performance Mode	• Faulty APS • Faulty APS+Brake • Faulty APS + Vehicle speed sensor • Faulty APS + Vehicle speed sensor + Brake • Faulty ECM
Enable Conditions	• Ignition "ON"	
Threshold value	• Limit Performance Mode is active	
Diagnosis Time	• -	
MIL On Condition	• 1 Driving Cycle	

※ If Main relay has a fault(ex. Open) under engine running, the DTCs,P0638/P0685/P1295/P2106, can happen at the same time.

<DTC Name>

- P0638 Throttle Actuator Control Range/Performance(Bank 1)
- P0685 ECM/ECM Power Relay Control Circuit /Open
- P1295 Throttle Actuator Control System - Power Management
- P2106 Throttle Actuator Control System - Forced Limited Power

Monitor Scantool Data

1. Connect scantool to DLC(Data Link Connector)
2. IG "ON" & Monitor that any different DTC(Diagnostic Trouble Code) is existed.
(There will be at least one more DTC which causes this DTC P2106 to retrieve)
3. Repair the DTCs cause DTC P2106 first according to the designated trouble shooting guide.
(After repairing the DTCs cause DTC P2106 , don't forget to do "ETC Initialization" as follows.)

4. Is the same DTC occurred ?

YES

- Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO

- Go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off.(It will take 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

Verification of Vehicle Repair

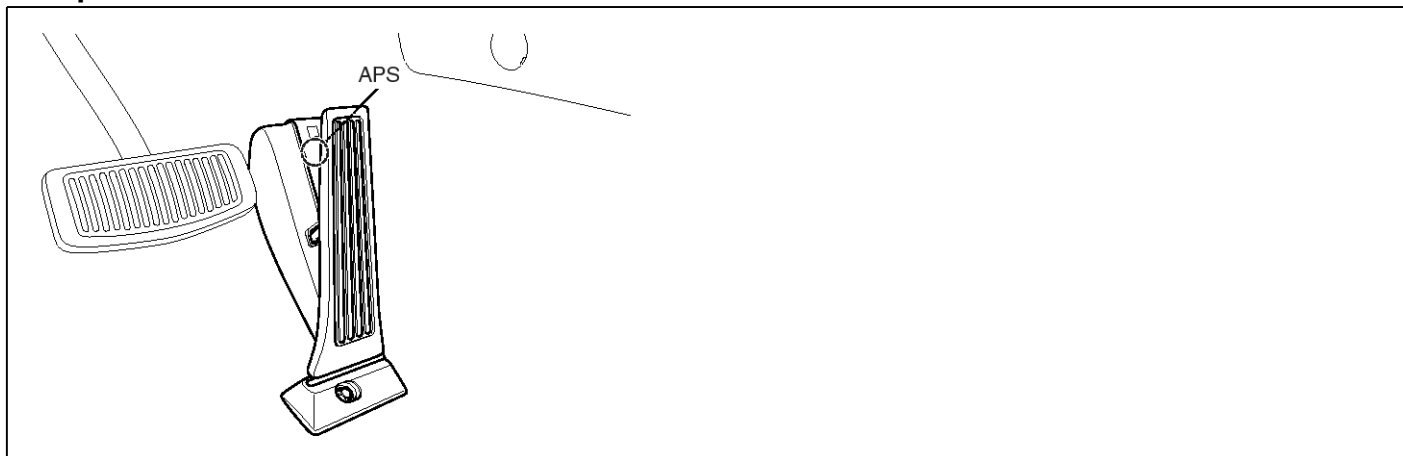
Refer to DTC P2104 : Throttle Actuator Control System-Forced Idle

Engine Control System

FL-687

P2122 Throttle/Pedal Position Sensor/Switch "D" Circuit Low Input

Component Location



SBHFL9315L

General Description

The Electronic Throttle Control(ETC) system is made of the components throttle body, Throttle Position Sensor(TPS) 1&2 and Accelerator Position Sensor(APS) 1&2. The APS is mounted in the accelerator pedal to detect the opening angle of the accelerator pedal. It has 2 sensors to detect the accelerator position and a malfunction of the accelerator position sensor. The ECM judges the current opening angle of the accelerator pedal from APS1&2, and the ECM controls the throttle motor based on these signals.

DTC Description

Checking output signals from APS 1 under detecting condition, if output signals are below the threshold, ECM sets P2122. And then MIL(Malfunction Indication Lamp) turns on.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• This code detects a continuous short to ground or open in either the circuit or the sensor (0-100%)	• Poor connection • Open or short to ground in power circuit • Open or short to ground in signal circuit • Faulty APS • Faulty ECM
Enable Conditions	• Ignition "ON"	
Threshold value	• $APS1 < 0.125V$	
Diagnosis Time	• Continuous	
MIL On Condition	• 1 Driving Cycle	

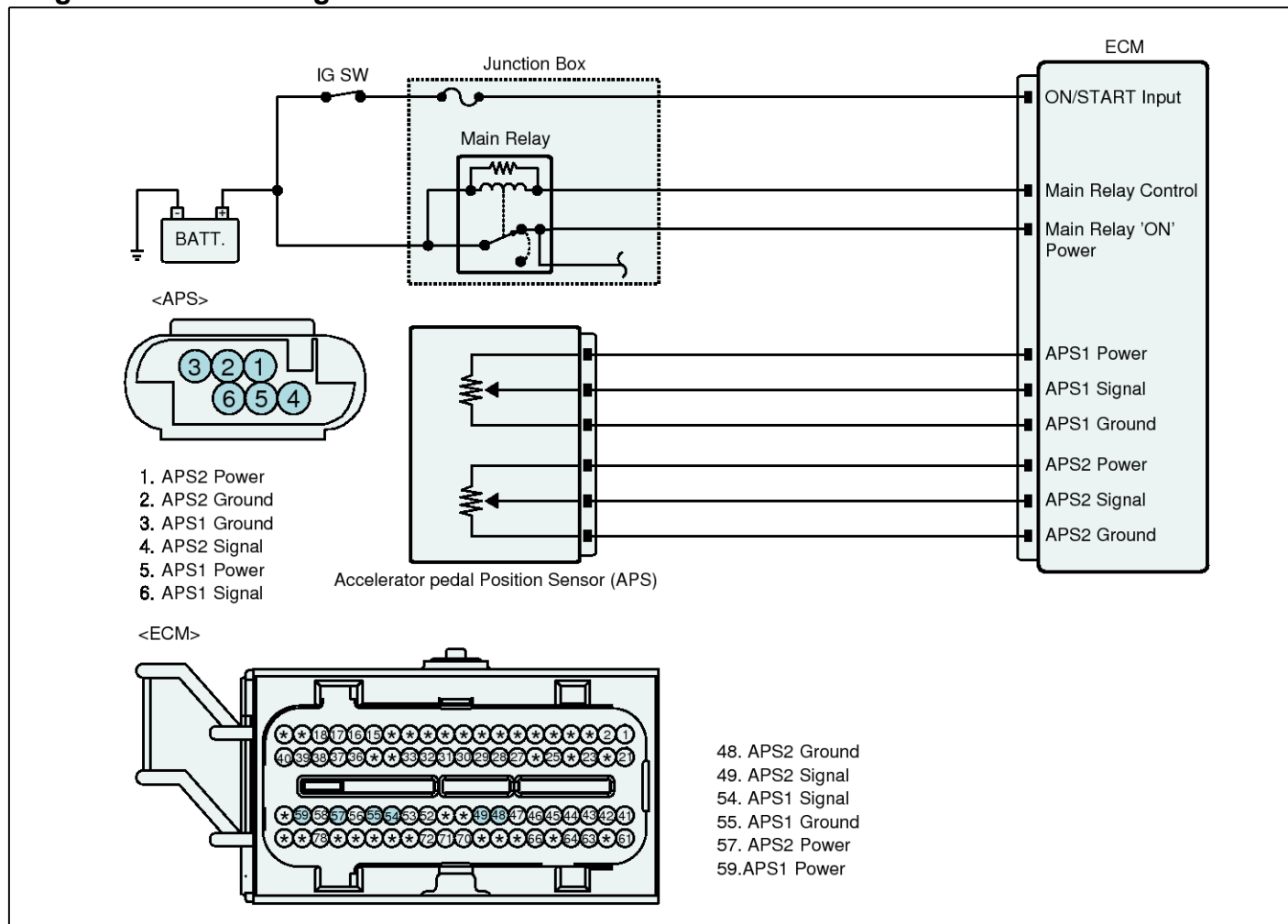
Specification

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

FL-688

Fuel System

Diagnostic Circuit Diagram



SBHFL9539L

Signal Waveform & Data

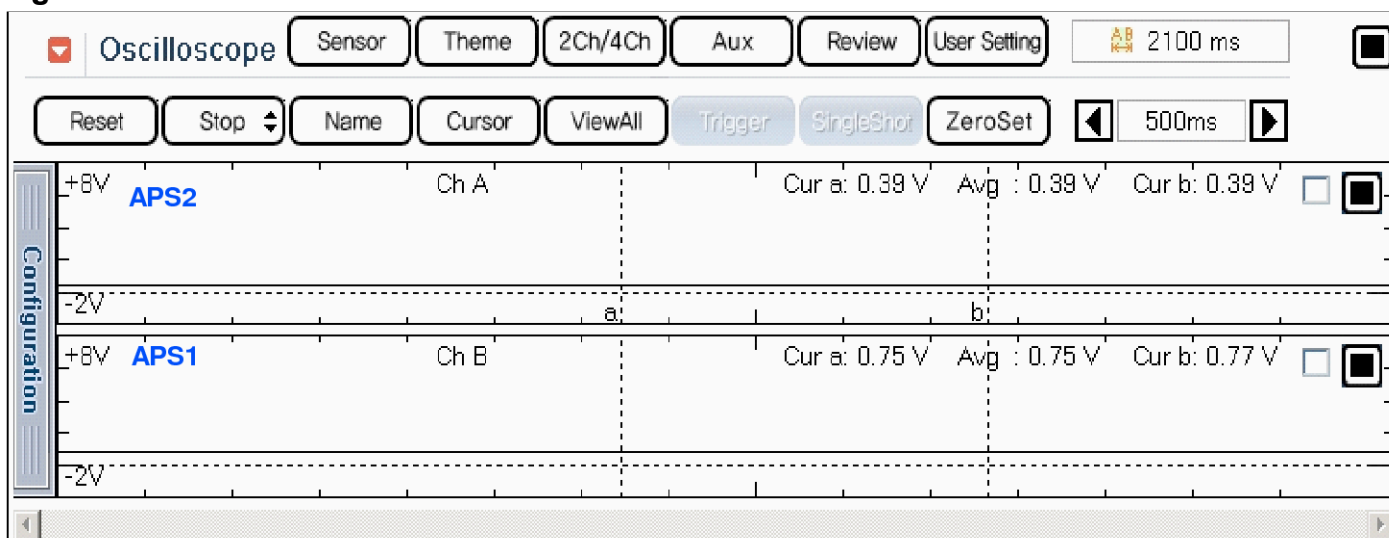


Fig.1

SBHFL9688L

Engine Control System

FL-689

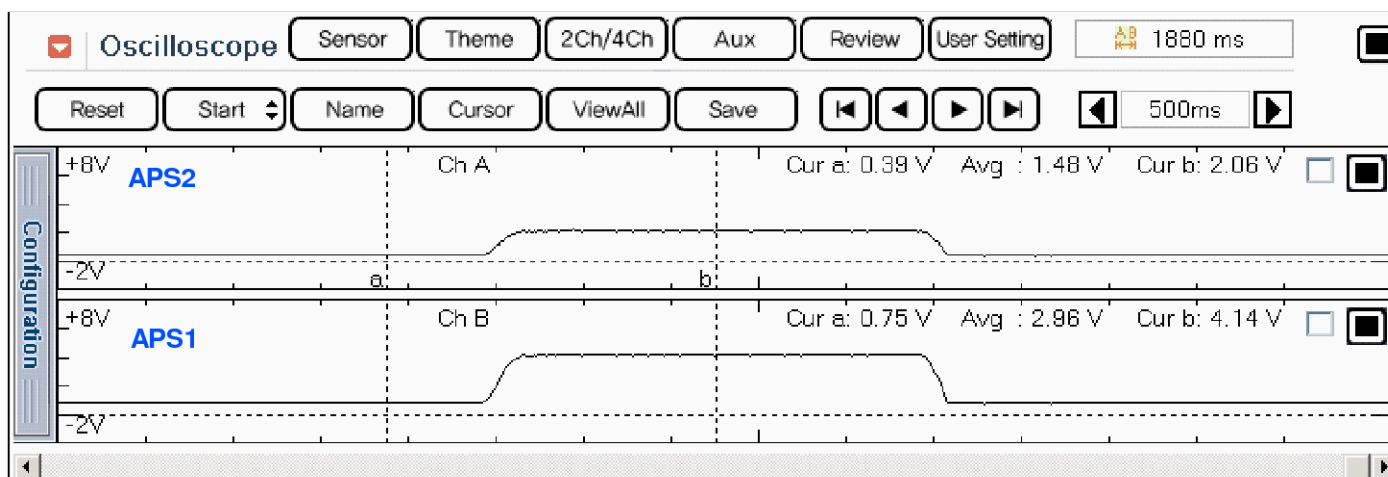


Fig.2

SBHFL9689L

Sensor Name	Value	Unit
☒ Accelerator Pedal Position Sensor-1	0.7	V
☒ Accelerator Pedal Position Sensor-2	0.4	V
☒ Accelerator Pedal Position Sensor-1	15	%
☒ Accelerator Pedal Position Sensor-2	15	%
☒ Engine Speed	0	RPM

Fig.3

SBHFL9690L

Sensor Name	Value	Unit
☒ Accelerator Pedal Position Sensor-1	0.0	V
☒ Accelerator Pedal Position Sensor-2	0.0	V
☒ Accelerator Pedal Position Sensor-1	0	%
☒ Accelerator Pedal Position Sensor-2	0	%
☒ Engine Speed	0	RPM
☐ Battery Positive Voltage	11.8	V
☐ Engine Coolant Temperature Sensor	36.8	'C
☐ Intake Air Temperature Sensor	16.5	'C

DTC		
Erase All DTC	Freeze Frame	DTC Status
Erase Selective DTC		
Description	State	
P2122 Throttle/Pedal Position Sensor/Switch "D" Circuit Low Input		
P2127 Throttle/Pedal Position Sensor/Switch "E" Circuit Low Input		
P2104 Throttle Actuator Control System - Forced Idle		

Fig.4

SBHFL9691L

FL-690

Fuel System

Fig 1) Normal waveform of APS1 & APS2 with no acceleration

Fig 2) Normal waveform of APS1 & APS2 with acceleration

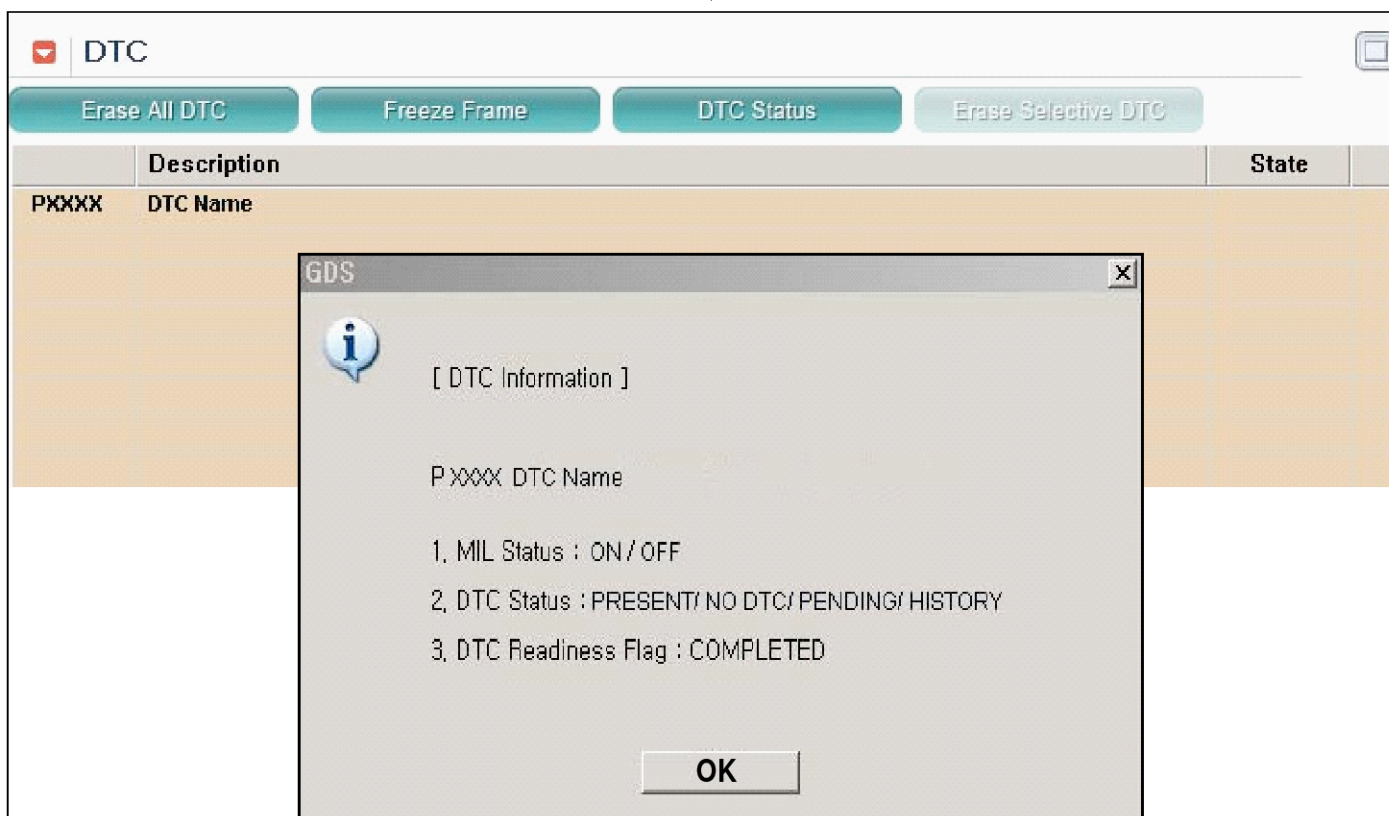
Fig 3) Normal data of APS1 & APS2 at ig on.

Fig 4) Abnormal data of APS1 & APS2 when APS1 & APS2 circuit open

Signal waveform of APS 1 & 2 shows that APS 2 increases voltage just half of APS 1 voltage increase when accelerating.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?
YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .
NO ► Go to " Power Circuit Inspection " procedure

Engine Control System

FL-691

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect APS connector.
2. IG "ON"
3. Measure voltage between APS1 power terminal of APS harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ▶ Go to "Signal Circuit Inspection" Procedure.

NO ▶ Repair open or short in harness and go to "Verification of Vehicle Repair" procedure.

Signal Circuit Inspection

■ Check short to ground in harness

1. IG "OFF".
2. Disconnect APS connector and ECM connector.
3. Measure resistance between APS1 signal terminal of APS harness connector and chassis ground.(Measurement "A")
4. Measure resistance between APS1 signal and APS1(2) ground terminals of APS harness connector.(Measurement "B")

Specification : Infinite

5. Is the measured resistance within specification ?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect APS connector and ECM connector.
2. Measure resistance between APS1 signal terminal of APS harness connector and APS1 signal terminal of ECM harness connector.

Specification : Approx. below 1Ω.

3. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check APS

1. IG "OFF" and install a scantool.
2. Connect probe to APS1 and APS2 to check signal waveform by using oscilloscope function.
3. Measure signal waveform of APS by pressing and depressing accelerator pedal.

Specification : Signal waveform will be displayed as follows.

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

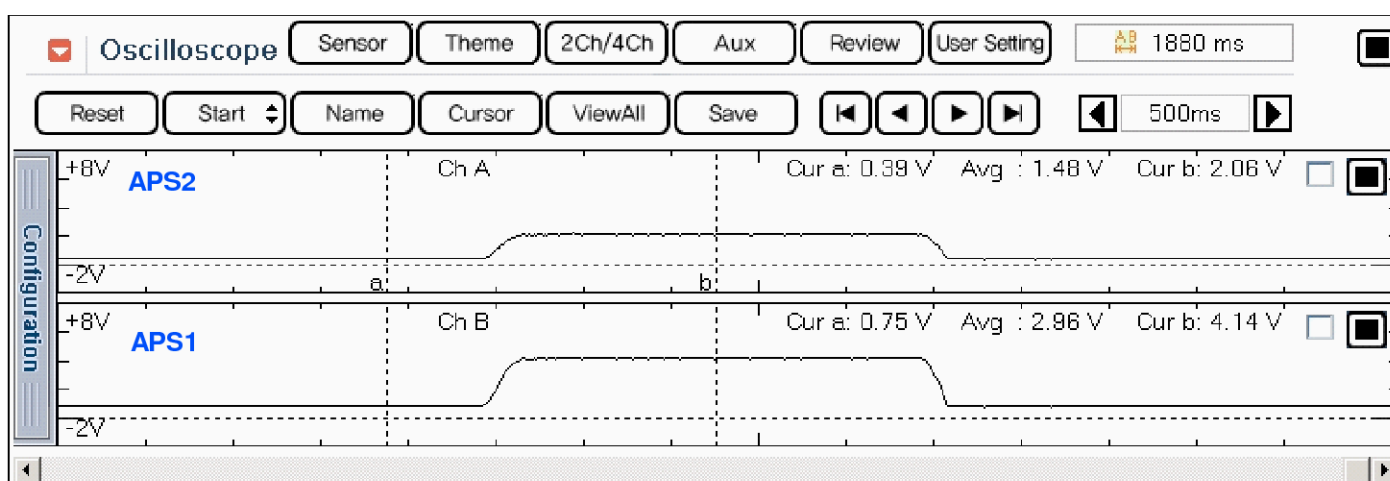


Fig.1

SBHFL9692L

Fig 1) Normal waveform of APS1 & APS2 with acceleration

4. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

 NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known-good APS and check for proper operation. If the problem is corrected, replace APS and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-693

P2123 Throttle/Pedal Position Sensor /Switch "D" Circuit High Input

Component Location

Refer to DTC P2122 : Throttle/Pedal Position Sensor/Switch "D" Circuit Low Input

General Description

Refer to DTC P2122 : Throttle/Pedal Position Sensor/Switch "D" Circuit Low Input

DTC Description

Checking output signals from APS 1 under detecting condition, if output signals are above the threshold, ECM sets P2123. And then MIL(Malfunction Indication Lamp) turns on.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	This code detects a short to high in either the circuit or the sensor (0-100%)	- Poor connection - Short to battery in signal circuit - Open in ground circuit - Faulty APS - Faulty ECM
Enable Conditions	Ignition "ON"	
Threshold value	APS1 > 4.5V	
Diagnosis Time	Continuous	
MIL On Condition	1 Driving Cycle	

Specification

Refer to DTC P2122 : Throttle/Pedal Position Sensor/Switch "D" Circuit Low Input

Diagnostic Circuit Diagram

Refer to DTC P2122 : Throttle/Pedal Position Sensor/Switch "D" Circuit Low Input

Signal Waveform & Data

Refer to DTC P2122 : Throttle/Pedal Position Sensor/Switch "D" Circuit Low Input

Monitor Scantool Data

Refer to DTC P2122 : Throttle/Pedal Position Sensor/Switch "D" Circuit Low Input

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Signal Circuit Inspection " procedure

Signal Circuit Inspection

■ Check short to battery in harness

- IG "OFF" and disconnect APS connector and ECM connector.
- Measure resistance between APS1 signal and APS1 power terminals of APS harness connector.
- Measure resistance between APS1 signal and APS2 power terminals of APS harness connector.

Specification : Infinite

- Is the measured resistance within specification ?

YES ► Go to "Ground Circuit Inspection" procedure.

NO ► Repair short to battery in harness and go to "Verification of Vehicle Repair" procedure.

Ground Circuit Inspection

■ Check open in harness

- IG "OFF" and disconnect APS connector.
- Measure voltage between APS1 power terminal of APS harness connector and chassis ground.(Measurement "A")
- Measure voltage between APS1 power and APS1 ground terminals of APS harness connector.(Measurement "B")

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

FL-694

Fuel System

4. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair contact resistance or open in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check APS

1. IG "OFF" and install a scantool.
2. Connect probe to APS1 and APS2 to check signal waveform by using oscilloscope function.

3. Measure signal waveform of APS by pressing and depressing accelerator pedal.

Specification : Signal waveform will be displayed as follows.

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

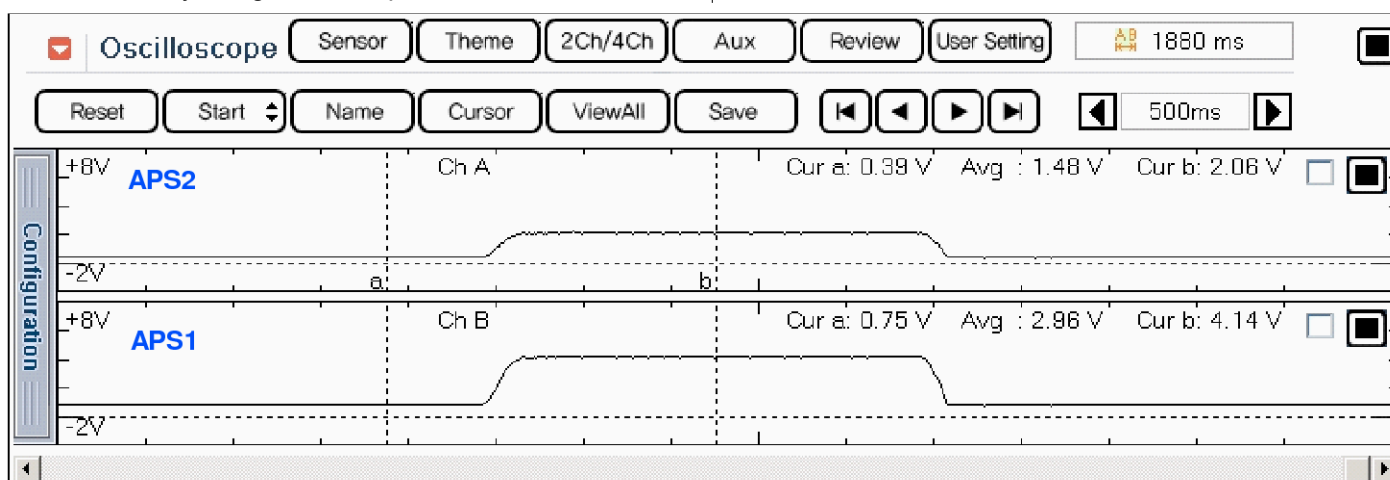


Fig.1

SBHFL9692L

Fig 1) Normal waveform of APS1 & APS2 with acceleration

4. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known-good APS and check for proper operation. If the problem is corrected, replace APS and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

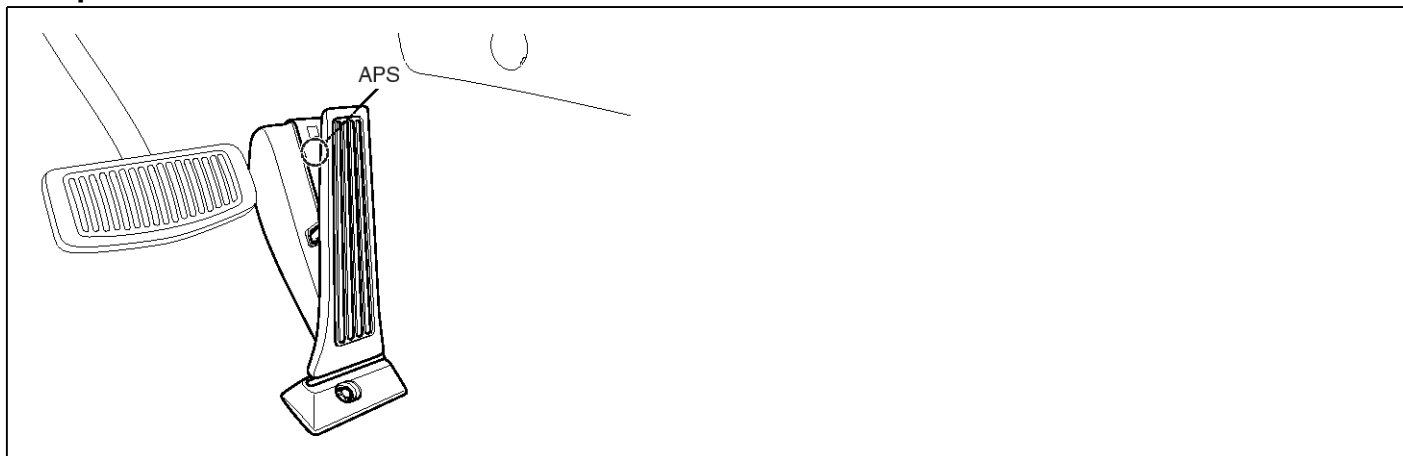
Refer to DTC P2122 : Throttle/Pedal Position Sensor/Switch "D" Circuit Low Input

Engine Control System

FL-695

P2127 Throttle/Pedal Position Sensor/Switch "E" Circuit Low Input

Component Location



SBHFL9315L

General Description

The Electronic Throttle Control(ETC) system is made of the components throttle body, Throttle Position Sensor(TPS) 1&2 and Accelerator Position Sensor(APS) 1&2. The APS is mounted in the accelerator pedal to detect the opening angle of the accelerator pedal. It has 2 sensors to detect the accelerator position and a malfunction of the accelerator position sensor. The ECM judges the current opening angle of the accelerator pedal from APS1&2, and the ECM controls the throttle motor based on these signals.

DTC Description

Checking output signals from APS 2 under detecting condition, if output signals are below the threshold, ECM sets P2127. And then MIL(Malfunction Indication Lamp) turns on.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• This code detects a continuous short to ground or open in either the circuit or the sensor (0-100%)	• Poor connection • Open or short to ground in power circuit • Open or short to ground in signal circuit • Faulty APS • Faulty ECM
Enable Conditions	• Ignition "ON"	
Threshold value	• $APS2 < 0.125V$	
Diagnosis Time	• Continuous	
MIL On Condition	• 1 Driving Cycle	

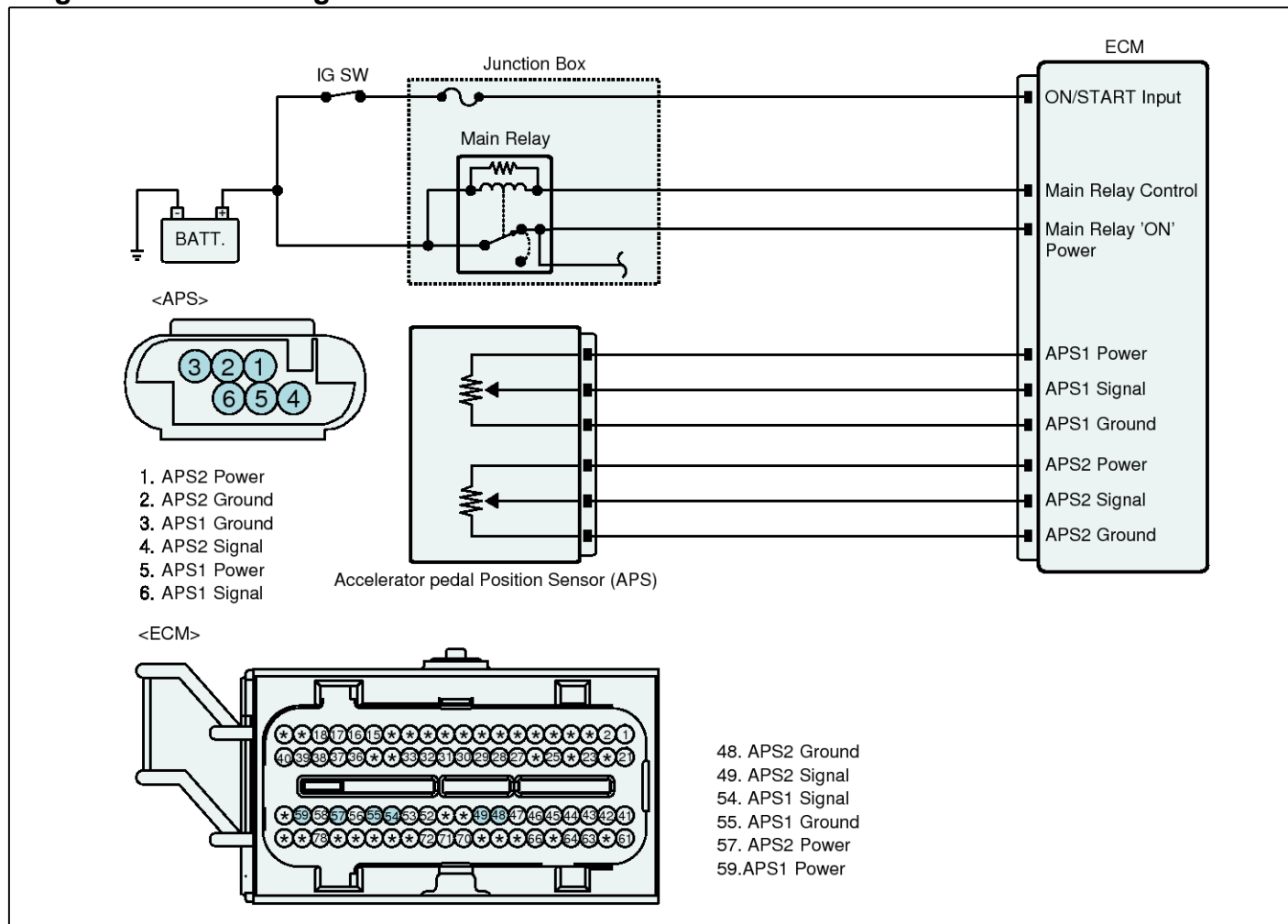
Specification

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

FL-696

Fuel System

Diagnostic Circuit Diagram



SBHFL9539L

Signal Waveform & Data

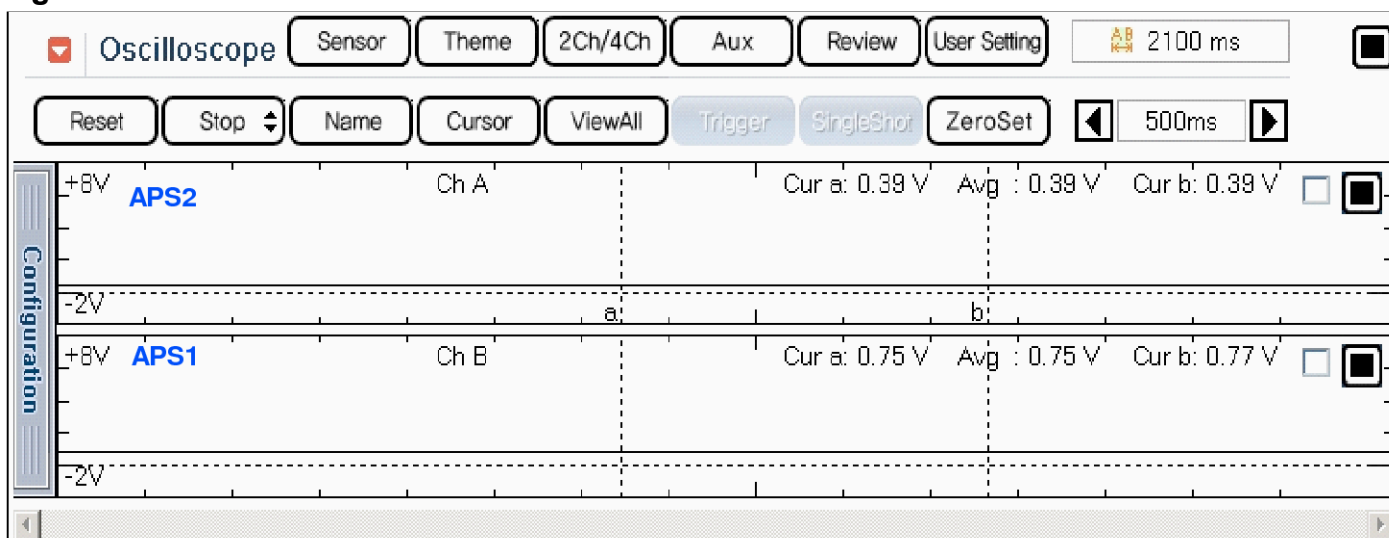


Fig.1

SBHFL9688L

Engine Control System

FL-697

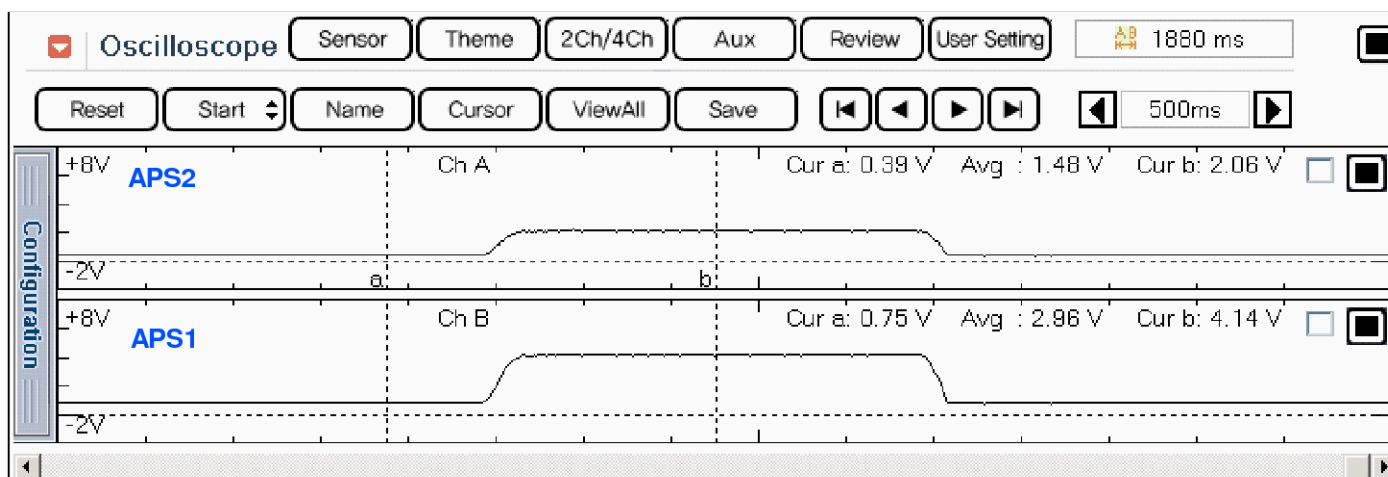


Fig.2

SBHFL9689L

Sensor Name	Value	Unit
☒ Accelerator Pedal Position Sensor-1	0.7	V
☒ Accelerator Pedal Position Sensor-2	0.4	V
☒ Accelerator Pedal Position Sensor-1	15	%
☒ Accelerator Pedal Position Sensor-2	15	%
☒ Engine Speed	0	RPM

Fig.3

SBHFL9690L

Sensor Name	Value	Unit
☒ Accelerator Pedal Position Sensor-1	0.0	V
☒ Accelerator Pedal Position Sensor-2	0.0	V
☒ Accelerator Pedal Position Sensor-1	0	%
☒ Accelerator Pedal Position Sensor-2	0	%
☒ Engine Speed	0	RPM
☐ Battery Positive Voltage	11.8	V
☐ Engine Coolant Temperature Sensor	36.8	'C
☐ Intake Air Temperature Sensor	16.5	'C

DTC		
Erase All DTC	Freeze Frame	DTC Status
Erase Selective DTC		
Description	State	
P2122 Throttle/Pedal Position Sensor/Switch "D" Circuit Low Input		
P2127 Throttle/Pedal Position Sensor/Switch "E" Circuit Low Input		
P2104 Throttle Actuator Control System - Forced Idle		

Fig.4

SBHFL9691L

FL-698

Fuel System

Fig 1) Normal waveform of APS1 & APS2 with no acceleration

Fig 2) Normal waveform of APS1 & APS2 with acceleration

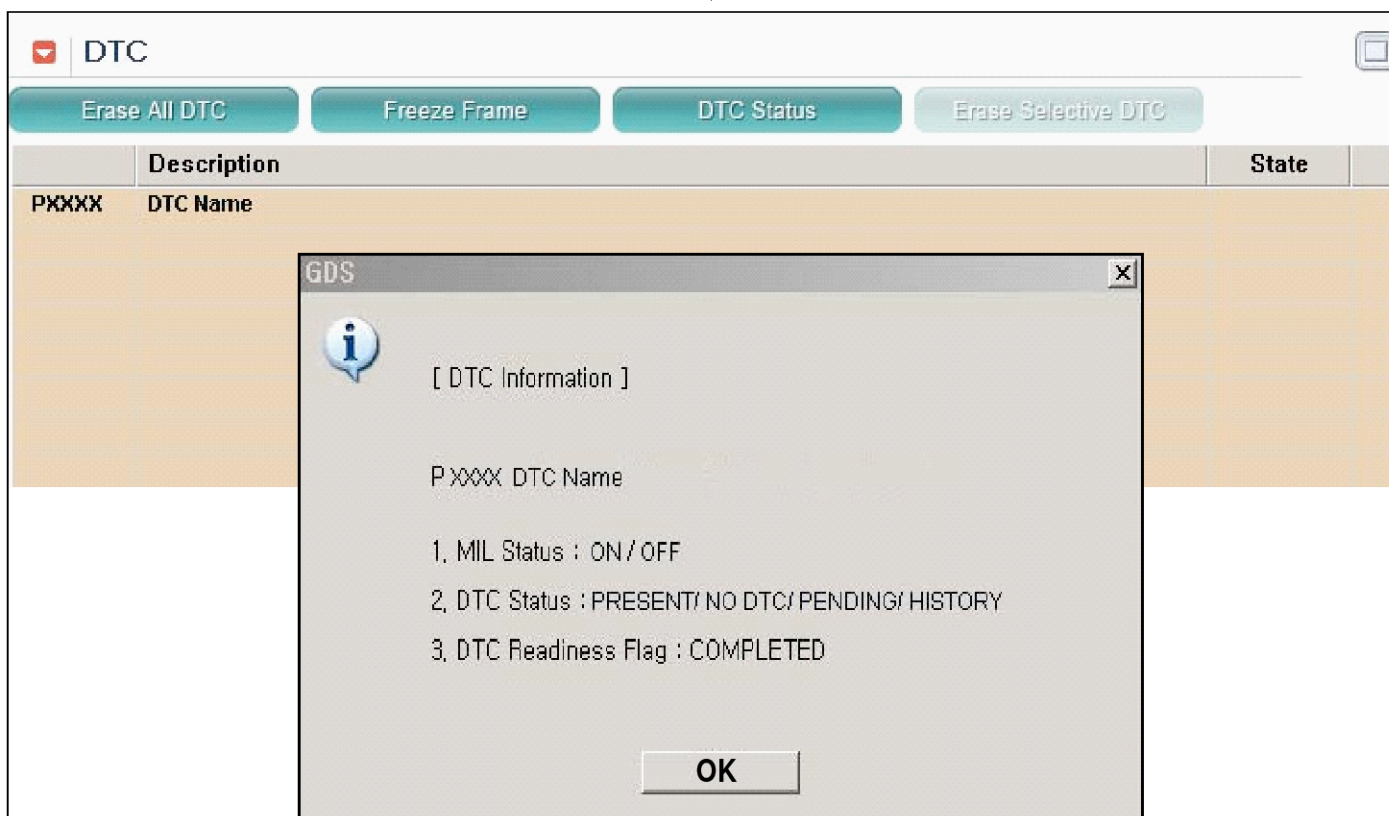
Fig 3) Normal data of APS1 & APS2 at ig on.

Fig 4) Abnormal data of APS1 & APS2 when APS1 & APS2 circuit open

Signal waveform of APS 1 & 2 shows that APS 2 increases voltage just half of APS 1 voltage increase when accelerating.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?
YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .
NO ► Go to " Power Circuit Inspection " procedure

Engine Control System

FL-699

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect APS connector.
2. IG "ON"
3. Measure voltage between APS2 power terminal of APS harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ▶ Go to "Signal Circuit Inspection" Procedure.

NO ▶ Repair open or short in harness and go to "Verification of Vehicle Repair" procedure.

Signal Circuit Inspection

■ Check short to ground in harness

1. IG "OFF".
2. Disconnect APS connector and ECM connector.
3. Measure resistance between APS2 signal terminal of APS harness connector and chassis ground.(Measurement "A")
4. Measure resistance between APS2 signal and APS1(2) ground terminals of APS harness connector.(Measurement "B")

Specification : Infinite

5. Is the measured resistance within specification ?

YES ▶ Go to "Check open in harness" as follows.

NO ▶ Repair short to ground in harness and go to "Verification of Vehicle Repair" procedure.

■ Check open in harness

1. IG "OFF" and disconnect APS connector and ECM connector.
2. Measure resistance between APS2 signal terminal of APS harness connector and APS2 signal terminal of ECM harness connector.

Specification : Approx. below 1Ω.

3. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair open in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check APS

1. IG "OFF" and install a scantool.
2. Connect probe to APS1 and APS2 to check signal waveform by using oscilloscope function.
3. Measure signal waveform of APS by pressing and depressing accelerator pedal.

Specification : Signal waveform will be displayed as follows.

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

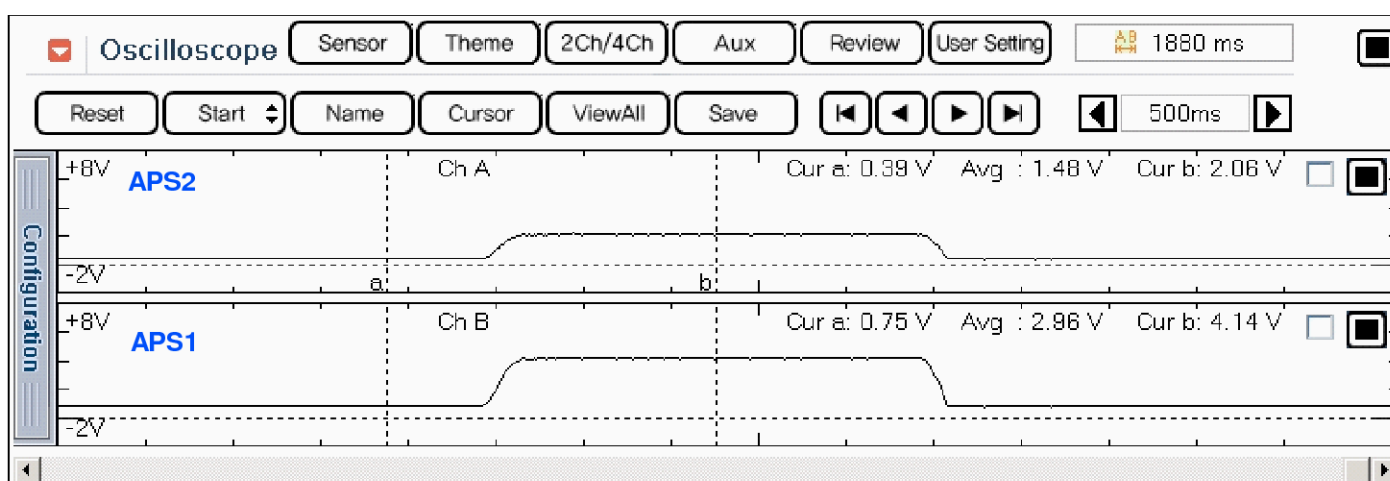


Fig.1

SBHFL9692L

FL-700

Fuel System

Fig 1) Normal waveform of APS1 & APS2 with acceleration

4. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known-good APS and check for proper operation. If the problem is corrected, replace APS and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-701

P2128 Throttle/Pedal Position Sensor/Switch "E" Circuit-High Input

Component Location

Refer to DTC P2127 : Throttle/Pedal Position Sensor/Switch "E" Circuit Low Input

General Description

Refer to DTC P2127 : Throttle/Pedal Position Sensor/Switch "E" Circuit Low Input

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	This code detects a short to high in either the circuit or the sensor (0-100%)	- Poor connection - Short to battery in Signal Circuit - Open in Ground Circuit - Faulty APS - Faulty ECM
Enable Conditions	Ignition "ON"	
Threshold value	APS2 > 3V	
Diagnosis Time	Continuous	
MIL On Condition	1 Driving Cycle	

Specification

Refer to DTC P2127 : Throttle/Pedal Position Sensor/Switch "E" Circuit Low Input

Diagnostic Circuit Diagram

Refer to DTC P2127 : Throttle/Pedal Position Sensor/Switch "E" Circuit Low Input

Signal Waveform & Data

Refer to DTC P2127 : Throttle/Pedal Position Sensor/Switch "E" Circuit Low Input

Monitor Scantool Data

Refer to DTC P2127 : Throttle/Pedal Position Sensor/Switch "E" Circuit Low Input

Terminal and Connector Inspection

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Signal Circuit Inspection " procedure .

DTC Description

Checking output signals from APS 2 under detecting condition, if output signals are above the threshold, ECM sets P2128. And then MIL(Malfunction Indication Lamp) turns on.

Signal Circuit Inspection

■ Check short to battery in harness

- IG "OFF" and disconnect APS connector and ECM connector.
- Measure resistance between APS2 signal and APS1 power terminals of APS harness connector.
- Measure resistance between APS2 signal and APS2 power terminals of APS harness connector.

Specification : Infinite

- Is the measured resistance within specification ?

YES ► Go to "Ground Circuit Inspection" procedure.

NO ► Repair short to battery in harness and go to "Verification of Vehicle Repair" procedure.

Ground Circuit Inspection

■ Check open in harness

- IG "OFF" and disconnect APS connector.
- Measure voltage between APS2 power terminal of APS harness connector and chassis ground.(Measurement "A")
- Measure voltage between APS2 power and APS2 ground terminals of APS harness connector.(Measurement "B")

Specification : Voltage difference between measurement "A" and "B" is below 200mV.

FL-702

Fuel System

4. Is the measured voltage within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair contact resistance or open in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check APS

1. IG "OFF" and install a scantool.
2. Connect probe to APS1 and APS2 to check signal waveform by using oscilloscope function.

3. Measure signal waveform of APS by pressing and depressing accelerator pedal.

Specification : Signal waveform will be displayed as follows.

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

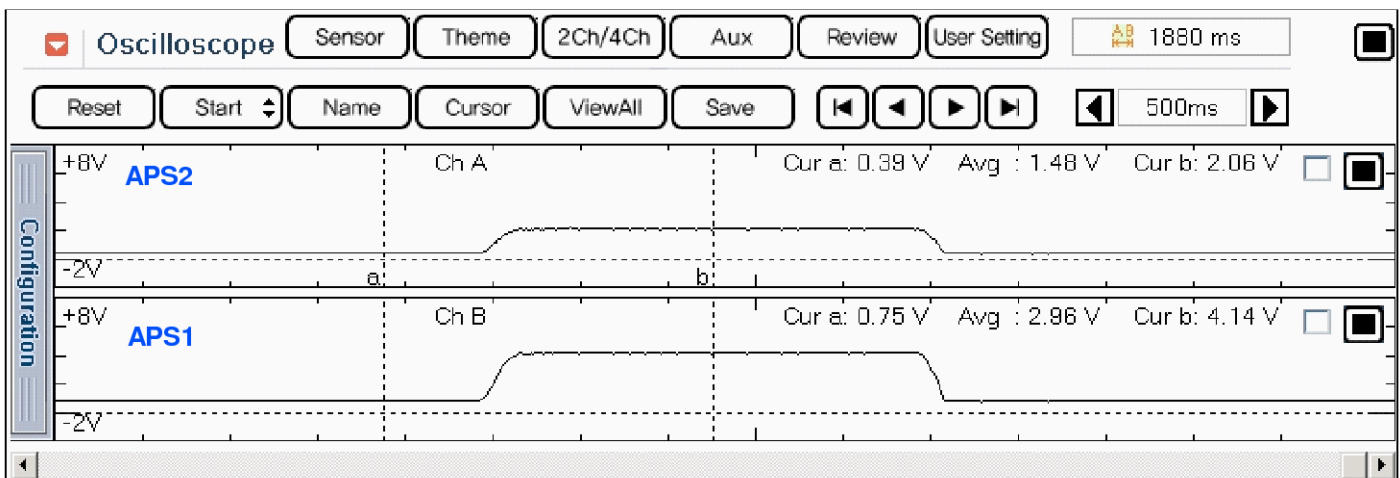


Fig.1

SBHFL9692L

Fig 1) Normal waveform of APS1 & APS2 with acceleration

4. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known-good APS and check for proper operation. If the problem is corrected, replace APS and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P2127 : Throttle/Pedal Position Sensor/Switch "E" Circuit Low Input

Engine Control System

FL-703

P2135 Throttle/Pedal Position Sensor/Switch A/B Voltage Correlation

Component Location



SBHFL9302L

General Description

The Electronic Throttle Control(ETC) system is made of the components throttle body, Throttle Position Sensor(TPS)1&2 and Accelerator Position Sensor(APS) 1&2. TPS1&2 are sharing the same source voltage and ground. The throttle valve opening is control by throttle motor which is controlled by Engine Control Module(ECM). The opposite position indicator shows inverted signal characteristics. TPS1 output voltage increases smoothly in proportion with the throttle valve opening angle after starting. TPS2 output voltage decreases in inverse proportion with the throttle valve opening angle after starting. TPS provides feedback to the ECM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC Description

Checking output signals from TPS 1 and 2 under detecting condition, if output signals difference between TPS1 and TPS2 are detected more than 4.5% for the specified number of times., ECM sets P2135. And then MIL(Malfunction Indication Lamp) turns on.

DTC Detecting Condition

Item	Detecting Condition	Possible Cause
DTC Strategy	• Determines if TPS#1 disagrees with TPS#2	• Poor connection • Open or short in TPS circuit • Faulty TPS • Faulty ECM
Enable Conditions	• Ignition "ON"	
Threshold value	• Difference between average values of TPS1 and TPS2 > 4.5%	
Diagnosis Time	• Continuous	
MIL On Condition	• 1 driving cycles	

FL-704

Fuel System

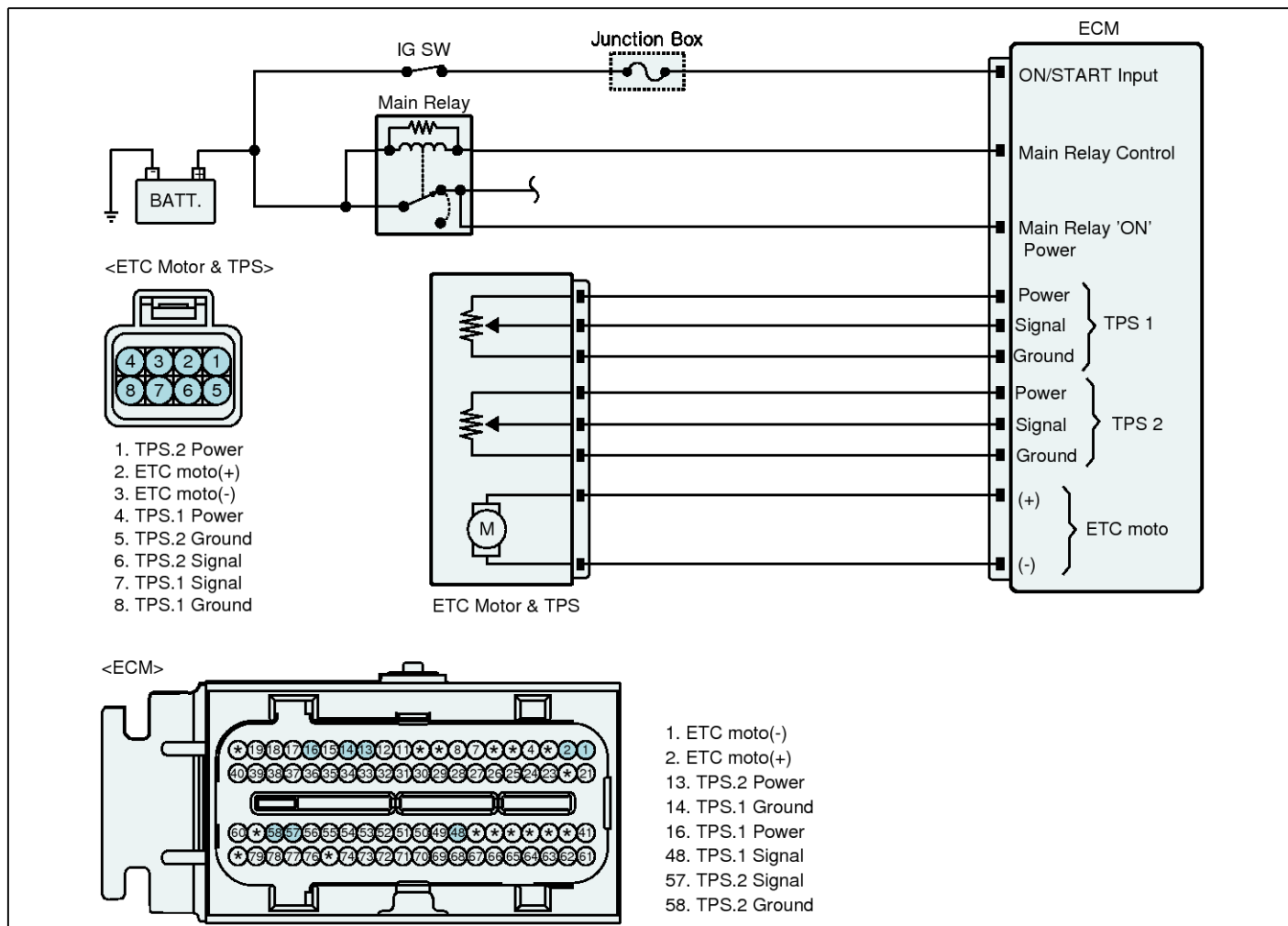
Specification

Throttle Opening (°)	Output Voltage (V) [Vref=5.0]	
	TPS1	TPS2
0°	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	0.0V

Diagnostic Circuit Diagram

Engine Control System

FL-705



SBHFL9516L

Signal Waveform & Data

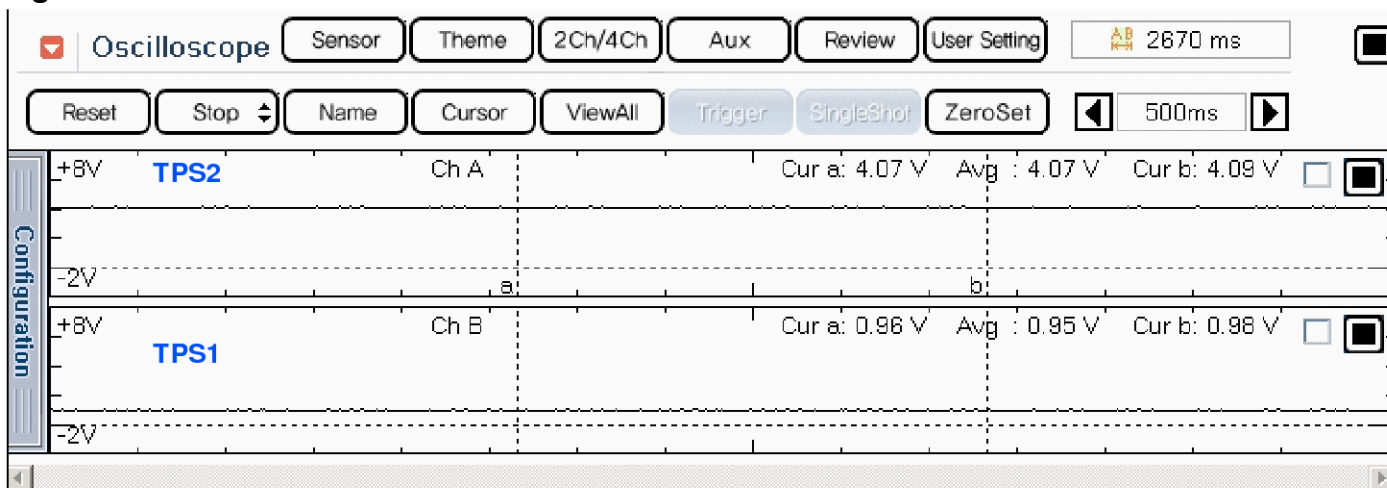


Fig.1

SBHFL9634L

FL-706

Fuel System

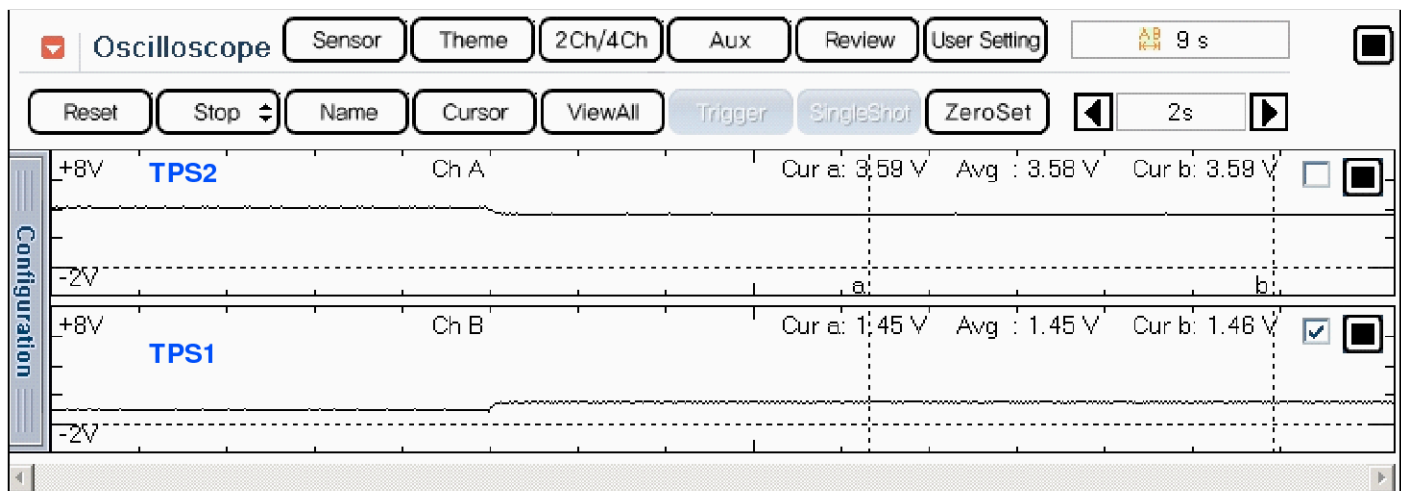


Fig.2

SBHFL9635L

Sensor Name	Value	Unit
☒ ETC Throttle Position	4.1	DEG
☒ Throttle Position1 Duty	5.1	DEG
☒ Throttle Position2 Duty	5.2	DEG
☒ Throttle Position1 Voltage	0.7	V
☒ Throttle Position2 Voltage	4.3	V
☒ ETC Motor Duty	-12	%

Fig.3

SBHFL9636L

Sensor Name	Value	Unit
☒ Engine Speed	0	RPM
☒ ETC Throttle Position	9.9	DEG
☒ Throttle Position1 Duty	130.1	DEG
☒ Throttle Position2 Duty	132.0	DEG
☒ Throttle Position1 Voltage	4.9	V
☒ Throttle Position2 Voltage	0.1	V

Fig.4

SBHFL9637L

Sensor Name	Value	Unit
☒ Throttle Position1 Duty	5.2	DEG
☒ Throttle Position2 Duty	133.5	DEG
☒ Throttle Position1 Voltage	0.7	V
☒ Throttle Position2 Voltage	0.0	V
☒ Engine Speed	640	RPM

Fig.5

SBHFL9645L

Fig 1) Normal waveform of TPS1 & TPS2 with no accel pedal depressed under IG ON condition

Fig 2) Normal waveform of TPS1 & TPS2 with accel pedal depressed under IG ON condition

Engine Control System

FL-707

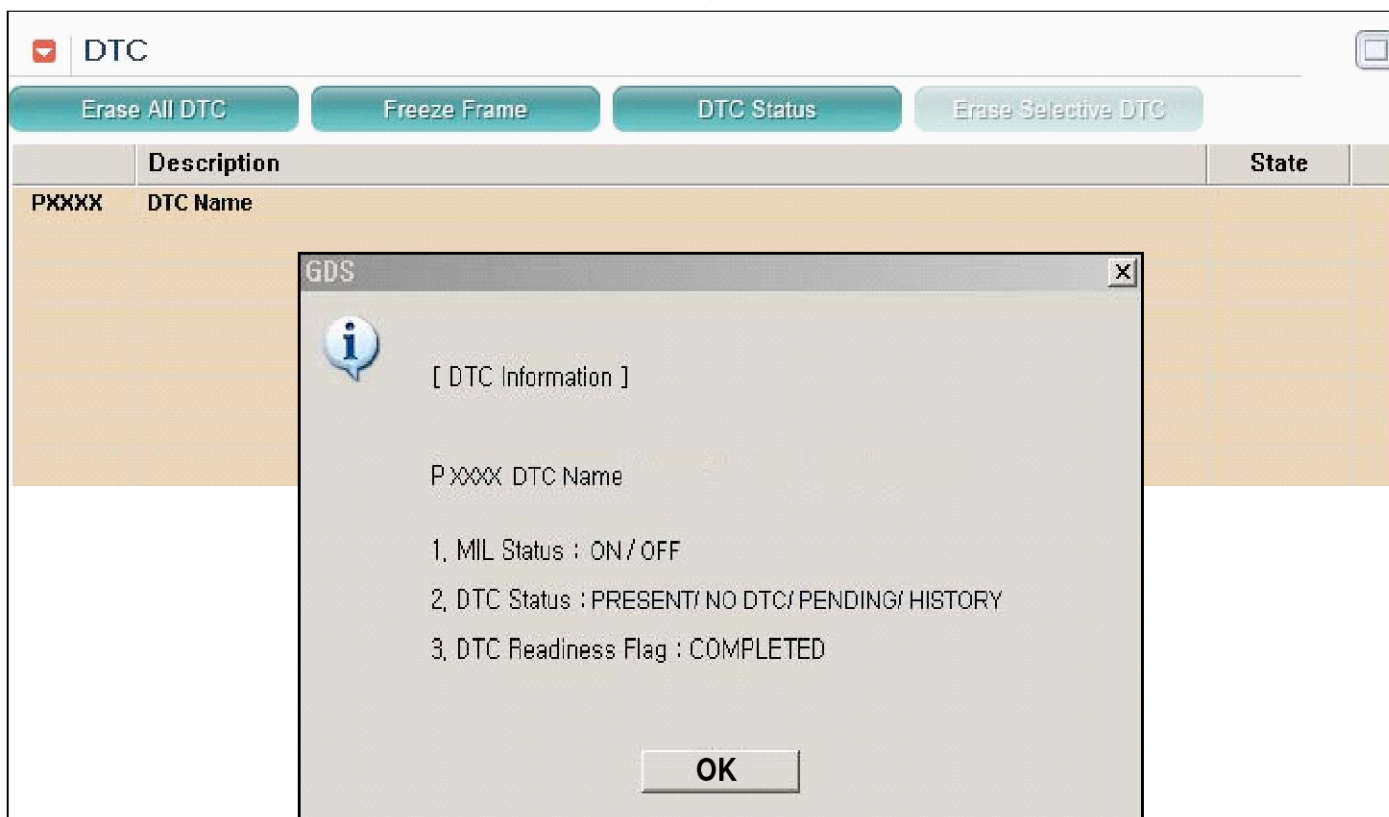
Fig 3) Normal data of TPS1 & TPS2 under IG ON condition

Fig 4) Normal data of TPS1 & TPS2 under open condition

Fig 5) Normal data of TPS1 & TPS2 under short to ground in TSP2 circuit

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination,

deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure .

NO ► Go to " Power Circuit Inspection " procedure

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect ETC Motor & TPS connector.
2. IG "ON".
3. Measure voltage between TPS1(2) power terminal of ETC Motor & TPS harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

FL-708

Fuel System

YES ▶ Go to "Signal circuit inspection" procedure.

NO ▶ Repair open or short in harness and go to "Verification of Vehicle Repair" procedure.

Signal Circuit Inspection

■ Check short in harness

1. IG "OFF" and disconnect ETC Motor & TPS connector and ECM connector.
2. Measure resistance between TPS1 signal and TPS2 signal terminals of ETC Motor & TPS harness connector.

Specification : Infinite

3. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair shorted in harnesses and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check TPS

1. IG "ON"
2. Monitor signal waveform of TPS by stepping on and off the accelerator pedal on scantool.

Specification :

Throttle Opening (°)	Output Voltage (V) [Vref=5.0]	
	TPS1	TPS2
0°	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	0.0V

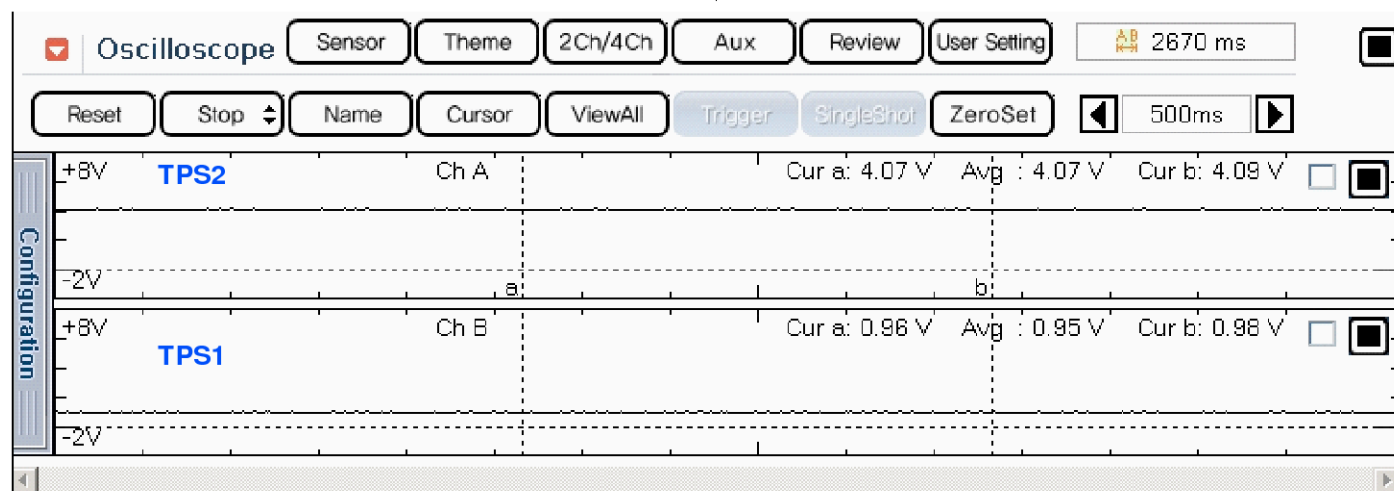


Fig.1

SBHFL9634L

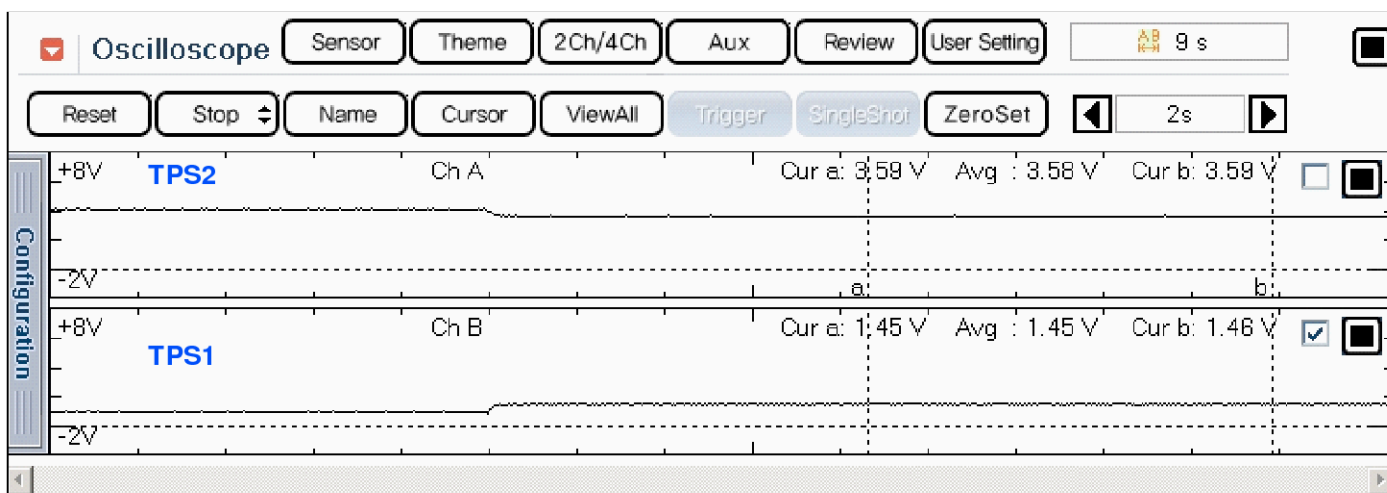


Fig.2

SBHFL9635L

Fig 1) Normal waveform of TPS1 & TPS2 with no accel pedal depressed under IG ON condition

Fig 2) Normal waveform of TPS1 & TPS2 with accel pedal depressed under IG ON condition

3. Is the measured resistance within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good ECT motor & TPS and check for proper operation. If the problem is corrected, replace ECT motor & TPS and go to "Verification of Vehicle Repair" procedure.

※ Procedure of ETS Initialization

1. Erase the trouble codes on ECM
2. Turn the ignition key off and keep this condition until the main relay is turned off. (It will take 10sec.)
3. Turn ignition key on more than 1second to record the throttle motor position on the EEPROM

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

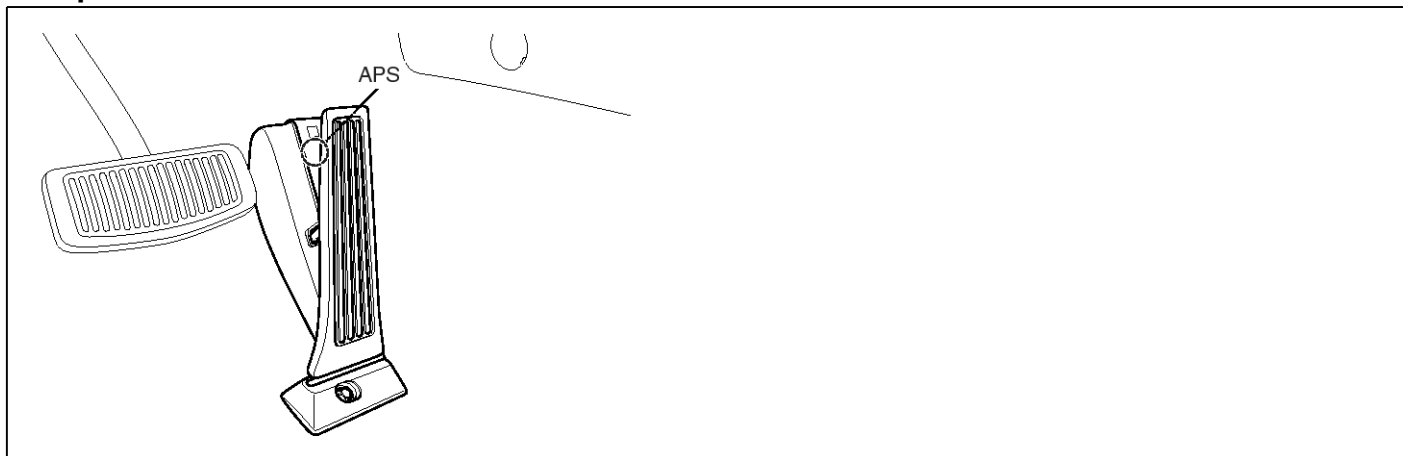
NO ▶ Go to the applicable troubleshooting procedure.

FL-710

Fuel System

P2138 Throttle/Pedal Position Sensor/Switch D/E Voltage Correlation

Component Location



SBHFL9315L

General Description

The Electronic Throttle Control(ETC) system is made of the components throttle body, Throttle Position Sensor(TPS) 1&2 and Accelerator Position Sensor(APS) 1&2. The APS is mounted in the accelerator pedal to detect the opening angle of the accelerator pedal. It has 2 sensors to detect the accelerator position and a malfunction of the accelerator position sensor. The ECM judges the current opening angle of the accelerator pedal from APS1&2, and the ECM controls the throttle motor based on these signals.

DTC Description

Checking output signals from APS 1 and 2 under detecting condition, if output signals difference between APS 1 and 2 are detected more than 4.5% for the specified number of times., ECM sets P2138. And then MIL(Malfunction Indication Lamp) turns on.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• This code detects a correlation error between APS 1 and APS 2.	• Poor connection • Open or short in APS circuit • Faulty APS • Faulty ECM
Enable Conditions	• Ignition "ON"	
Threshold value	• Difference between APS1 and APS2 Normalized values > 4.5%	
Diagnosis Time	• Continuous	
MIL On Condition	• 1 Driving Cycle	

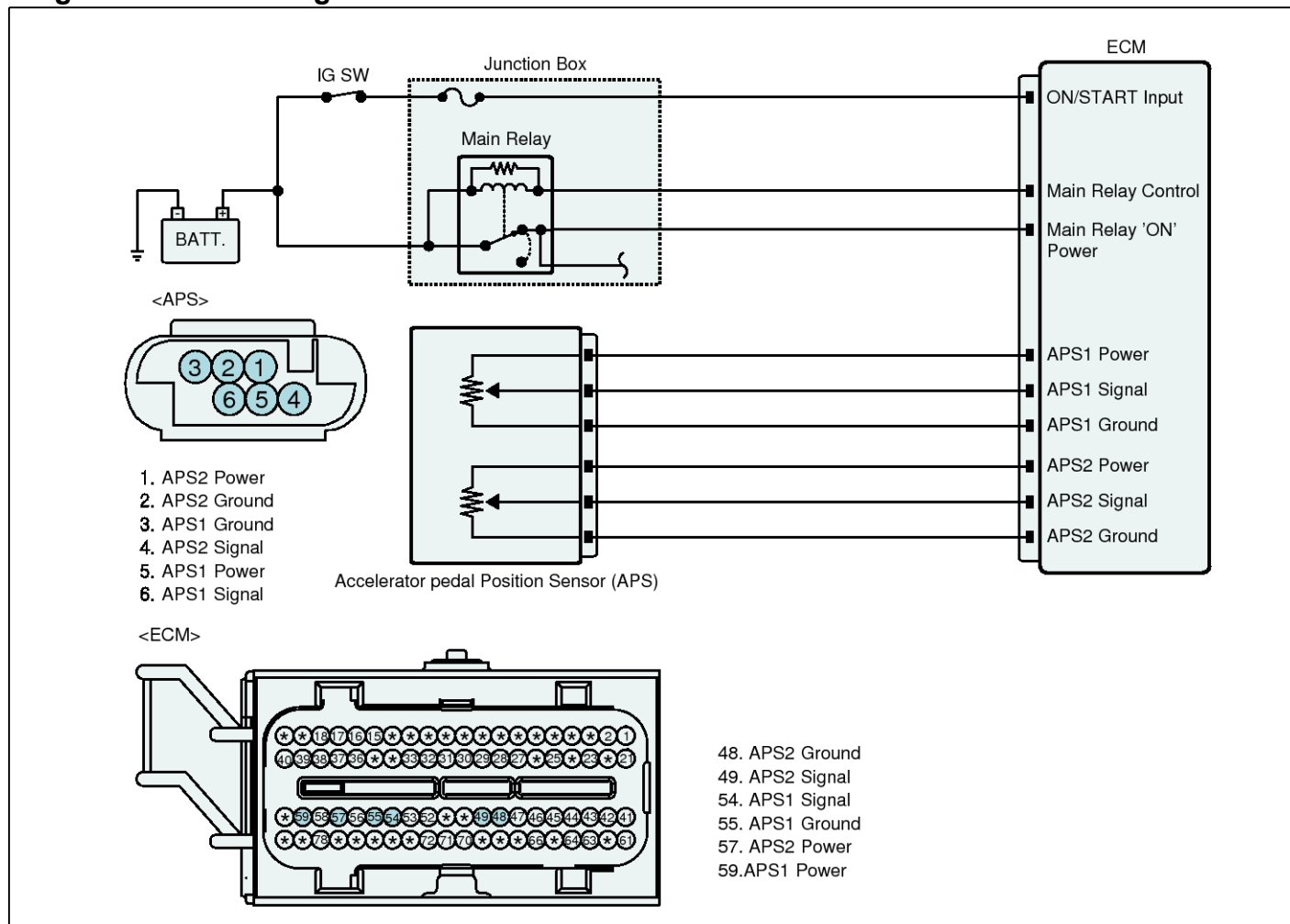
Specification

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

Engine Control System

FL-711

Diagnostic Circuit Diagram



SBHFL9539L

Signal Waveform & Data

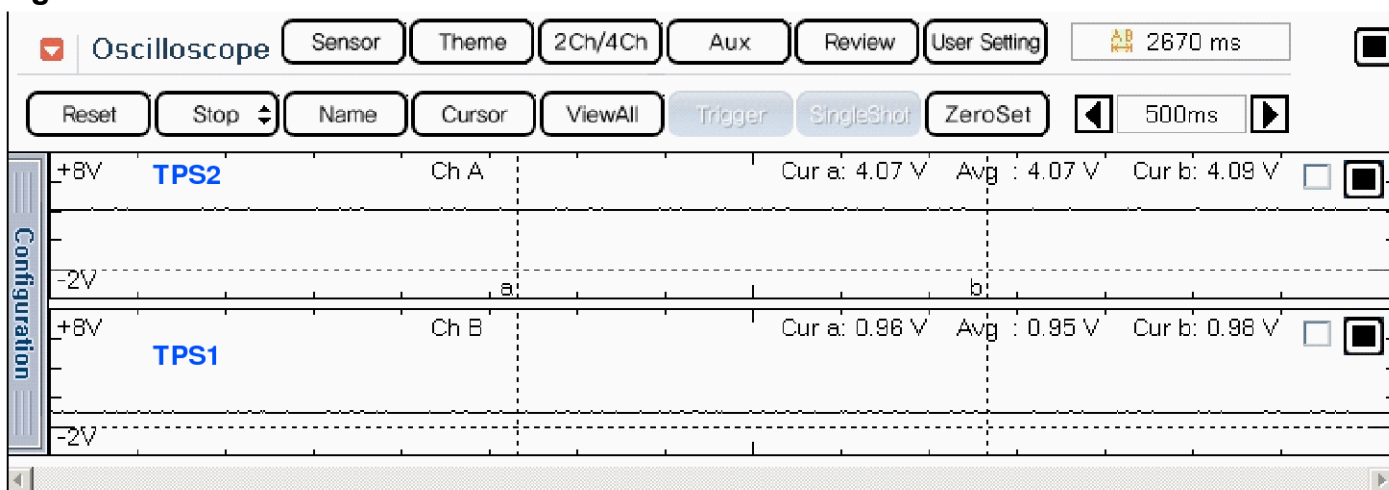


Fig.1

SBHFL9634L

FL-712

Fuel System

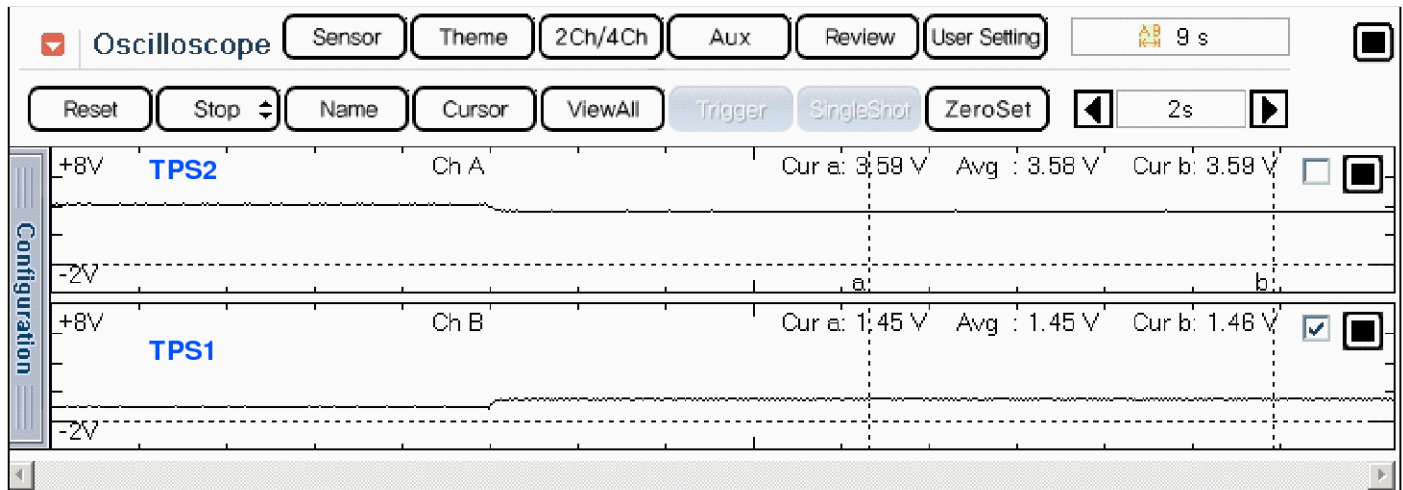


Fig.2

SBHFL9635L

Sensor Name	Value	Unit
☒ ETC Throttle Position	4.1	DEG
☒ Throttle Position1 Duty	5.1	DEG
☒ Throttle Position2 Duty	5.2	DEG
☒ Throttle Position1 Voltage	0.7	V
☒ Throttle Position2 Voltage	4.3	V
☒ ETC Motor Duty	-12	%

Fig.3

SBHFL9636L

Sensor Name	Value	Unit
☒ Engine Speed	0	RPM
☒ ETC Throttle Position	9.9	DEG
☒ Throttle Position1 Duty	130.1	DEG
☒ Throttle Position2 Duty	132.0	DEG
☒ Throttle Position1 Voltage	4.9	V
☒ Throttle Position2 Voltage	0.1	V

Fig.4

SBHFL9637L

Sensor Name	Value	Unit
☒ Throttle Position1 Duty	5.2	DEG
☒ Throttle Position2 Duty	133.5	DEG
☒ Throttle Position1 Voltage	0.7	V
☒ Throttle Position2 Voltage	0.0	V
☒ Engine Speed	640	RPM

Fig.5

SBHFL9645L

Engine Control System

FL-713

Fig 1) Normal waveform of TPS1 & TPS2 with no accel pedal depressed under IG ON condition

Fig 2) Normal waveform of TPS1 & TPS2 with accel pedal depressed under IG ON condition

Fig 3) Normal data of TPS1 & TPS2 under IG ON condition

Fig 4) Normal data of TPS1 & TPS2 under open condition

Fig 5) Normal data of TPS1 & TPS2 under short to ground in TSP2 circuit

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.
5. Is parameter displayed "Present fault"?

YES ▶ Go to "Terminal and Connector inspection" procedure.

NO ▶ Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ▶ Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ▶ Go to "Power Circuit Inspection" procedure

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect APS connector.
2. IG "ON"

3. Measure voltage between APS1(2) power terminal of APS harness connector and chassis ground.

Specification : Approx. 5V

4. Is the measured voltage within specification ?

YES ▶ Go to "Signal Circuit Inspection" Procedure.

NO ▶ Repair open or short in harness and go to "Verification of Vehicle Repair" procedure.

Signal Circuit Inspection

■ Check short to ground in harness

1. IG "OFF", disconnect APS connector and ECM connector.
2. Measure resistance between APS1 signal and APS2 signal terminals of APS harness connector.

Specification : Infinite

3. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair short to ground in harness and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check APS

1. IG "OFF" and install a scantool
2. Connect probe to APS1 and APS2 to check signal waveform by using oscilloscope function.
3. Measure signal waveform of APS by pressing and depressing accelerator pedal.

Specification : Signal waveform will be displayed as follows.

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

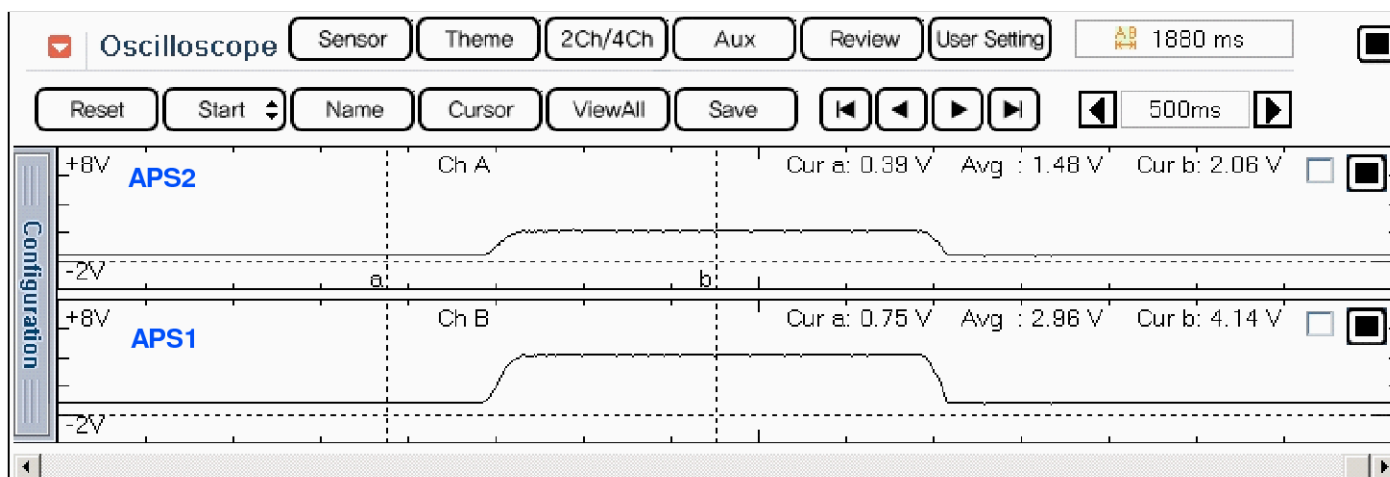


Fig.1

SBHFL9692L

Fig 1) Normal waveform of APS1 & APS2 with acceleration

4. Is the measured signal waveform O.K ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known-good APS and check for proper operation. If the problem is corrected, replace APS and then go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

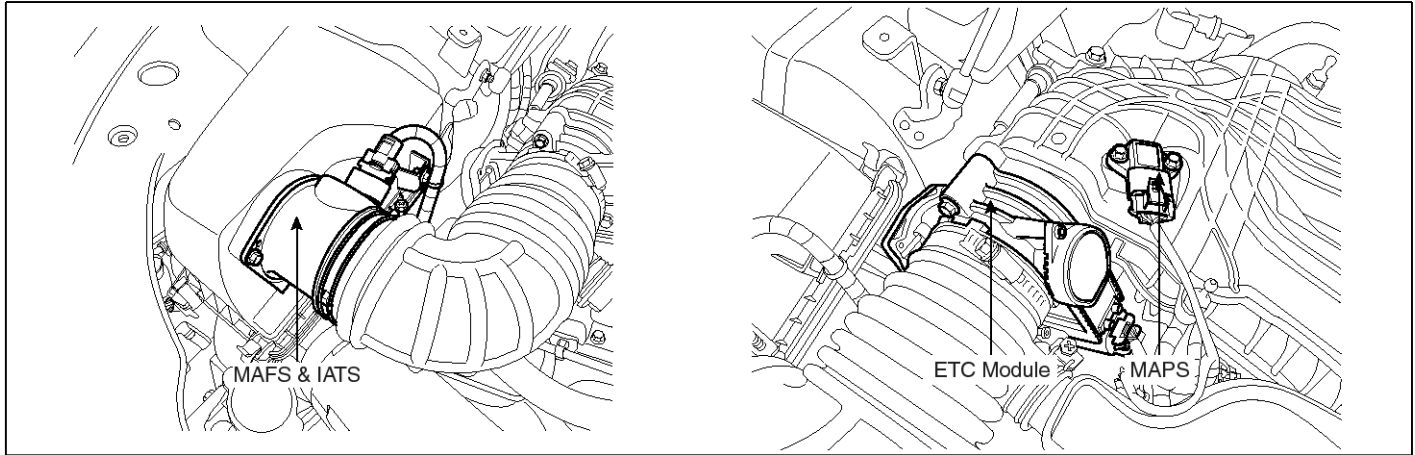
NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-715

P2173 Throttle Actuator Control System- High Air Flow Detected.

Component Location



SBHFL9332L

General Description

The Electronic Throttle Control(ETC) system is made of the components throttle body, Throttle Position Sensor(TPS)1&2 and Accelerator Position Sensor(APS) 1&2. The throttle body contains the actuator, the throttle plate and the throttle position sensor (potentiometer), which are integrated in one housing. The actuator consists of a DC motor with a two-stage gear. The opening angle of the throttle valve is detected by the throttle position sensor which is mounted on the throttle body. And it provides feedback to the ECM to control the throttle motor in order to control the throttle valve opening angle properly in response to the driving condition.

DTC Description

Comparing real intake air flow and the intake air flow calculated by ETS under detecting condition, if the air flow more than threshold value is detected for more than 19 sec., ECM sets P2173. And then MIL(Malfunction Indication Lamp) turns on.

DTC Detecting Condition

Item		Detecting Condition	Possible cause
DTC Strategy		Monitor the measured engine airflow and the estimated airflow	- Air Leakage between TPS and MAFS - Faulty throttle body or intake manifold - Faulty MAFS
EnableConditions		- Engine running - No faults present	
Threshold value	Case1	MAPS reading - ETC estimated airflow > 9 g/s	
	Case2	MAFS reading - ETC estimated airflow > 7g/s	
Diagnosis Time		Continuous (Within 20 sec.)	
MIL On Condition		1 Driving Cycle	

FL-716

Fuel System

Specification

TPS		
Throttle Opening (°)	Output Voltage (V) [Vref=5.0]	
	TPS1	TPS2
0°	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	0.0V

MAFS	
Air Flow(kg/h)	Frequency(Hz)
12.6	2617
18	2958
23.4	3241
32.4	3653
43.2	4024
57.6	4399
72	4704
108	5329
144	5897
198	6553
270	7240
360	7957
486	8738
666	9644
900	10590

Engine Control System

FL-717

MAP	
Pressure(kPa)	Voltage(V)
20	0.79
46.66	1.84
101.32	4.0

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.
5. Is parameter displayed "Present fault"?

YES ► Go to "System Inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

System Inspection

■ Visual Inspection

1. Check the air hose between MAFS and throttle body is torn or installation.
2. Check deformation, crack or installation of throttle valve(body)
3. Has a problem been found ?

YES ► Substitute with a known-good Air hose or throttle body and check for proper operation. If the problem is corrected, replace air hose or throttle body and then go to "Verification of Vehicle Repair" procedure.

NO ► Go to "Check MAFS" as follows..

■ Check MAFS

1. IG "OFF" and install a scantool
2. ENG "ON" and monitor "MAFS" data on the service data.
3. Monitor signal waveform at signal terminal of MAFS with scantool.

Specification : Signal waveform will be displayed as follows. Frequency will be increased during acceleration. (Be aware that the signal of MAFS is not voltage display but frequency display.)

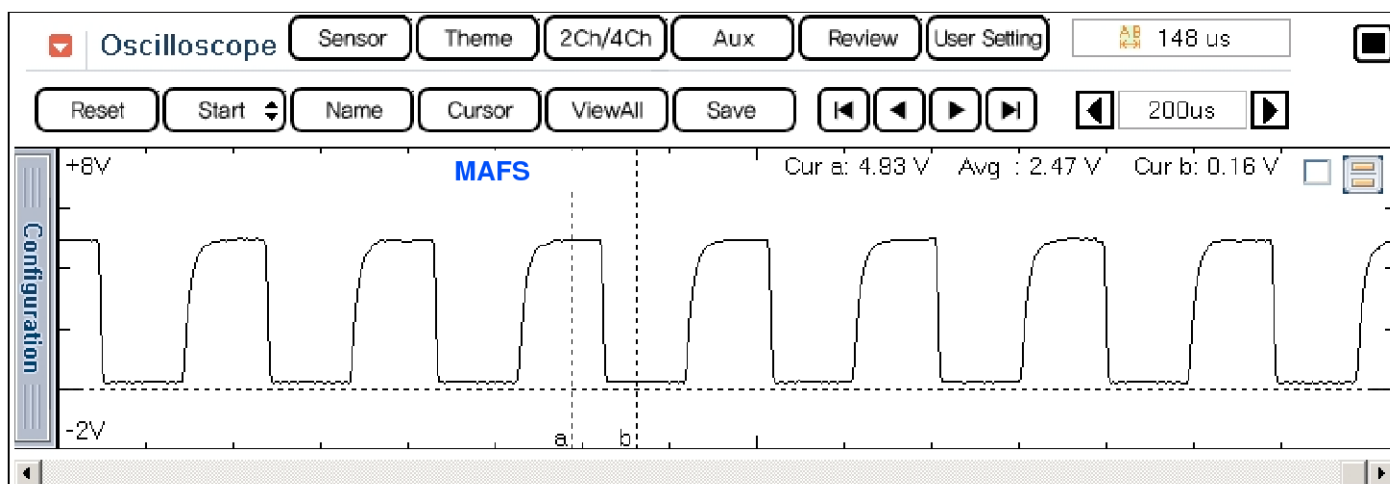


Fig.1

SBHFL9693L

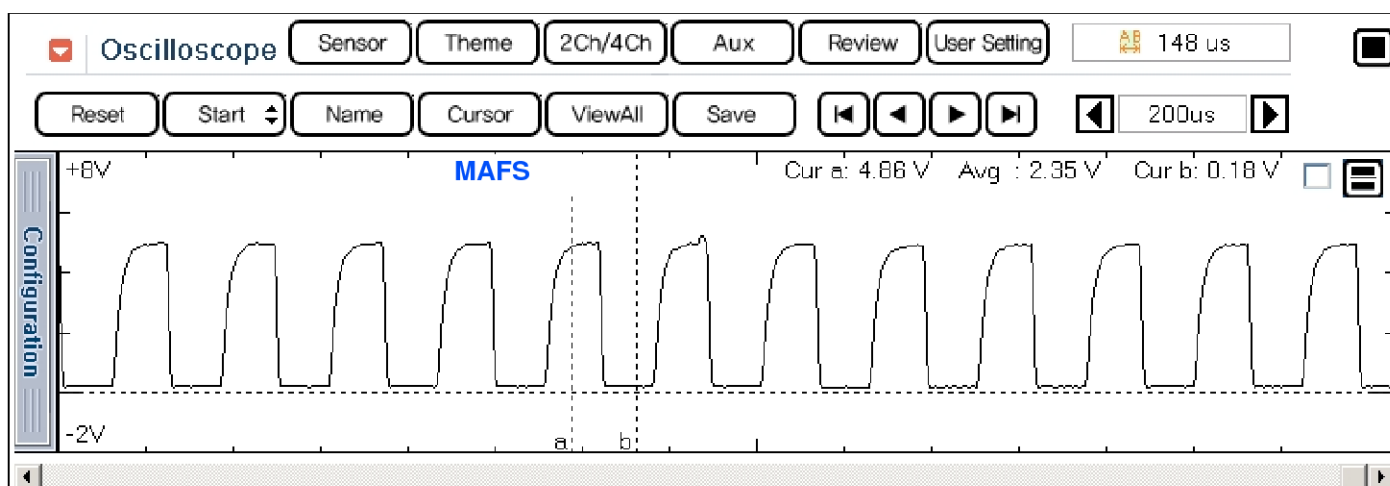


Fig.2

SBHFL9694L

Fig 1) Normal waveform of MAFS at idle. (640rpm & 13.0 kg/h)

Fig 2) Normal waveform of MAFS at acceleration. (2520rpm & 43.7 kg/h)

4. Are both service data and signalwave form displayed correctly ?

YES ▶ Go to "Verification of Vehicle Repair" procedure.

NO ▶ Substitute with a known - good MAFS and check for proper operation. If the problem is corrected, replace MAFS and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-719

P2187 System too Lean at Idle (←Additive) (Bank 1)

General Description

In order to provide the best possible combination of drivability, fuel economy and emission control, the ECM uses a closed loop air/fuel metering system. The ECM monitors the HO2S signal voltage and adjusts fuel delivery based on it in closed loop fuel control. Changes in fuel delivery will be indicated by the long-term and the short-term fuel trim values. The ideal fuel trim value is around 0%. The ECM will add fuel when the HO2S signal is indicating a lean condition. Additional fuel is indicated by fuel trim values that are above 0%. The ECM will reduce fuel when the HO2S signal is indicating a rich condition. Reduction in fuel is indicated by fuel trim values that are below 0%. The DTC relevant to fuel trim will be set when the amount reaches excessive levels because of a lean or rich condition.

DTC Description

Checking the fuel trim value at idle under detecting condition, if its average exceeds the limit over certain period, ECM sets P2187.

MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycles.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor the fuel trim value at idle	- Air leakage - Improper fuel pressure - PCV valve stuck - Clogging of injector
Enable Conditions	- Engine warm-up sufficiently - Engine running under Idle state over 5 minutes 60°C(140°F) ≤ Engine coolant temperature ≤ 115°C(239°F) - No disabling faults (DTCs related to HO2S, purge valve, catalyst)	
Threshold value	Average of short term fuel trim > 0.8 and Average of long term fuel trim > 1.24	
Diagnosis Time	Continuous	
MIL On Condition	2 Driving Cycles	

Monitor Scantool Data

1. Monitor DTCs related to HO2S, MAFS, MAPS, ECTS, PCSV, Injector or CVVT items with scantool.

2. Are there the DTCs above-mentioned?

YES ▶ Do all repairs associated with those codes before proceeding with this procedure.

NO ▶ Go to "System Inspection" procedure

System Inspection

■ Check air leakage

1. Visually/physically inspect the air leakage in intake/exhaust system for following items

▶ Vacuum hoses for splits, kinks and improper connections.

▶ Throttle body gasket

▶ Gasket between intake manifold and cylinder head

▶ Seals between intake manifold and fuel injectors

▶ Exhaust system between HO2S and three way catalyst for air leakage

2. Has a problem found in this procedure?

YES ▶ Repair or replace it which has a problem, and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check the fuel line" as follows

FL-720

Fuel System

■ Check the fuel line

1. Check the fuel line for following items
 - ▶ Connector connection state
 - ▶ Damage/ connection state for vacuum hoses connected to fuel line
 - ▶ Bent/ pressed/ twisted fuel line or fuel leakage
2. Has a problem found in this procedure?

YES ▶ Repair or replace it which has a problem, and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check fuel pressure" as follows

■ Check fuel pressure

NOTICE

1. *Be cautious that Fuel is explosive and an empty fuel tank can still contain explosive gases. When working on fuel system make sure to supply adequate ventilation to the work area. Do not smoke, and keep sparks and open flames away.*
2. *The fuel system remains under pressure when the engine is not running. Release fuel system pressure before disconnecting any fuel line to reduce the chance of personal injury or fire damage to vehicle components.*
1. IG "OFF" and disconnect Fuel Pump Relay in Junction Box.
2. Start-up and wait until it stops itself.
3. IG "OFF" and connect Fuel Pump Relay.
4. Install the fuel pressure gauge to the delivery pipe with the fuel pressure gauge adaptor.
5. Activate the fuel pump, and with fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.
6. Measure the fuel pressure at idle.

Specification : 374.6 ~ 384.4 kPa(3.82 ~ 3.92 kg/cm², 54.3 ~ 55.8 psi)

7. Is the measured fuel pressure within specifications ?

YES ▶ Go to "Component Inspection" procedure.

NO ▶ Repair or replace according to the below table. And then, go to "Verification of Vehicle Repair" procedure.

Condition	Possible Cause

Condition	Possible Cause
Fuel Pressure is too low	Fuel filter, fuel pressure regulator, in-tank fuel hose or the fuel pump
Fuel Pressure is too high	Fuel pressure regulator, hose or pipe

Component Inspection

■ Check PCV

1. IG "OFF" and remove PCV valve from rocker cover.
2. Insert a thin stick into the PCV valve from the threaded side and verify that the plunger is moving.
3. Is the PCV valve normally moving?

YES ▶ Go to "Check injector for normal operation" as follows.

NO ▶ Replace it, and go to "Verification of Vehicle Repair" procedure.

■ Check injector for normal operation

1. Start engine.
2. Check its RPM decrease when doing the injector's actuation test.
3. Is there any cylinder with no change in RPM or only a small change in RPM?

YES ▶ Clear DTC and Test-drive under enable conditions above-mentioned. After the test, If this DTC is set, go to "Inspection & Repair" procedure. If not, troubleshooting is completed.

NO ▶ Replace injector, and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-721

P2188 System too Rich at Idle (Bank 1)

General Description

Refer to DTC P2187 : System too Lean at Idle (←Additive) (Bank 1)

DTC Description

Checking the fuel trime value at idle under detecting condition, if its average exceeds the limit over certain period, ECM sets P2188. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycles.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Monitor the fuel trim value at idle	• Blocking of intake system • Fuel leakage in injector • Improper fuel pressure
Enable Conditions	• Engine warm-up sufficiently • Engine running under Idle state over 5 minutes • $60^{\circ}\text{C}(140^{\circ}\text{F}) \leq \text{Engine coolant temperature} \leq 115^{\circ}\text{C}(239^{\circ}\text{F})$ • No disabling faults (DTCs related to HO2S, purge valve ,catalyst)	
Threshold value	• Average of short term fuel trim < 1.5 and Average of long term fuel trim < 0.76	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 Driving Cycles	

Monitor Scantool Data

1. Monitor DTCs related to HO2S, MAFS, MAPS, ECTS, PCSV, Injector or CVVT items with scantool.
2. Are there the DTCs above-mentioned?

YES ▶ Do all repairs associated with those codes before proceeding with this procedure.

NO ▶ Go to "System Inspection" procedure

System Inspection

■ Check blocking of intake system

1. Visually/physically inspect the blocking in intake system for following items
 - ▶ Throttle body gasket and damage
 - ▶ Blocking in intake manifold and injector caused by any foreign substance
2. Has a problem found in this procedure?

YES ▶ Repair or replace it which has a problem, and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to " Check fuel pressure" as follows.

■ Check fuel pressure

NOTICE

1. Be cautious that Fuel is explosive and an empty fuel tank can still contain explosive gases. When working on fuel system make sure to supply adequate ventilation to the work area. Do not smoke, and keep sparks and open flames away.
 2. The fuel system remains under pressure when the engine is not running. Release fuel system pressure before disconnecting any fuel line to reduce the chance of presonal injury or fire damage to vehicle components.
1. IG "OFF" and disconnect Fuel Pump Relay in Junction Box.
 2. Start-up and wait until it stops itself.
 3. IG "OFF" and connect Fuel Pump Relay.
 4. Install the fuel pressure gauge to the delivery pipe with the fuel pressure gauge adaptor.
 5. Activate the fuel pump, and with fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.

FL-722

Fuel System

6. Measure the fuel pressure at idle.

Specification : 374.6 ~ 384.4 kPa(3.82 ~ 3.92 kg/cm², 54.3 ~ 55.8 psi)

7. Is the measured fuel pressure within specifications ?

YES ▶ Go to "Check fuel leakage in injector" as follow.

NO ▶ Repair or replace according to the below table. And then, go to " Verification of Vehicle Repair" procedure.

Condition	Possible Cause
Fuel Pressure is too low	Fuel filter, fuel pressure regulator, in-tank fuel hose or the fuel pump
Fuel Pressure is too high	Fuel pressure regulator, hose or pipe

■ Check fuel leakage in injector

1. IG "OFF" after checking the fuel pressure test..
2. Stop engine and check for a change in the fuel pressure gauge reading for 5 minutes.

Specification : After engine stops, fuel gauge reading is maintained for 5 minutes.

3. Is the fuel gauge reading maintained ?

YES ▶ Clear DTC and Test-drive under enable conditions above-mentioned. After the test, If this DTC is set, go to "Inspection & Repair" procedure. If not, troubleshooting is completed.

NO ▶ There is a fuel leakage in injector. Replace it , and go to " Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P2187 : System too Lean at Idle (←Additive) (Bank 1)

Engine Control System

FL-723

P2189 System too Lean at Idle (- Additive) (Bank 2)

General Description

Refer to DTC P2187 : System too Lean at Idle (←Additive) (Bank 1)

DTC Description

Checking the fuel trim value at idle under detecting condition, if its average exceeds the limit over certain period, ECM sets P2189. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycles.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor the fuel trim value at idle	- Air leakage - Improper fuel pressure - PCV valve stuck - Clogging of injector
Enable Conditions	- Engine warm-up sufficiently - Engine running under Idle state over 5 minutes $60^{\circ}\text{C}(140^{\circ}\text{F}) \leq \text{Engine coolant temperature} \leq 115^{\circ}\text{C}(239^{\circ}\text{F})$ - No disabling faults (DTCs related to HO2S, purge valve, catalyst)	
Threshold value	Average of short term fuel trim > 0.8 and Average of long term fuel trim > 1.24	
Diagnosis Time	Continuous	
MIL On Condition	2 Driving Cycles	

Monitor Scantool Data

- Monitor DTCs related to HO2S, MAFS, MAPS, ECTS, PCSV, Injector or CVVT items with scantool.
- Are there the DTCs above-mentioned?

YES ▶ Do all repairs associated with those codes before proceeding with this procedure.

NO ▶ Go to "System Inspection" procedure

System Inspection

■ Check air leakage

- Visually/physically inspect the air leakage in intake/exhaust system for following items
 - ▶ Vacuum hoses for splits, kinks and improper connections.
 - ▶ Throttle body gasket
 - ▶ Gasket between intake manifold and cylinder head
 - ▶ Seals between intake manifold and fuel injectors
 - ▶ Exhaust system between HO2S and three way catalyst for air leakage

- Has a problem found in this procedure?

YES ▶ Repair or replace it which has a problem, and go to "Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check the fuel line" as follows

■ Check the fuel line

- Check the fuel line for following items

- ▶ Connector connection state
- ▶ Damage/ connection state for vacuum hoses connected to fuel line
- ▶ Bent/ pressed/ twisted fuel line or fuel leakage

- Has a problem found in this procedure?

YES ▶ Repair or replace it which has a problem, and go to " Verification of Vehicle Repair" procedure.

NO ▶ Go to "Check fuel pressure" as follows

FL-724

Fuel System

■ Check fuel pressure

NOTICE

1. Be cautious that Fuel is explosive and an empty fuel tank can still contain explosive gases. When working on fuel system make sure to supply adequate ventilation to the work area. Do not smoke, and keep sparks and open flames away.
2. The fuel system remains under pressure when the engine is not running. Release fuel system pressure before disconnecting any fuel line to reduce the chance of personal injury or fire damage to vehicle components.
1. IG "OFF" and disconnect Fuel Pump Relay in Junction Box.
2. Start-up and wait until it stops itself.
3. IG "OFF" and connect Fuel Pump Relay.
4. Install the fuel pressure gauge to the delivery pipe with the fuel pressure gauge adaptor.
5. Activate the fuel pump, and with fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.
6. Measure the fuel pressure at idle.

Specification : 374.6 ~ 384.4 kPa(3.82 ~ 3.92 kg/cm², 54.3 ~ 55.8 psi)

7. Is the measured fuel pressure within specifications ?

YES ► Go to "Component Inspection" procedure.

NO ► Repair or replace according to the below table. And then, go to " Verification of Vehicle Repair" procedure.

Condition	Possible Cause
Fuel Pressure is too low	Fuel filter,fuel pressure regulator, in-tank fuel hose or the fuel pump
Fuel Pressure is too high	Fuel pressure regulator, hose or pipe

Verification of Vehicle Repair

Refer to DTC P2187 : System too Lean at Idle (←Additive) (Bank 1)

Engine Control System

FL-725

P2190 System too Rich at Idle (Bank 2)

General Description

Refer to DTC P2187 : System too Lean at Idle (←Additive) (Bank 1)

DTC Description

Checking the fuel trime value at idle under detecting condition, if its average exceeds the limit over certain period, ECM sets P2190. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycles.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor the fuel trim value at idle	- Blocking of intake system - Fuel leakage in injector - Improper fuel pressure
Enable Conditions	- Engine warm-up sufficiently - Engine running under Idle state over 5 minutes 60°C(140°F) ≤ Engine coolant temperature ≤ 115°C(239°F) - No disabling faults (DTCs related to HO2S, purge valve ,catalyst)	
Threshold value	Average of short term fuel trim < 1.5 and Average of long term fuel trim < 0.76	
Diagnosis Time	Continuous	
MIL On Condition	2 Driving Cycles	

Monitor Scantool Data

- Monitor DTCs related to HO2S, MAFS, MAPS, ECTS, PCSV, Injector or CVVT items with scantool.
- Are there the DTCs above-mentioned?

YES ► Do all repairs associated with those codes before proceeding with this procedure.

NO ► Go to "System Inspection" procedure

System Inspection

■ Check blocking of intake system

- Visually/physically inspect the blocking in intake system for following items
 - Throttle body gasket and damage
 - Blocking in intake manifold and injector caused by any foreign substance
- Has a problem found in this procedure?

YES ► Repair or replace it which has a problem, and go to "Verification of Vehicle Repair" procedure.

NO ► Go to " Check fuel pressure" as follows.

■ Check fuel pressure

NOTICE

- Be cautious that Fuel is explosive and an empty fuel tank can still contain explosive gases. When working on fuel system make sure to supply adequate ventilation to the work area. Do not smoke, and keep sparks and open flames away.*
 - The fuel system remains under pressure when the engine is not running. Release fuel system pressure before disconnecting any fuel line to reduce the chance of presonal injury or fire damage to vehicle components.*
- IG "OFF" and disconnect Fuel Pump Relay in Junction Box.
 - Start-up and wait until it stops itself.
 - IG "OFF" and connect Fuel Pump Relay.
 - Install the fuel pressure gauge to the delivery pipe with the fuel pressure gauge adaptor.
 - Activate the fuel pump, and with fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.

FL-726

Fuel System

6. Measure the fuel pressure at idle.

Specification : 374.6 ~ 384.4 kPa(3.82 ~ 3.92 kg/cm², 54.3 ~ 55.8 psi)

7. Is the measured fuel pressure within specifications ?

YES ▶ Go to "Check fuel leakage in injector" as follow.

NO ▶ Repair or replace according to the below table. And then, go to " Verification of Vehicle Repair" procedure.

Condition	Possible Cause
Fuel Pressure is too low	Fuel filter, fuel pressure regulator, in-tank fuel hose or the fuel pump
Fuel Pressure is too high	Fuel pressure regulator, hose or pipe

■ Check fuel leakage in injector

1. IG "OFF" after checking the fuel pressure test.
2. Stop engine and check for a change in the fuel pressure gauge reading for 5 minutes.

Specification : After engine stops, fuel gauge reading is maintained for 5 minutes.

3. Is the fuel gauge reading maintained ?

YES ▶ Clear DTC and Test-drive under enable conditions above-mentioned. After the test, If this DTC is set, go to "Inspection & Repair" procedure. If not, troubleshooting is completed.

NO ▶ There is a fuel leakage in injector. Replace it, and go to " Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

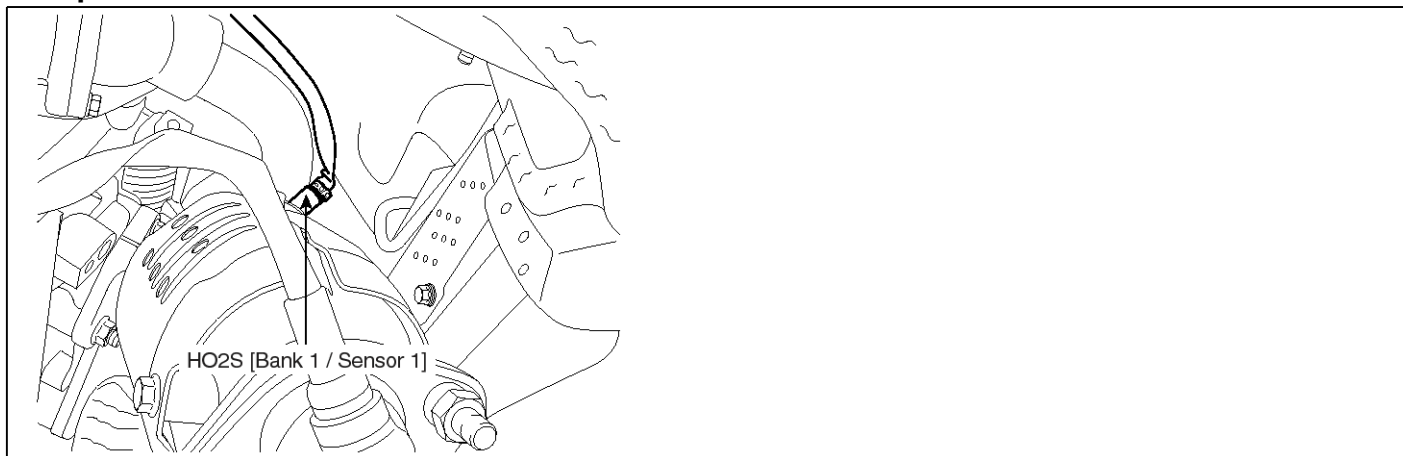
Refer to DTC P2187 : System too Lean at Idle (←Additive) (Bank 1)

Engine Control System

FL-727

P2195 O2 Sensor Signal Stuck Lean (Bank 1 Sensor 1)

Component Location



SBHFL9311L

General Description

In order to control emissions of the CO, HC and NOx components of the exhaust gas, heated oxygen sensor (HO2S), mounted on the front side and rear side of catalytic converter, detects the oxygen content in the exhaust gas. The front HO2S signal is used to control air/fuel ratio (closed loop fuel control) and the rear HO2S signal is used to monitor front HO2S and catalyst for proper operation. The HO2S requires a minimum temperature to operate properly and provide a closed loop fuel control system. The HO2S contains the heater element to reduce its warming-up time and ensure its performance during all driving conditions. The oxygen sensor generates a voltage that indicates the difference between the oxygen content of the exhaust stream and the oxygen content of ambient air. When the exhaust stream is "rich," there is more oxygen in the ambient air than in the exhaust stream, so the voltage will be higher.

DTC Description

Checking output signals from HO2S under detecting condition, if HO2S's signal is lean during power enrichment conditions, ECM sets P2195. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycles.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor HO2S's signal	- Poor Connection - Faulty HO2S - Clogging of fuel filter in fuel pump - Faulty ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running $\geq 60sec.$ - Power Enrichment conditions - Engine warm-up state - Not in Transient Conditions	
Threshold value	HO2S's signal $< 0.35V$ and Air Fuel Ratio ≤ 13.5	
Diagnosis Time	Continuous (More than 8 sec. failure for every 9 sec. Test)	
MIL On Condition	2 Driving Cycles	

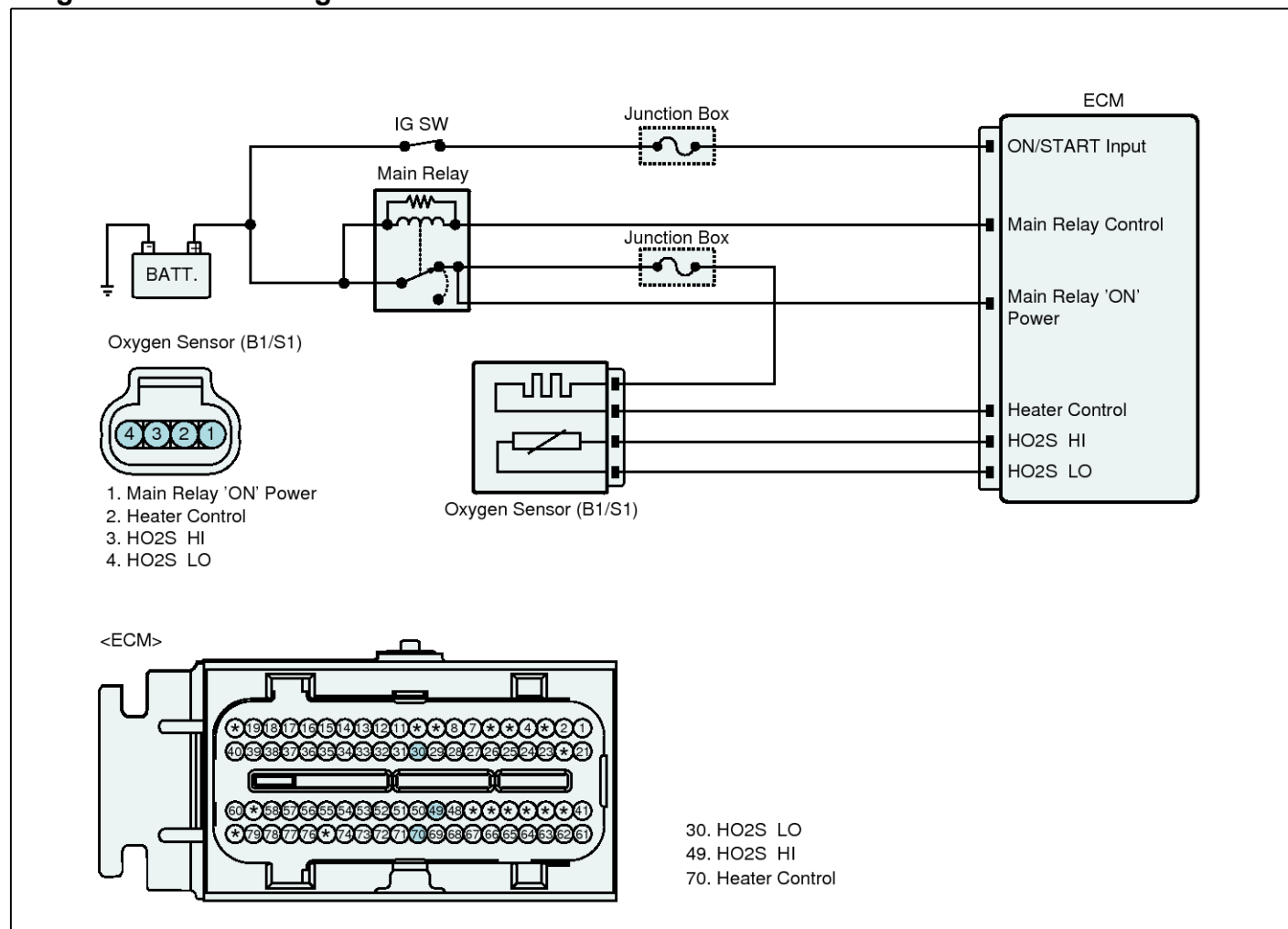
FL-728

Fuel System

Specification (Reference only)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is commonly switching from rich to lean more than 3 times in 10 sec.	Signal is commonly above 0.6V.
HO2S signal at open circuit (Pumping current OFF)	Approx. 0.45V	
HO2S signal at open circuit (Pumping current ON)	Approx. 3.5V	

Diagnostic Circuit Diagram



SBHFL9508L

Signal Waveform & Data

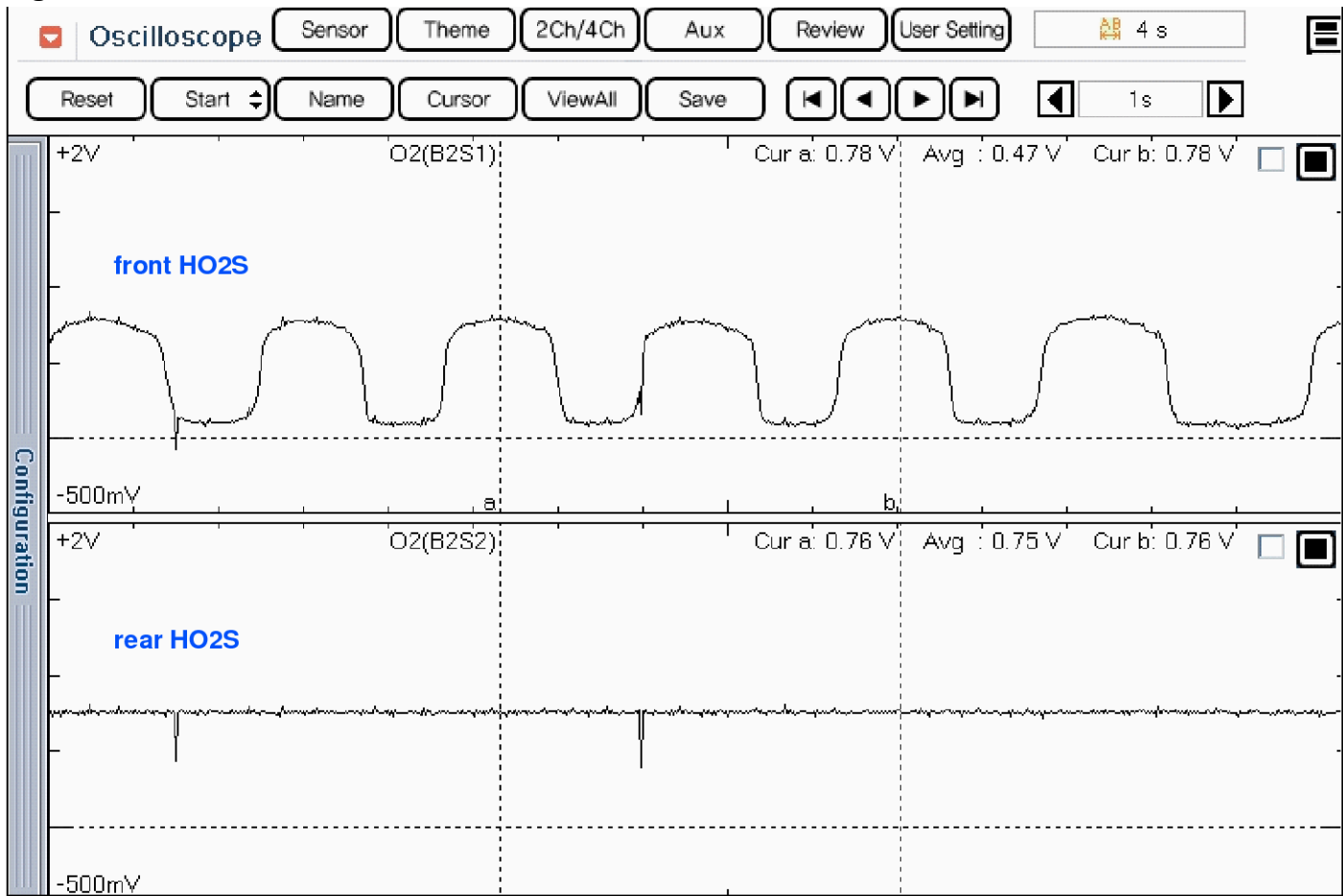


Fig.1

SBHFL9698L

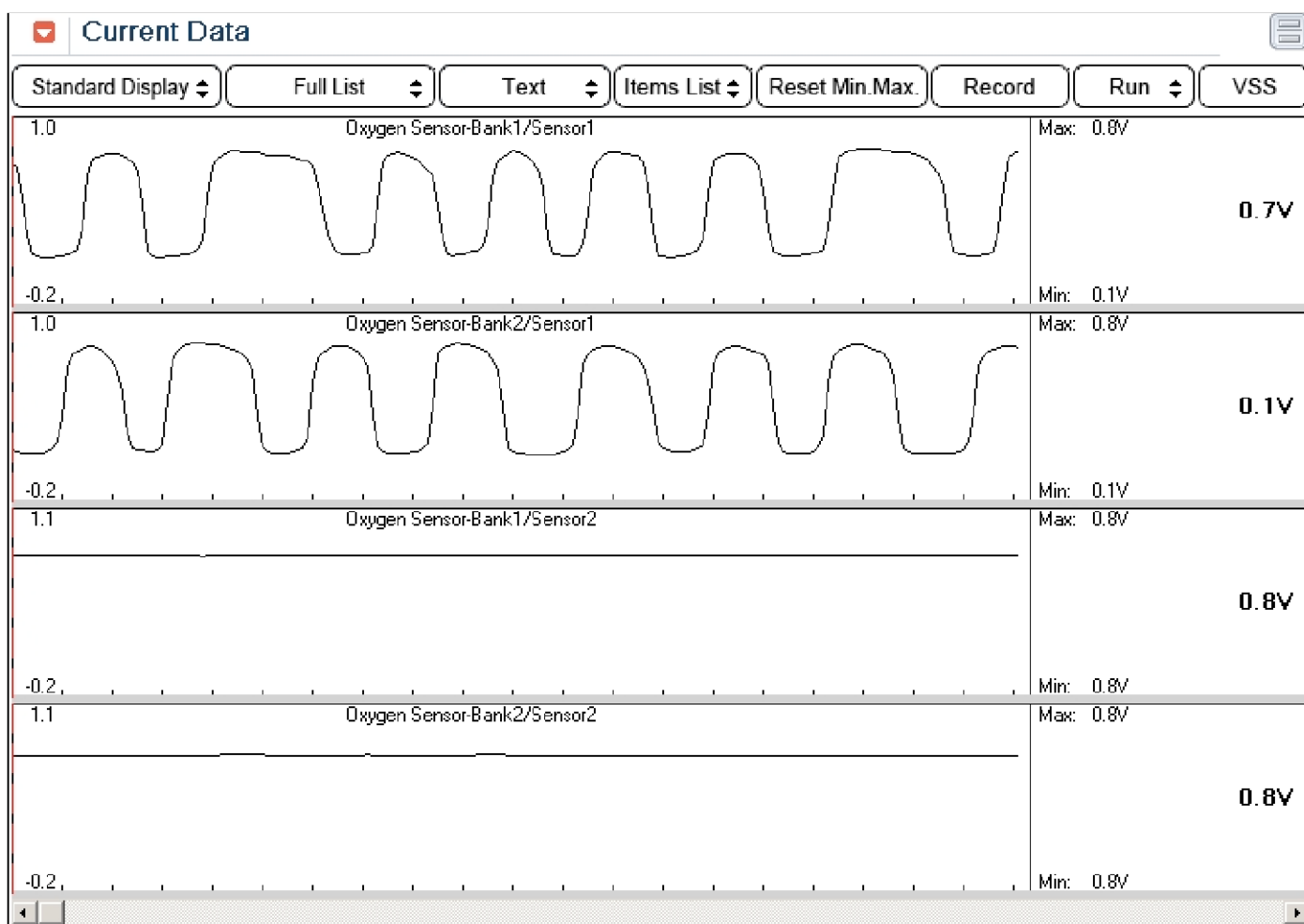


Fig.2

SBHFL9639L

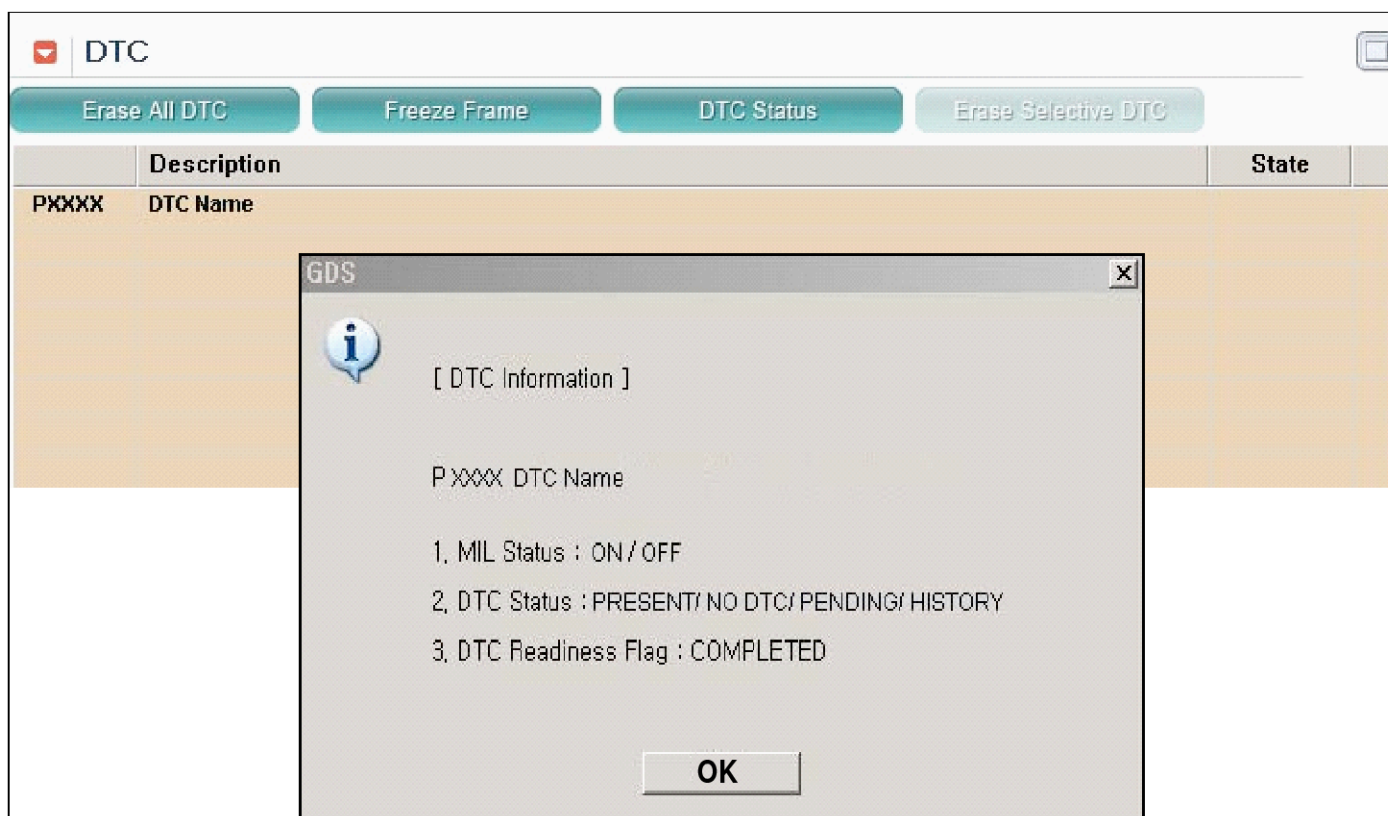
Fig 1) Normal waveforms of front HO2S(the upper) and rear HO2S(the lower)

Fig 2) Normal graph of front HO2S and rear HO2S at idle.

After warming-up, if accelerator pedal is released suddenly around 4000rpm, the HO2S signal reading will be lower than 200mV resulting from Fuel cut-off for the moment. Conversely, if suddenly accelerator pedal is depressed, HO2S signal reading will be around 0.6V ~1.0V. At idle, Normally HO2S signal will switch from lean to rich with 3 Hz. And as racing, Its frequency rises.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Component Inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check the condition of HO2S

1. Check HO2S for poor connection or loose terminal.
2. Check if HO2S is ensurely installed.
3. Is the conditions of HO2S normal ?

YES ► Go to "Check the Signal waveform of HO2S" as follows.

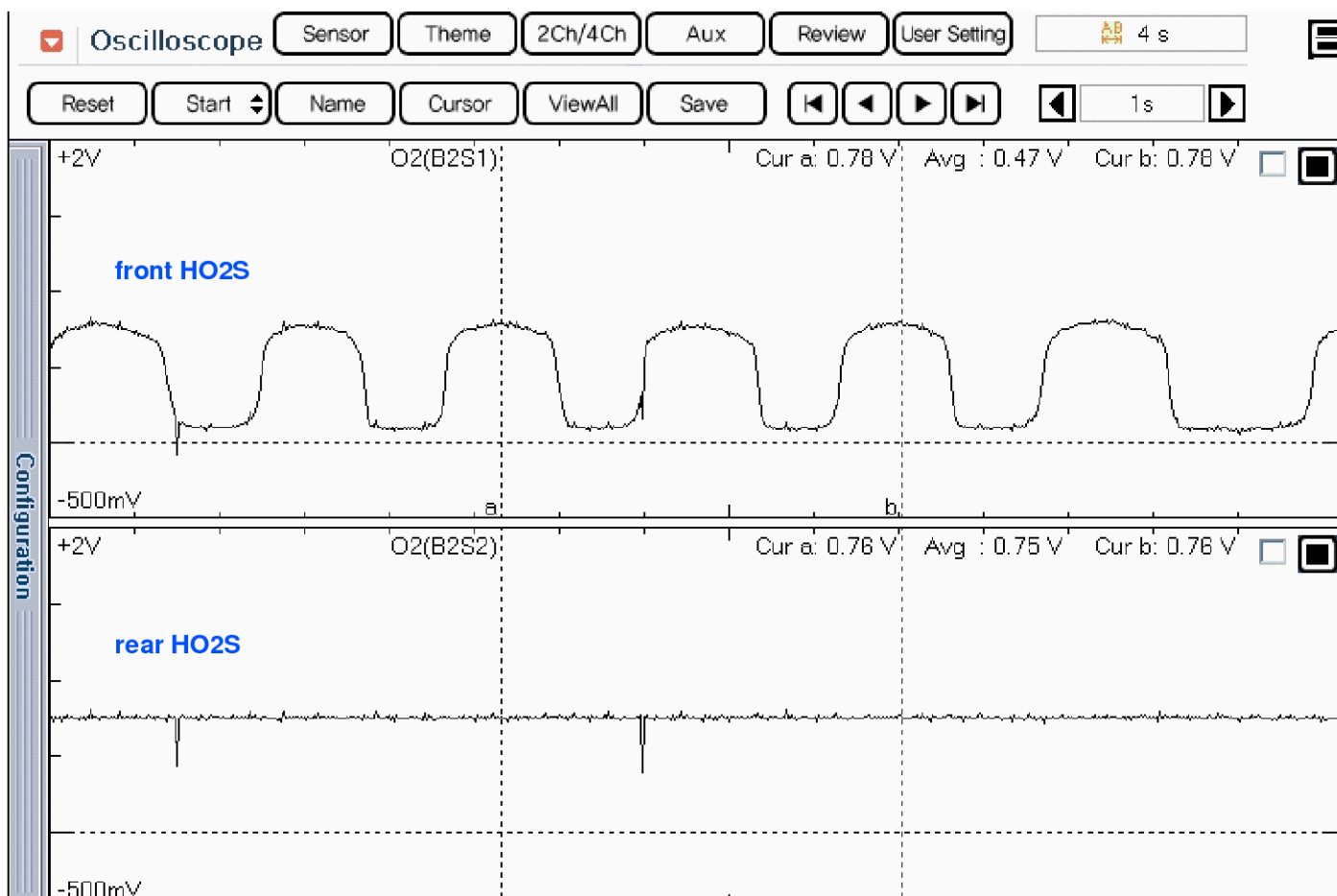
NO ► Repair it and then go to "Verification of Vehicle Repair" procedure.

■ Check the Signal waveform of HO2S

1. IG "OFF" and connect HO2S connector.
2. Engine start.
3. After warming-up, monitor signal waveform of HO2S with scantool.

FL-732

Fuel System



SBHFL9640L

4. Is the sensor switching properly?

YES ► Go to "Check fuel filter" as follows.

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

■ Check the fuel filter of fuel pump

1. IG "OFF" and disconnect the fuel pump connector.
2. Start the engine and wait until fuel in fuel line is exhausted. After the engine stalls, IG "OFF"
3. Remove the fuel pump assembly.
4. Check the fuel filter for clogging by dust, a foreign substance.

5. Is the fuel filter O.K.?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

⚠ NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Substitute with a known - good fuel filter and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Engine Control System

FL-733

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

FL-734

Fuel System

P2196 O2 Sensor Signal Stuck Rich (Bank 1 Sensor 1)

Component Location

Refer to DTC P2195 : O2 Sensor Signal Stuck Lean (Bank 1 Sensor 1)

General Description

Refer to DTC P2195 : O2 Sensor Signal Stuck Lean (Bank 1 Sensor 1)

DTC Description

Checking output signals from HO2S under detecting condition, if HO2S's signal is rich during fuel cut-off conditions, ECM sets P2196. MIL (Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycles.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor HO2S's signal	- Poor Connection - Faulty HO2S - Faulty ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running $\geq 60\text{sec.}$ - Fuel cut-off conditions - Engine warm-up state - Not in Transient Conditions	
Threshold value	HO2S's signal $> 0.42V$	
Diagnosis Time	Continuous (More than 8 sec. failure for every 9 sec. T-test)	
MIL On Condition	2 Driving Cycles	

Specification

Refer to DTC P2195 : O2 Sensor Signal Stuck Lean (Bank 1 Sensor 1)

Diagnostic Circuit Diagram

Refer to DTC P2195 : O2 Sensor Signal Stuck Lean (Bank 1 Sensor 1)

Signal Waveform & Data

Refer to DTC P2195 : O2 Sensor Signal Stuck Lean (Bank 1 Sensor 1)

Monitor Scantool Data

Refer to DTC P2195 : O2 Sensor Signal Stuck Lean (Bank 1 Sensor 1)

Component Inspection

■ Check the condition of HO2S

1. Check HO2S for poor connection or loose terminal.
2. Check if HO2S is ensurely installed.
3. Is the conditions of HO2S normal ?

YES ► Go to "Check the Signal waveform of HO2S" as follows.

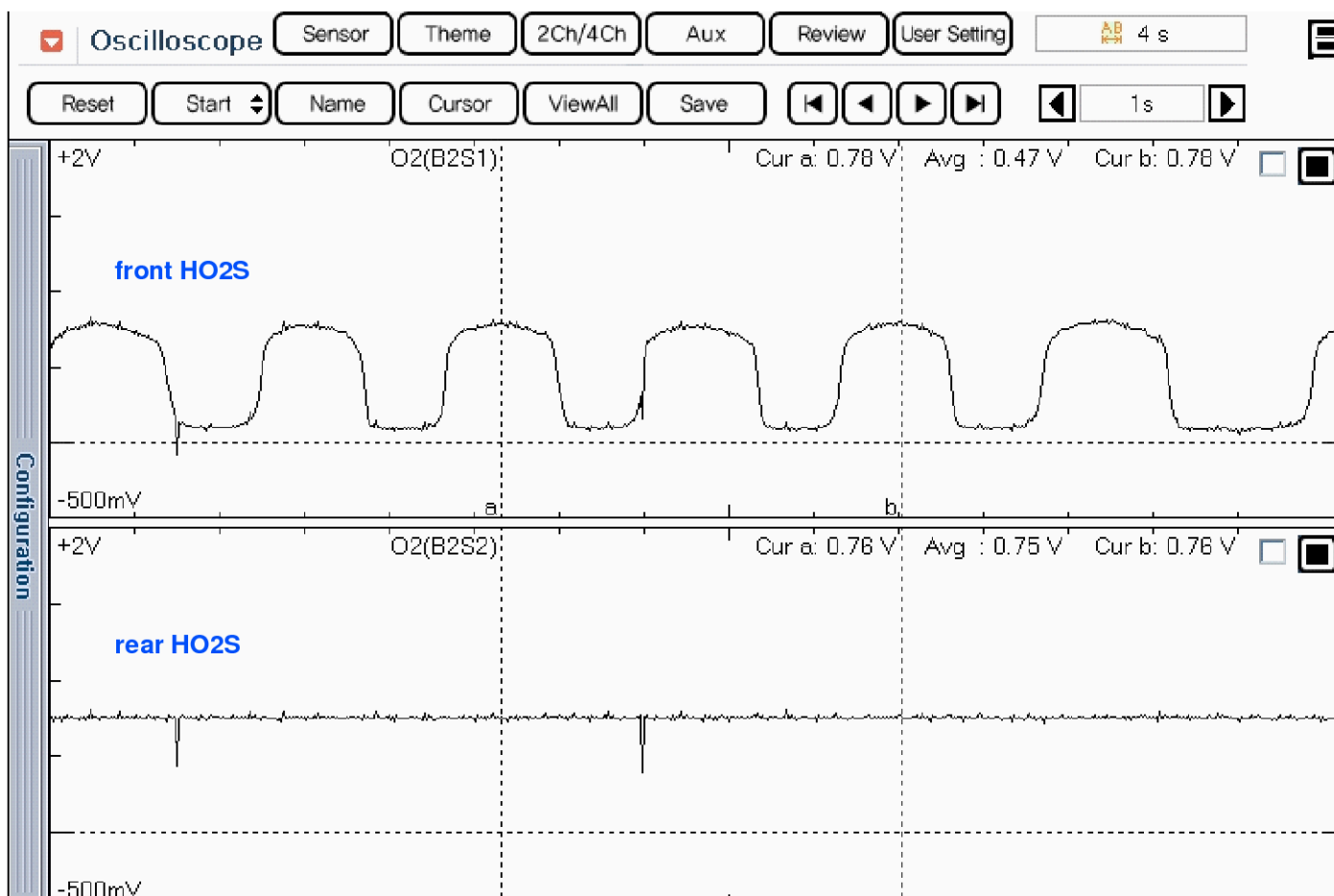
NO ► Repair it and then go to "Verification of Vehicle Repair" procedure.

■ Check the Signal waveform of HO2S

1. IG "OFF" and connect HO2S connector.
2. Engine start.
3. After warming-up, monitor signal waveform of HO2S with scantool.

Engine Control System

FL-735



SBHFL9640L

4. Is the sensor switching properly?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

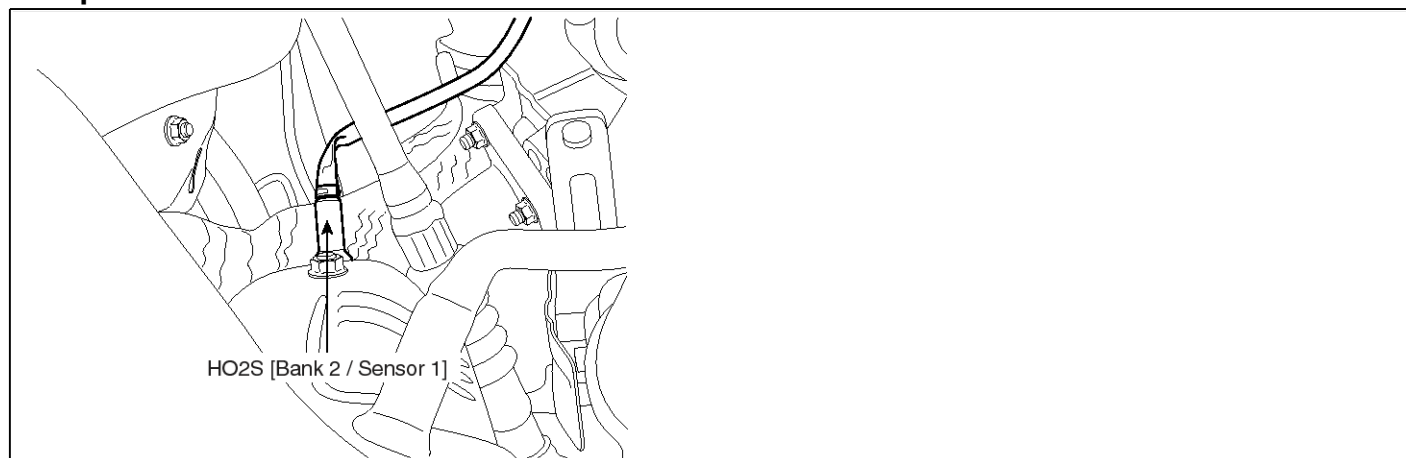
Refer to DTC P2195 : O2 Sensor Signal Stuck Lean (Bank 1 Sensor 1)

FL-736

Fuel System

P2197 O2 Sensor Signal Stuck Lean (Bank 2 Sensor 1)

Component Location



SBHFL9313L

General Description

In order to control emissions of the CO, HC and NOx components of the exhaust gas, heated oxygen sensor (HO2S), mounted on the front side and rear side of catalytic converter, detects the oxygen content in the exhaust gas. The front HO2S signal is used to control air/fuel ratio (closed loop fuel control) and the rear HO2S signal is used to monitor front HO2S and catalyst for proper operation. The HO2S requires a minimum temperature to operate properly and provide a closed loop fuel control system. The HO2S contains the heater element to reduce its warming-up time and ensure its performance during all driving conditions. The oxygen sensor generates a voltage that indicates the difference between the oxygen content of the exhaust stream and the oxygen content of ambient air. When the exhaust stream is "rich," there is more oxygen in the ambient air than in the exhaust stream, so the voltage will be higher..

DTC Description

Checking output signals from HO2S under detecting condition, if HO2S's signal is lean during power enrichment conditions, ECM sets P2197. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycles.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor HO2S's signal	- Poor Connection - Faulty HO2S - Clogging of fuel filter in fuel pump - Faulty ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running $\geq 60sec.$ - Power Enrichment conditions - Engine warm-up state - Not in Transient Conditions	
Threshold value	HO2S's signal $< 0.35V$ and Air Fuel Ratio ≤ 13.5	
Diagnosis Time	Continuous (More than 8 sec. failure for every 9 sec. Test)	
MIL On Condition	2 Driving Cycles	

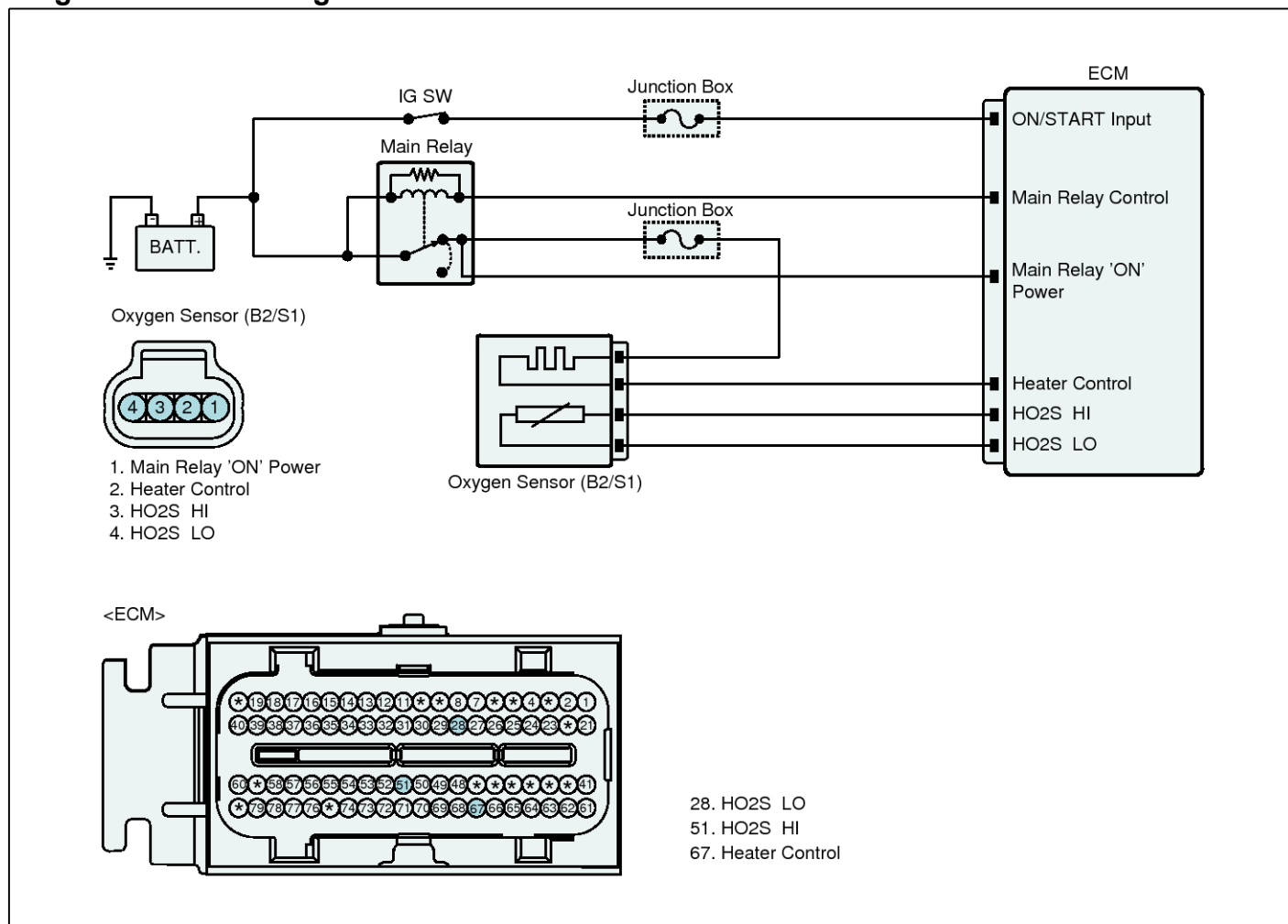
Engine Control System

FL-737

Specification (Reference only)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is commonly switching from rich to lean more than 3 times in 10 sec.	Signal is commonly above 0.6V.
HO2S signal at open circuit (Pumping current OFF)	Approx. 0.45V	
HO2S signal at open circuit (Pumping current ON)	Approx. 3.5V	

Diagnostic Circuit Diagram



SBHFL9510L

Signal Waveform & Data

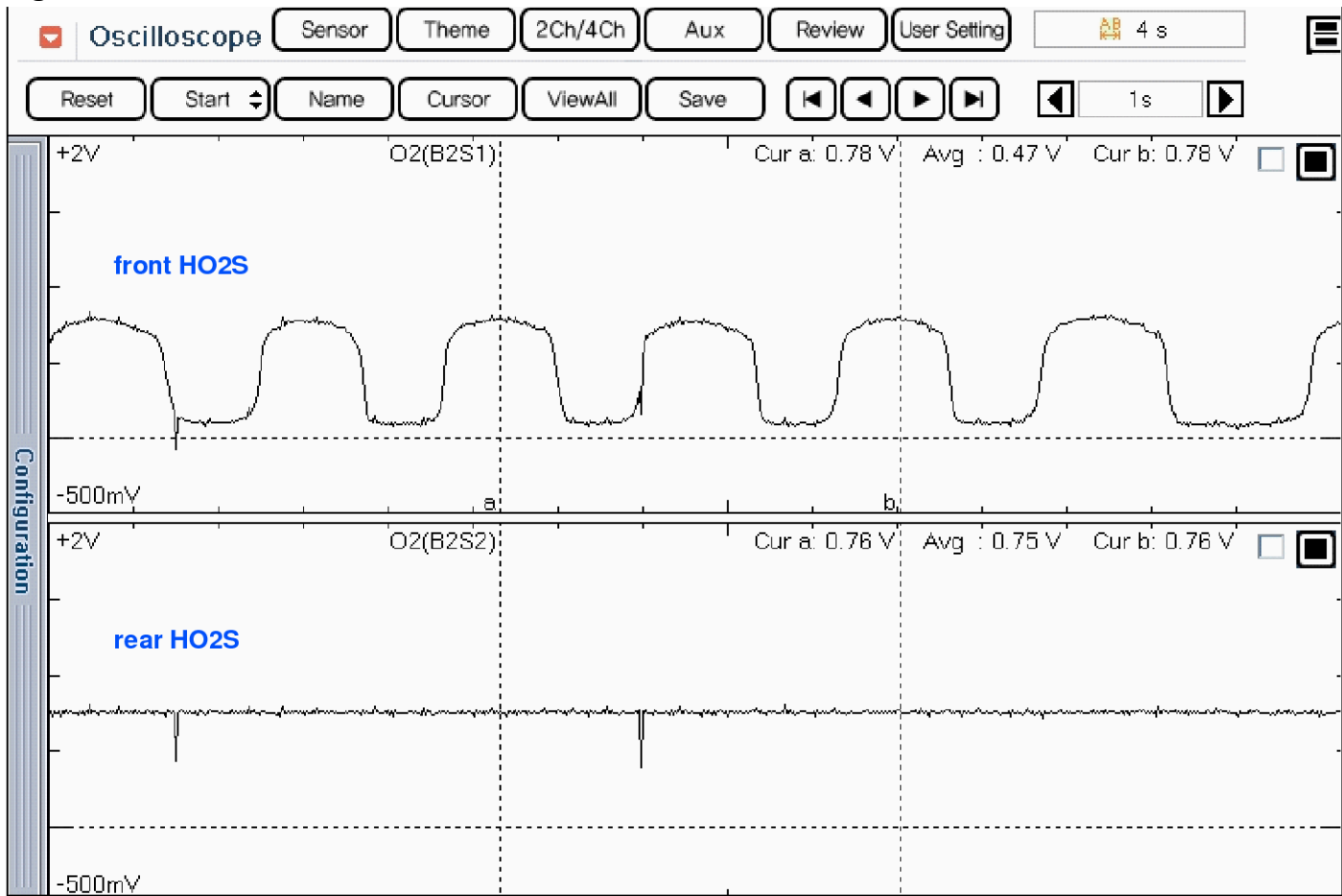


Fig.1

SBHFL9698L

Engine Control System

FL-739

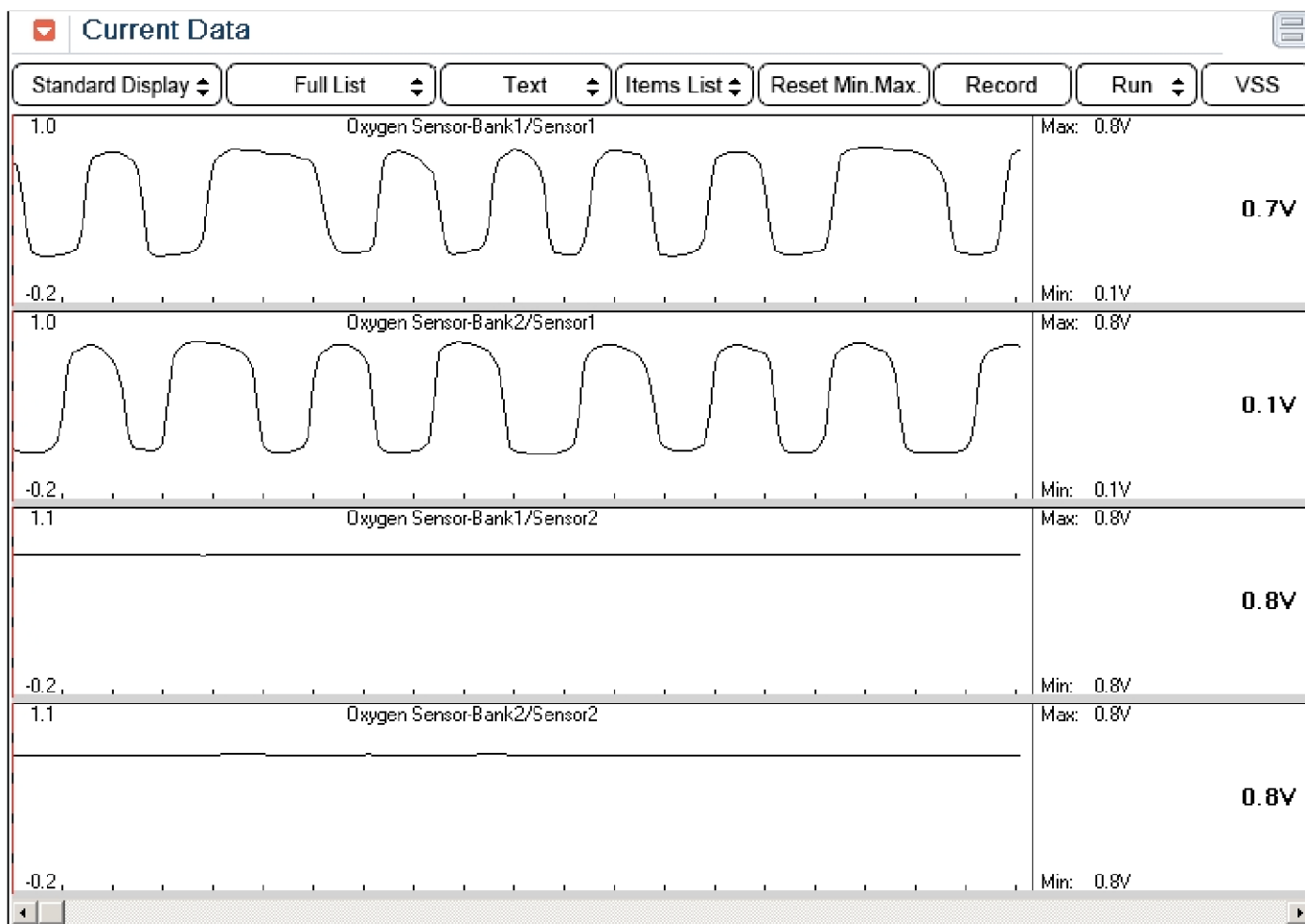


Fig.2

SBHFL9639L

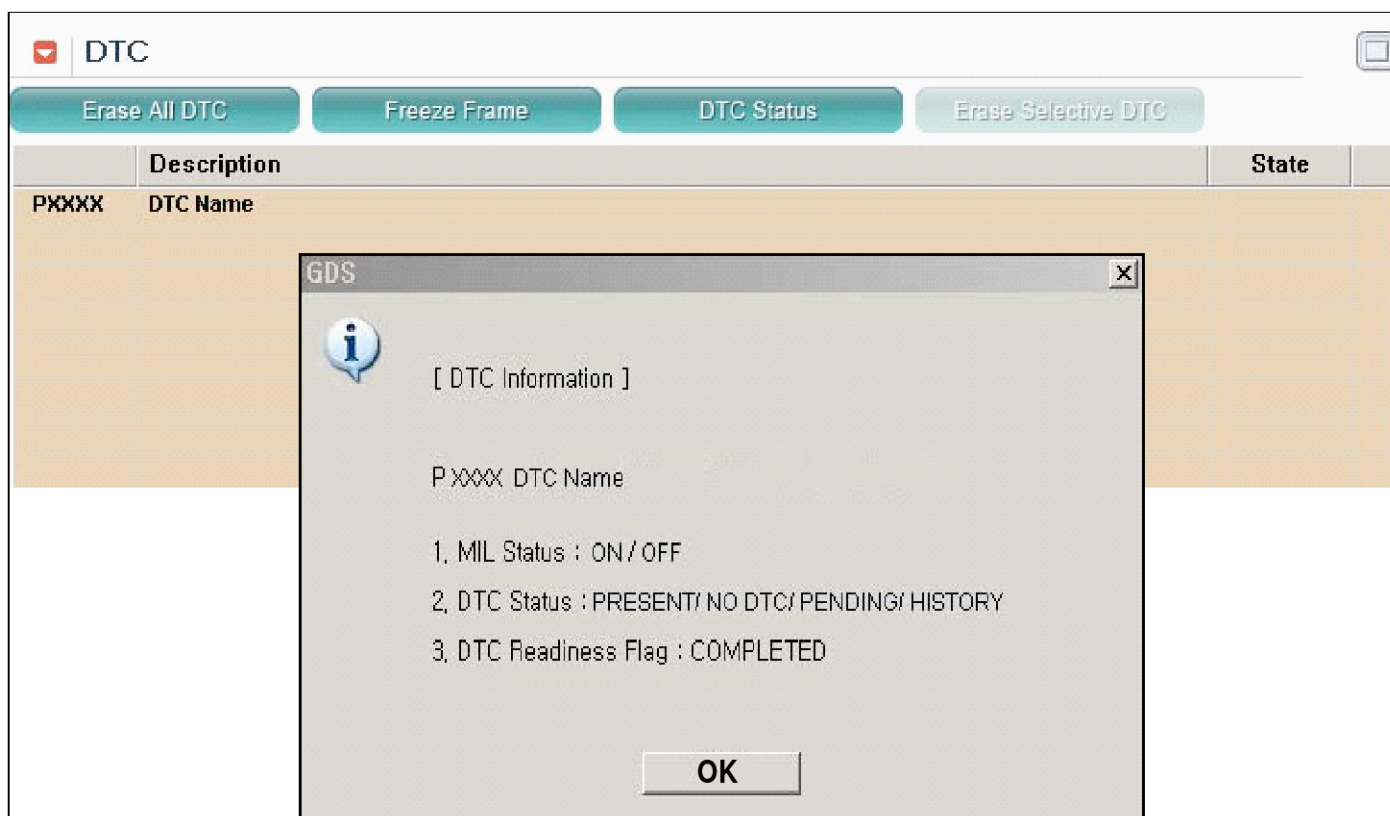
Fig 1) Normal waveforms of front HO2S(the upper) and rear HO2S(the lower)

Fig 2) Normal graph of front HO2S and rear HO2S at idle.

After warming-up, if accelerator pedal is released suddenly around 4000rpm, the HO2S signal reading will be lower than 200mV resulting from Fuel cut-off for the moment. Conversely, if suddenly accelerator pedal is depressed, HO2S signal reading will be around 0.6V ~1.0V. At idle, Normally HO2S signal will switch from lean to rich with 3 Hz. And as racing, Its frequency rises.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Component Inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check the condition of HO2S

1. Check HO2S for poor connection or loose terminal.
2. Check if HO2S is ensurely installed.
3. Is the conditions of HO2S normal ?

YES ► Go to "Check the Signal waveform of HO2S" as follows.

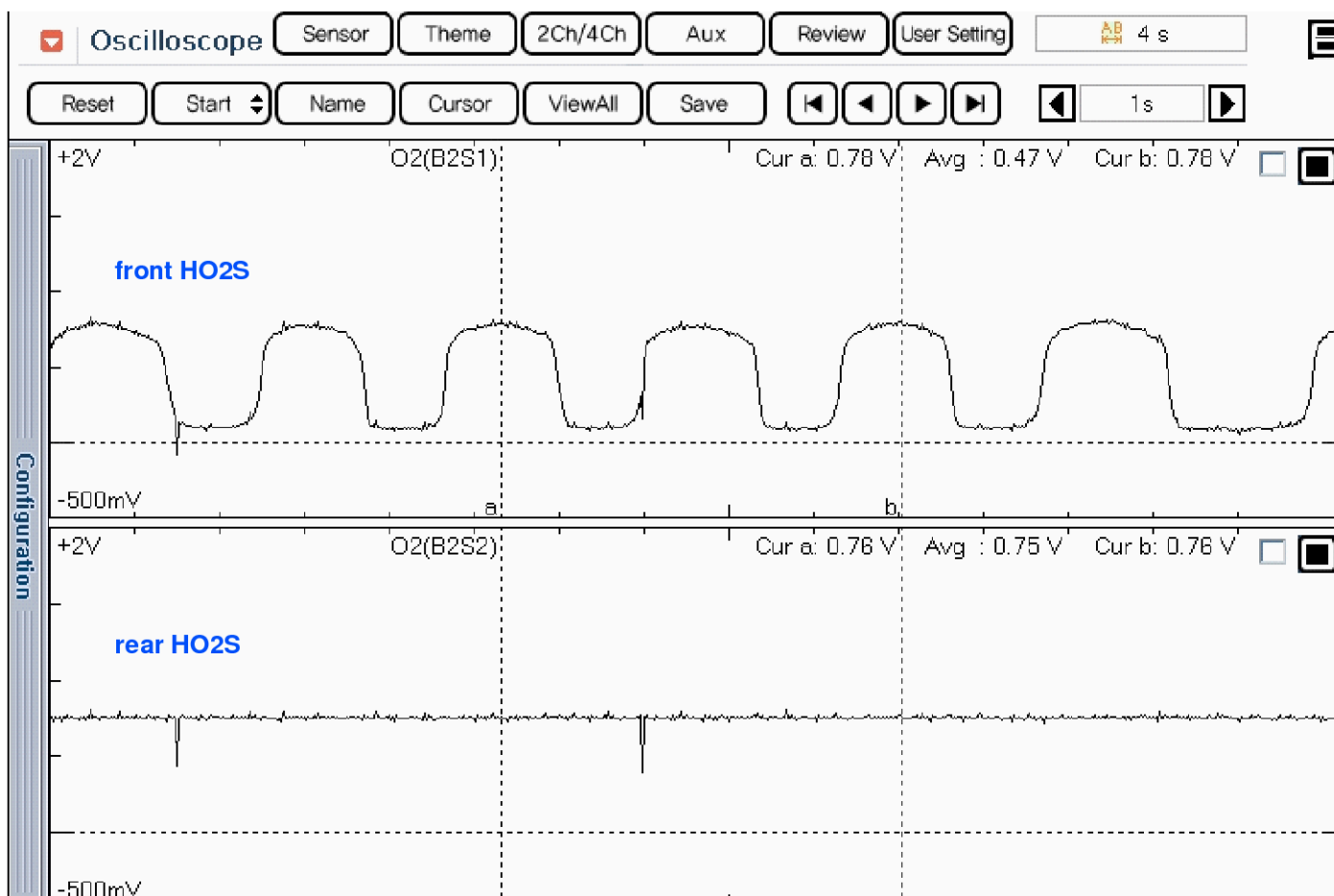
NO ► Repair it and then go to "Verification of Vehicle Repair" procedure.

■ Check the Signal waveform of HO2S

1. IG "OFF" and connect HO2S connector.
2. Engine start.
3. After warming-up, monitor signal waveform of HO2S with scantool.

Engine Control System

FL-741



SBHFL9640L

4. Is the sensor switching properly?

YES ► Go to "Check fuel filter" as follows.

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

■ Check the fuel filter of fuel pump

1. IG "OFF" and disconnect the fuel pump connector.
2. Start the engine and wait until fuel in fuel line is exhausted. After the engine stalls, IG "OFF"
3. Remove the fuel pump assembly.
4. Check the fuel filter for clogging by dust, a foreign substance.

5. Is the fuel filter O.K.?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

⚠ NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Substitute with a known - good fuel filter and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-743

P2198 O2 Sensor Signal Stuck Rich (Bank 2 Sensor 1)

Component Location

Refer to DTC P2197 : O2 Sensor Signal Stuck Lean (Bank 2 Sensor 1)

General Description

Refer to DTC P2197 : O2 Sensor Signal Stuck Lean (Bank 2 Sensor 1)

DTC Description

Checking output signals from HO2S under detecting condition, if HO2S's signal is rich during fuel cut-off conditions, ECM sets P2198. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycles.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor HO2S's signal	- Poor Connection - Faulty HO2S - Faulty ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running $\geq 60sec.$ - Fuel cut-off conditions - Engine warm-up state - Not in Transient Conditions	
Threshold value	HO2S's signal $> 0.42V$	
Diagnosis Time	Continuous (More than 8 sec. failure for every 9 sec. T-test)	
MIL On Condition	2 Driving Cycles	

Specification

Refer to DTC P2197 : O2 Sensor Signal Stuck Lean (Bank 2 Sensor 1)

Diagnostic Circuit Diagram

Refer to DTC P2197 : O2 Sensor Signal Stuck Lean (Bank 2 Sensor 1)

Signal Waveform & Data

Refer to DTC P2197 : O2 Sensor Signal Stuck Lean (Bank 2 Sensor 1)

Monitor Scantool Data

Refer to DTC P2197 : O2 Sensor Signal Stuck Lean (Bank 2 Sensor 1)

Component Inspection

■ Check the condition of HO2S

1. Check HO2S for poor connection or loose terminal.
2. Check if HO2S is ensurely installed.
3. Is the conditions of HO2S normal ?

YES ► Go to "Check the Signal waveform of HO2S" as follows.

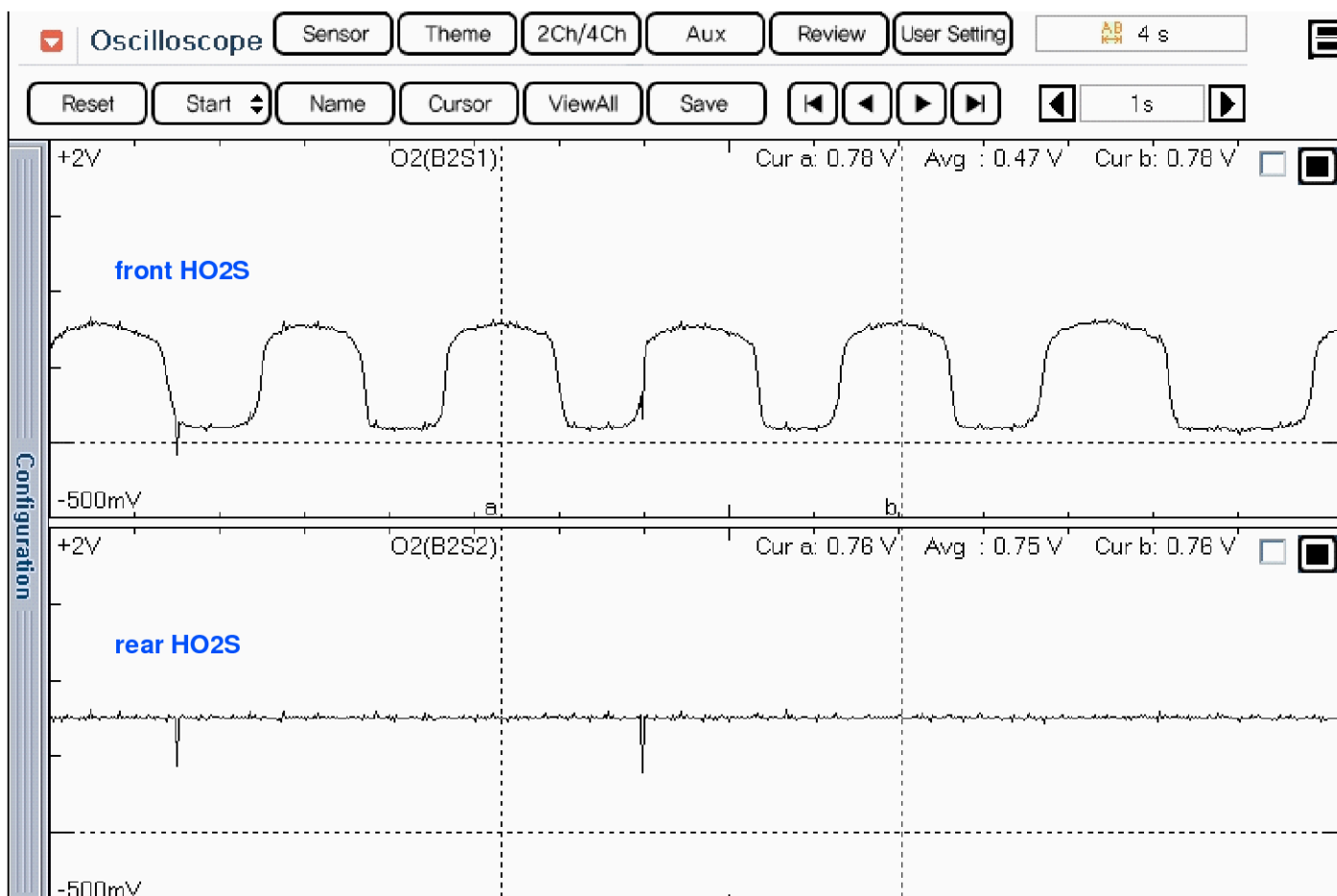
NO ► Repair it and then go to "Verification of Vehicle Repair" procedure.

■ Check the Signal waveform of HO2S

1. IG "OFF" and connect HO2S connector.
2. Engine start.
3. After warming-up, monitor signal waveform of HO2S with scantool.

FL-744

Fuel System



SBHFL9640L

4. Is the sensor switching properly?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P2197 : O2 Sensor Signal Stuck Lean (Bank 2 Sensor 1)

Engine Control System

FL-745

P2270 O2 Sensor Signal Stuck Lean (Bank 1 Sensor 2)

Component Location



SBHFL9312L

General Description

The rear heated oxygen sensor is mounted on the rear side of the Catalytic Converter (warm-up catalytic converter) or in the rear exhaust pipe, which is able to detect catalyst efficiency. The rear heated oxygen sensor (HO2S) produces a voltage between 0V and 1V. This rear heated oxygen sensor is used to estimate the oxygen storage capability. If a catalyst has good conversion properties, the oxygen fluctuations are smoothed by the oxygen storage capacity of the catalyst. If the conversion provided by the catalyst is low due to aging, poisoning or misfiring, then the oxygen fluctuations are similar to signals from the front oxygen sensor.

DTC Description

Checking output signals from HO2S under detecting condition, if HO2S's signal is lean during power enrichment conditions, ECM sets P2270. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycles.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor HO2S's signal	- Poor Connection - Faulty HO2S - Clogging of fuel filter in fuel pump - Faulty ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running $\geq 60sec.$ - Power Enrichment conditions - Engine warm-up state - Not in Transient Conditions	
Threshold value	HO2S's signal $< 0.35V$ and Air Fuel Ratio ≤ 13.5	
Diagnosis Time	Continuous (More than 8 sec. failure for every 9 sec. Test)	
MIL On Condition	2 Driving Cycles	

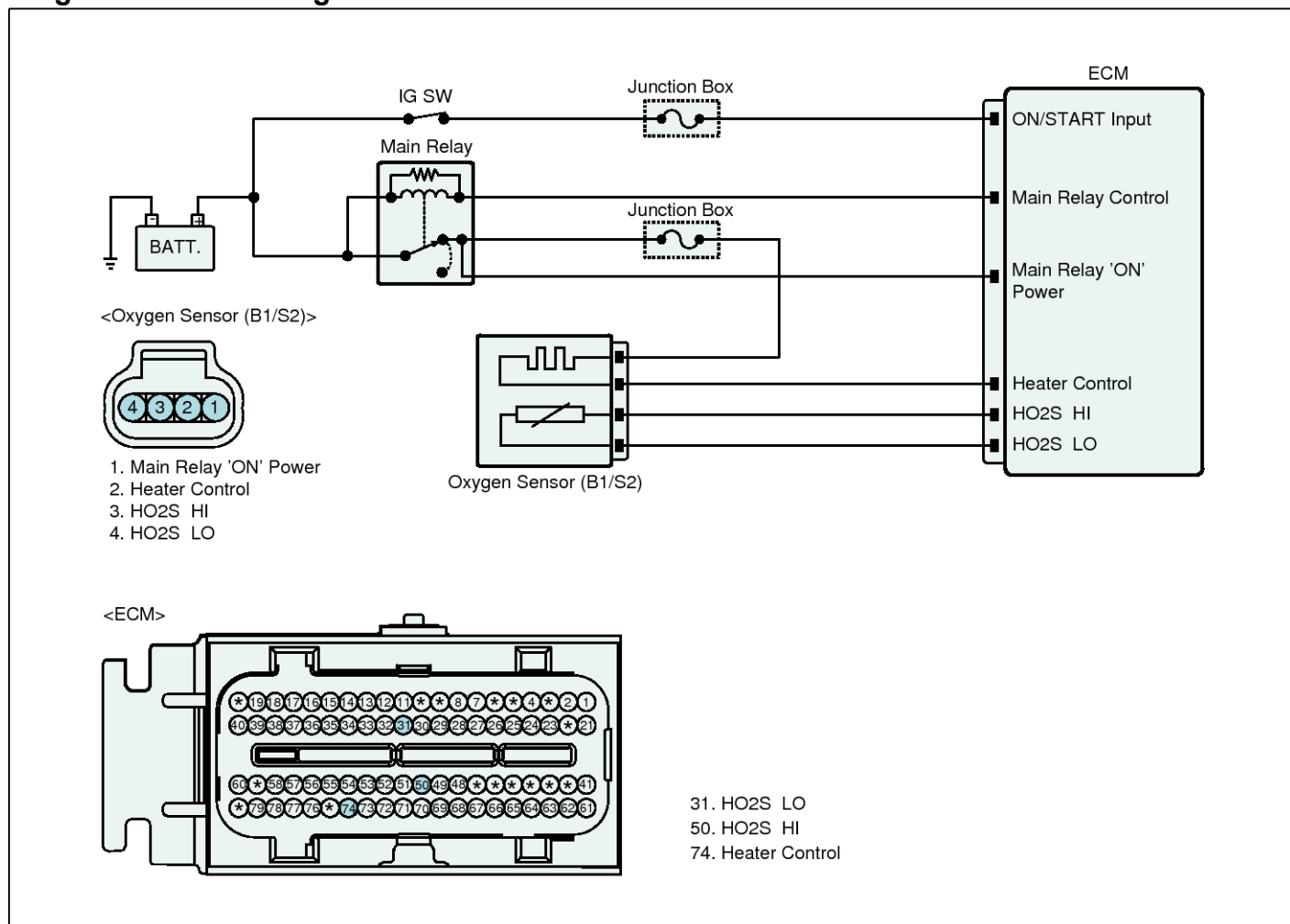
FL-746

Fuel System

Specification (Reference only)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is commonly switching from rich to lean more than 3 times in 10 sec.	Signal is commonly above 0.6V.
HO2S signal at open circuit (Pumping current OFF)	Approx. 0.45V	
HO2S signal at open circuit (Pumping current ON)	Approx. 3.5V	

Diagnostic Circuit Diagram



SBHFL9509L

Signal Waveform & Data

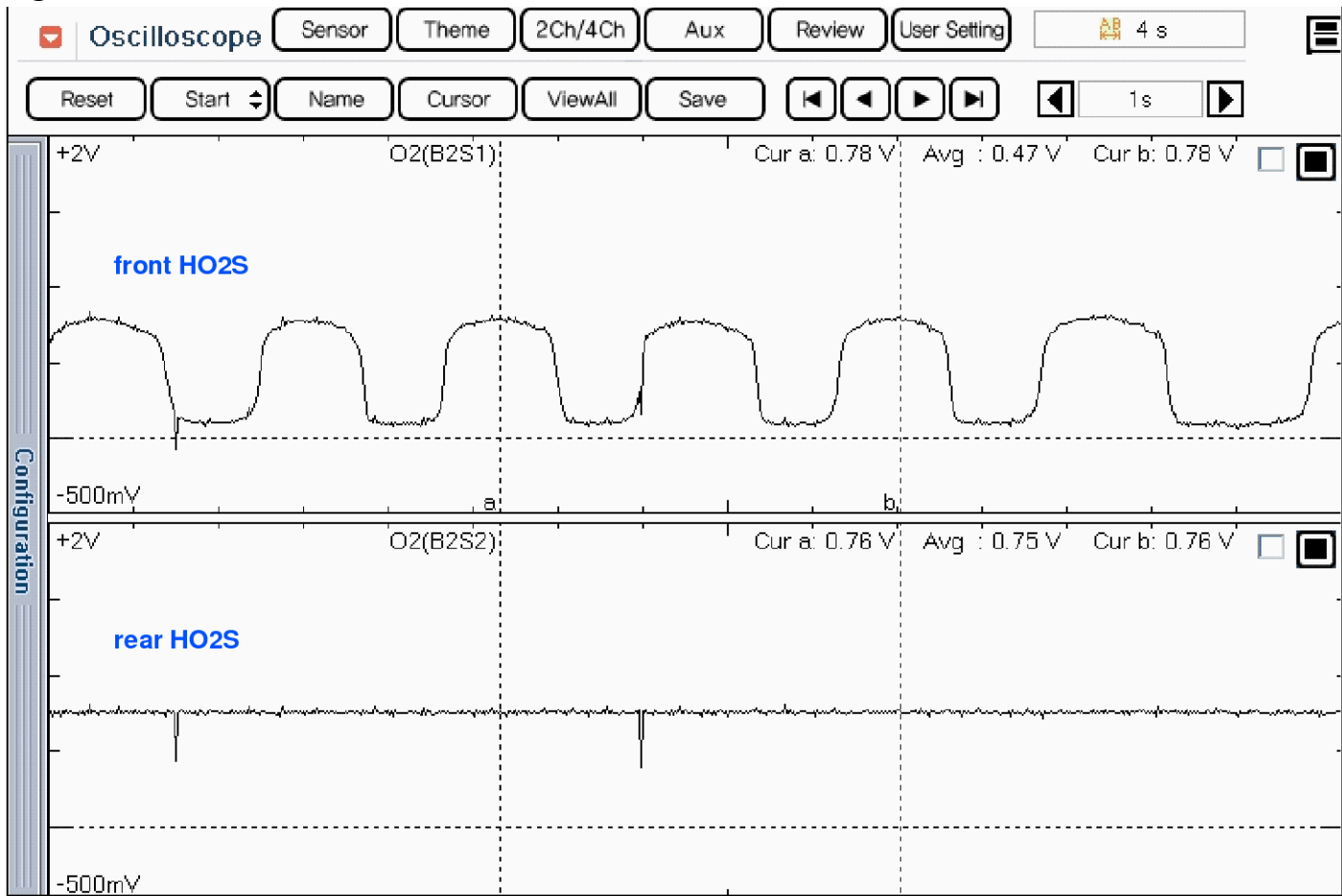


Fig.1

SBHFL9698L

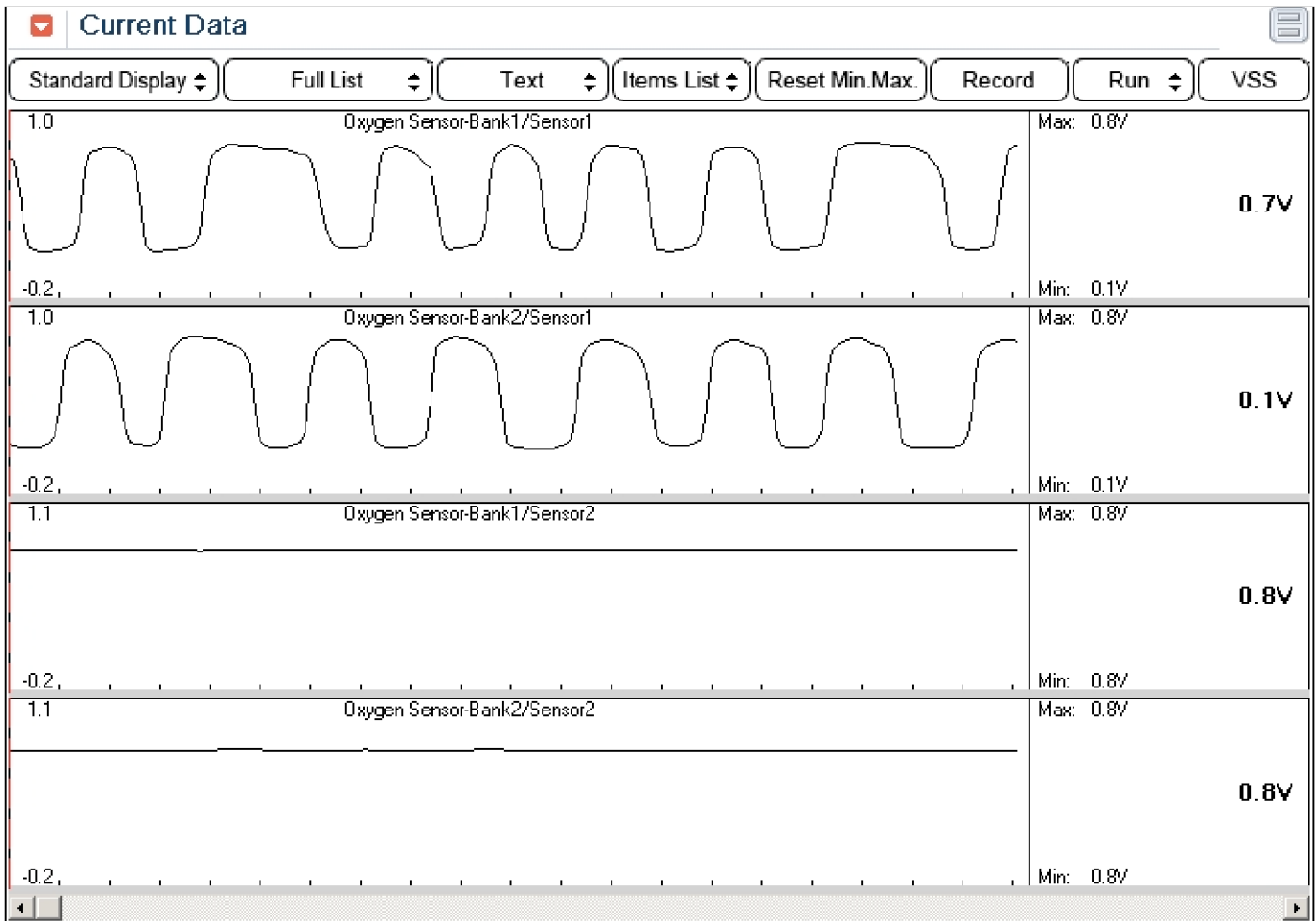


Fig.2

SBHFL9639L

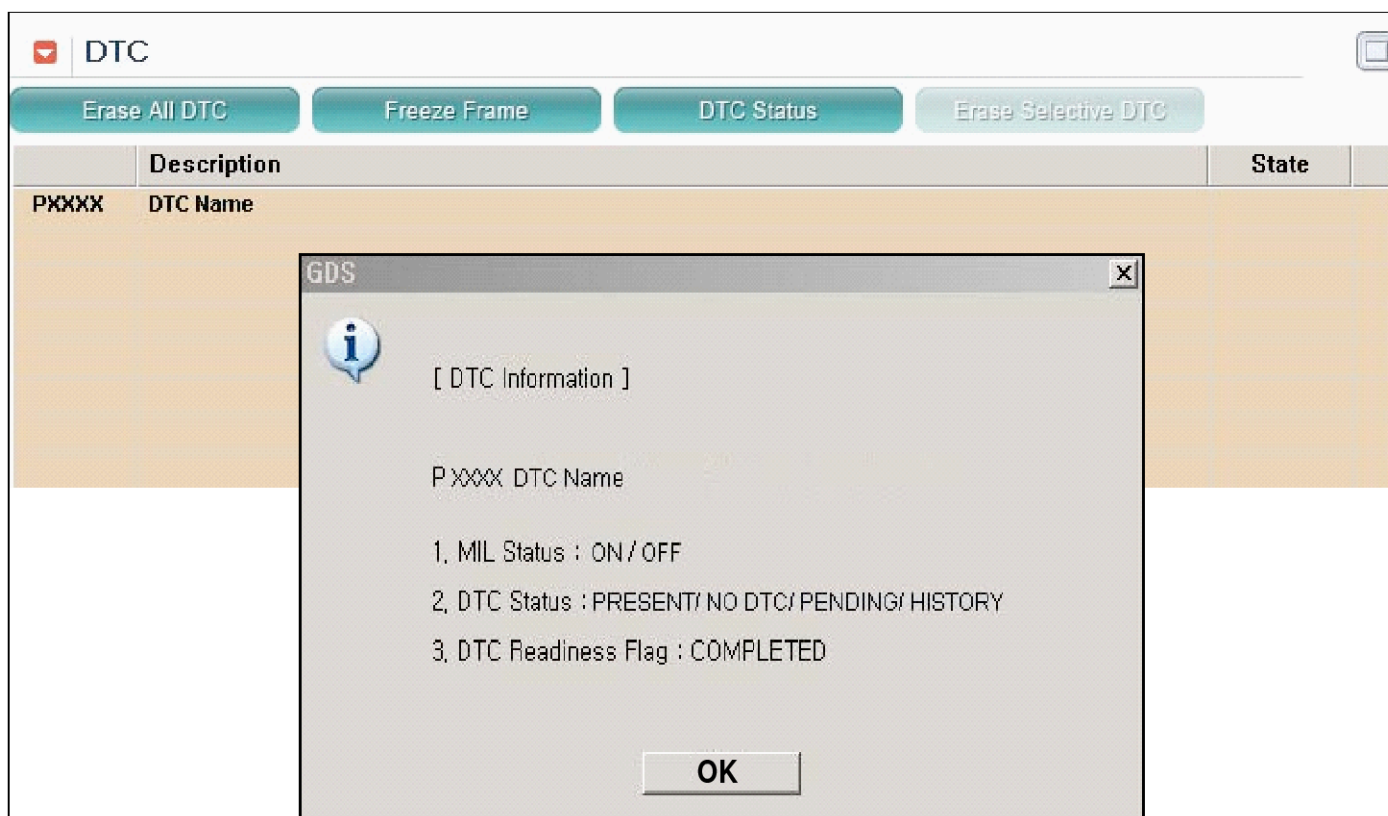
Fig 1) Normal waveforms of front HO2S(the upper) and rear HO2S(the lower)

Fig 2) Normal graph of front HO2S and rear HO2S at idle.

After warming-up, if accelerator pedal is released suddenly around 4000rpm, the HO2S signal reading will be lower than 200mV resulting from Fuel cut-off for the moment. Conversely, if suddenly accelerator pedal is depressed, HO2S signal reading will be around 0.6V ~1.0V. At idle, Normally HO2S signal will switch from lean to rich with 3 Hz. And as racing, Its frequency rises.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Component Inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check the condition of HO2S

1. Check HO2S for poor connection or loose terminal.
2. Check if HO2S is ensurely installed.
3. Is the conditions of HO2S normal ?

YES ► Go to "Check the Signal waveform of HO2S" as follows.

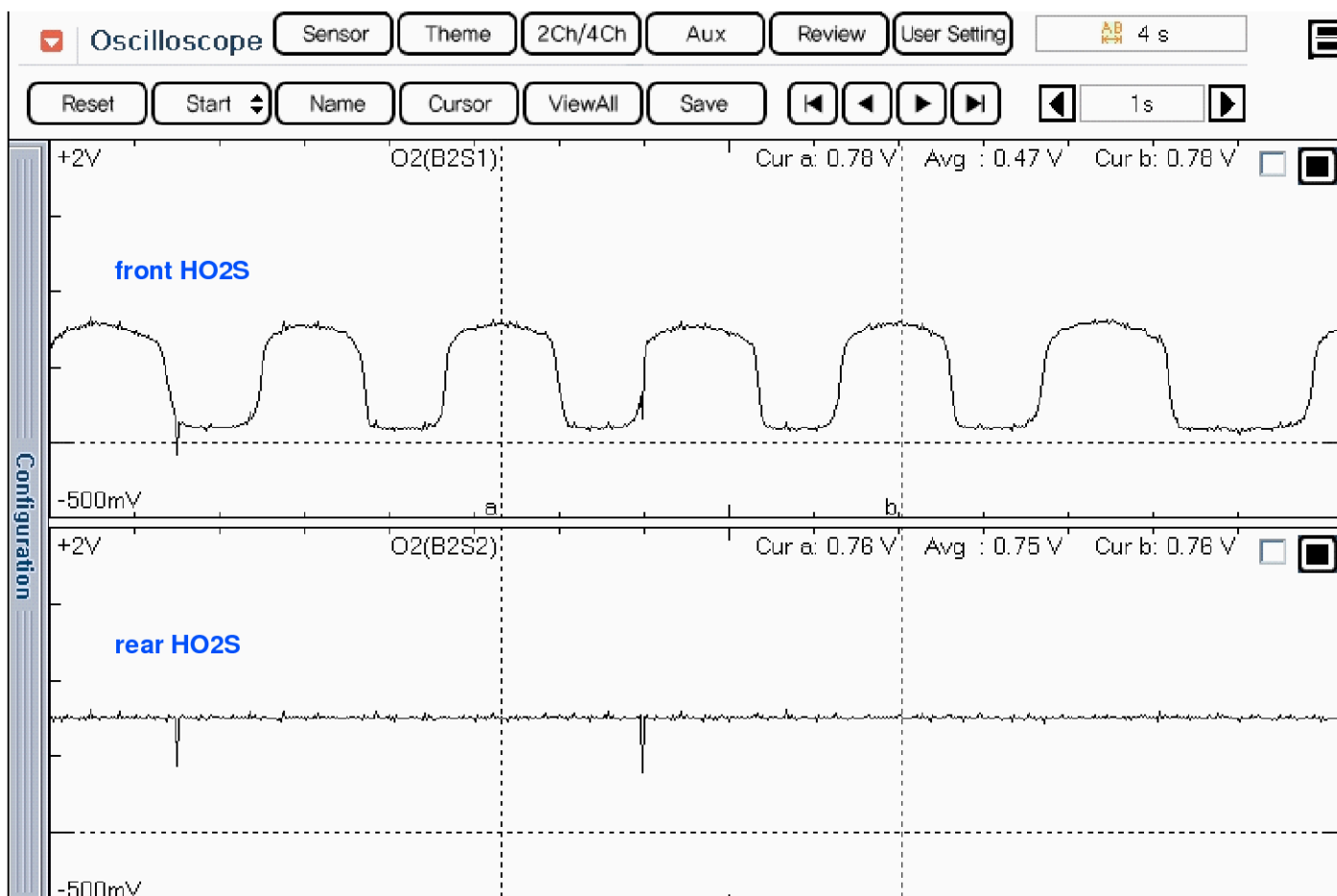
NO ► Repair it and then go to "Verification of Vehicle Repair" procedure.

■ Check the Signal waveform of HO2S

1. IG "OFF" and connect HO2S connector.
2. Engine start.
3. After warming-up, monitor signal waveform of HO2S with scantool.

FL-750

Fuel System



SBHFL9640L

4. Is the sensor switching properly?

YES ► Go to "Check fuel filter" as follows.

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

■ Check the fuel filter of fuel pump

1. IG "OFF" and disconnect the fuel pump connector.
2. Start the engine and wait until fuel in fuel line is exhausted. After the engine stalls, IG "OFF"
3. Remove the fuel pump assembly.
4. Check the fuel filter for clogging by dust, a foreign substance.

5. Is the fuel filter O.K.?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

⚠ NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Substitute with a known - good fuel filter and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Engine Control System

FL-751

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

FL-752

Fuel System

P2271 O2 Sensor Signal Stuck Rich (Bank 1 Sensor 2)

Component Location

Refer to DTC P2270 : O2 Sensor Signal Stuck Lean (Bank 1 Sensor 2)

General Description

Refer to DTC P2270 : O2 Sensor Signal Stuck Lean (Bank 1 Sensor 2)

DTC Description

Checking output signals from HO2S under detecting condition, if HO2S's signal is rich during fuel cut-off conditions, ECM sets P2271. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycles.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor HO2S's signal	- Poor Connection - Faulty HO2S - Faulty ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running $\geq 60\text{sec.}$ - Fuel cut-off conditions - Engine warm-up state - Not in Transient Conditions	
Threshold value	HO2S's signal $> 0.42V$	
Diagnosis Time	Continuous (More than 8 sec. failure for every 9 sec. T-test)	
MIL On Condition	2 Driving Cycles	

Specification

Refer to DTC P2270 : O2 Sensor Signal Stuck Lean (Bank 1 Sensor 2)

Diagnostic Circuit Diagram

Refer to DTC P2270 : O2 Sensor Signal Stuck Lean (Bank 1 Sensor 2)

Signal Waveform & Data

Refer to DTC P2270 : O2 Sensor Signal Stuck Lean (Bank 1 Sensor 2)

Monitor Scantool Data

Refer to DTC P2270 : O2 Sensor Signal Stuck Lean (Bank 1 Sensor 2)

Component Inspection

■ Check the condition of HO2S

1. Check HO2S for poor connection or loose terminal.
2. Check if HO2S is ensurely installed.
3. Is the conditions of HO2S normal ?

YES ► Go to "Check the Signal waveform of HO2S" as follows.

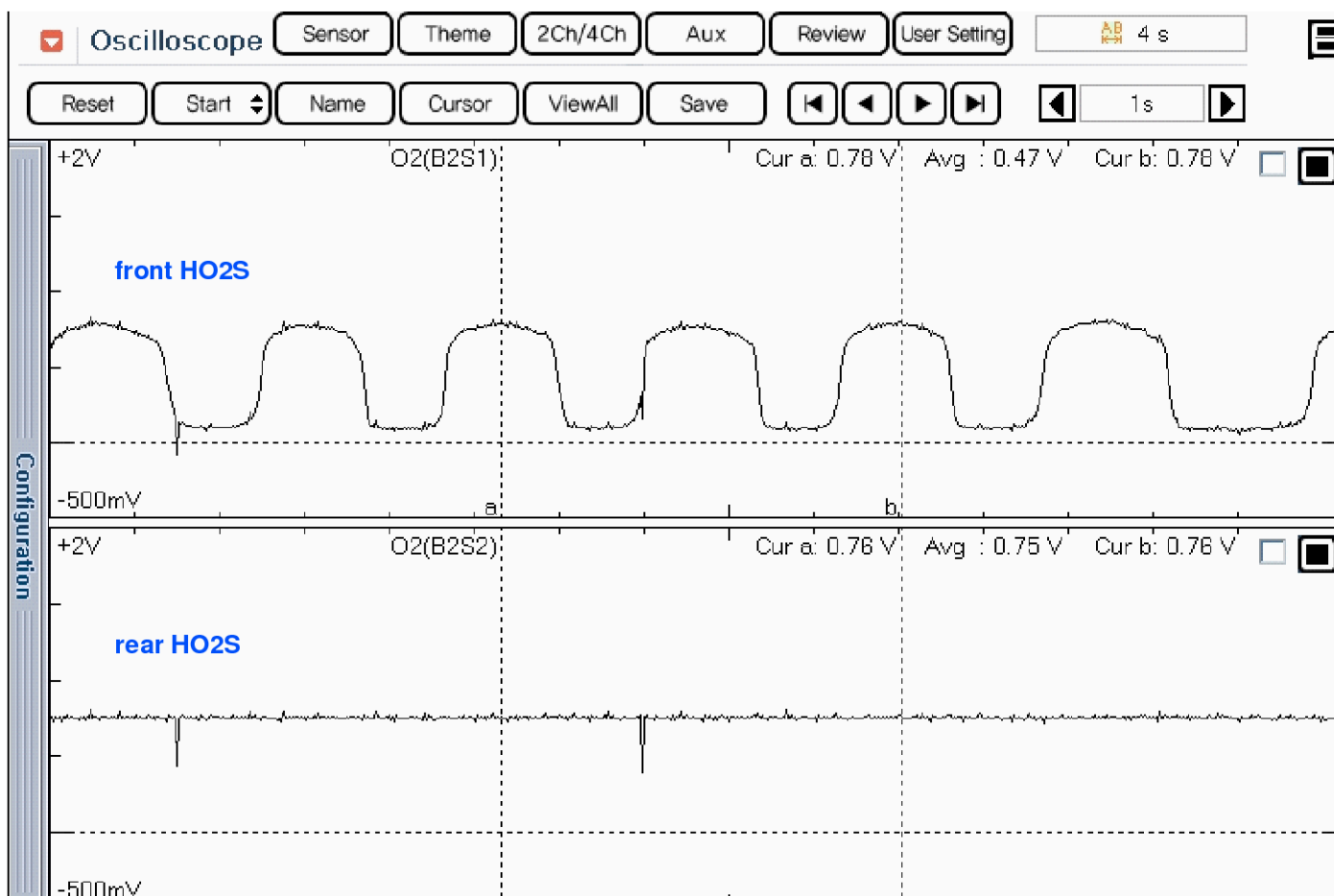
NO ► Repair it and then go to "Verification of Vehicle Repair" procedure.

■ Check the Signal waveform of HO2S

1. IG "OFF" and connect HO2S connector.
2. Engine start.
3. After warming-up, monitor signal waveform of HO2S with scantool.

Engine Control System

FL-753



SBHFL9640L

4. Is the sensor switching properly?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

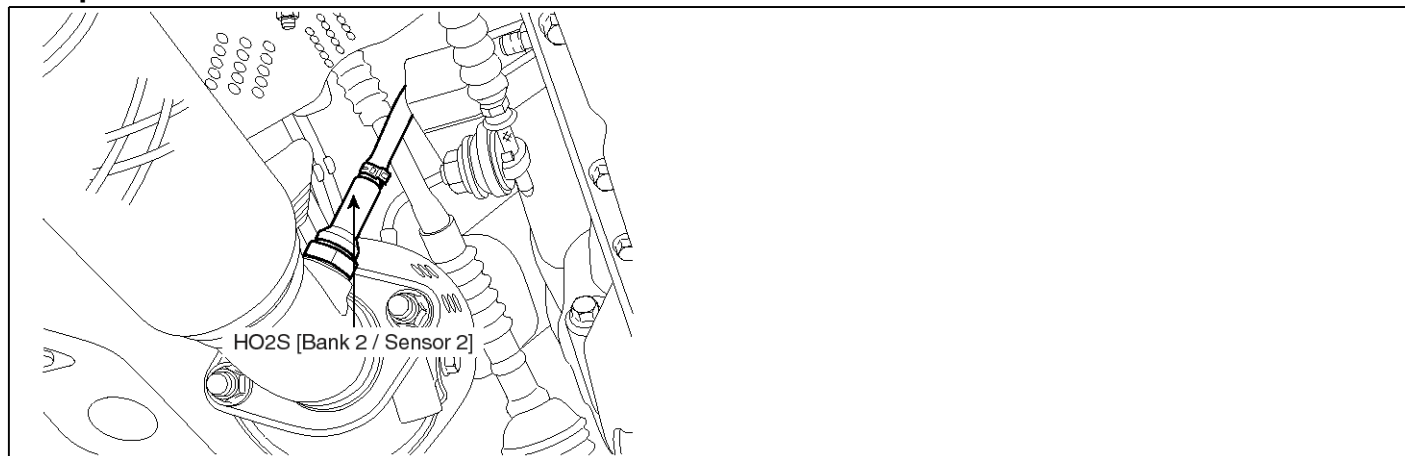
Refer to DTC P2270 : O2 Sensor Signal Stuck Lean (Bank 1 Sensor 2)

FL-754

Fuel System

P2272 O2 Sensor Signal Stuck Lean (Bank 2 Sensor 2)

Component Location



SBHFL9314L

General Description

The rear heated oxygen sensor is mounted on the rear side of the Catalytic Converter (warm-up catalytic converter) or in the rear exhaust pipe, which is able to detect catalyst efficiency. The rear heated oxygen sensor (HO2S) produces a voltage between 0V and 1V. This rear heated oxygen sensor is used to estimate the oxygen storage capability. If a catalyst has good conversion properties, the oxygen fluctuations are smoothed by the oxygen storage capacity of the catalyst. If the conversion provided by the catalyst is low due to aging, poisoning or misfiring, then the oxygen fluctuations are similar to signals from the front oxygen sensor.

DTC Description

Checking output signals from HO2S under detecting condition, if HO2S's signal is lean during power enrichment conditions, ECM sets P2272. MIL (Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycles.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor HO2S's signal	- Poor Connection - Faulty HO2S - Clogging of fuel filter in fuel pump - Faulty ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running $\geq 60\text{sec.}$ - Power Enrichment conditions - Engine warm-up state - Not in Transient Conditions	
Threshold value	HO2S's signal $< 0.35V$ and Air Fuel Ratio ≤ 13.5	
Diagnosis Time	Continuous (More than 8 sec. failure for every 9 sec. Test)	
MIL On Condition	2 Driving Cycles	

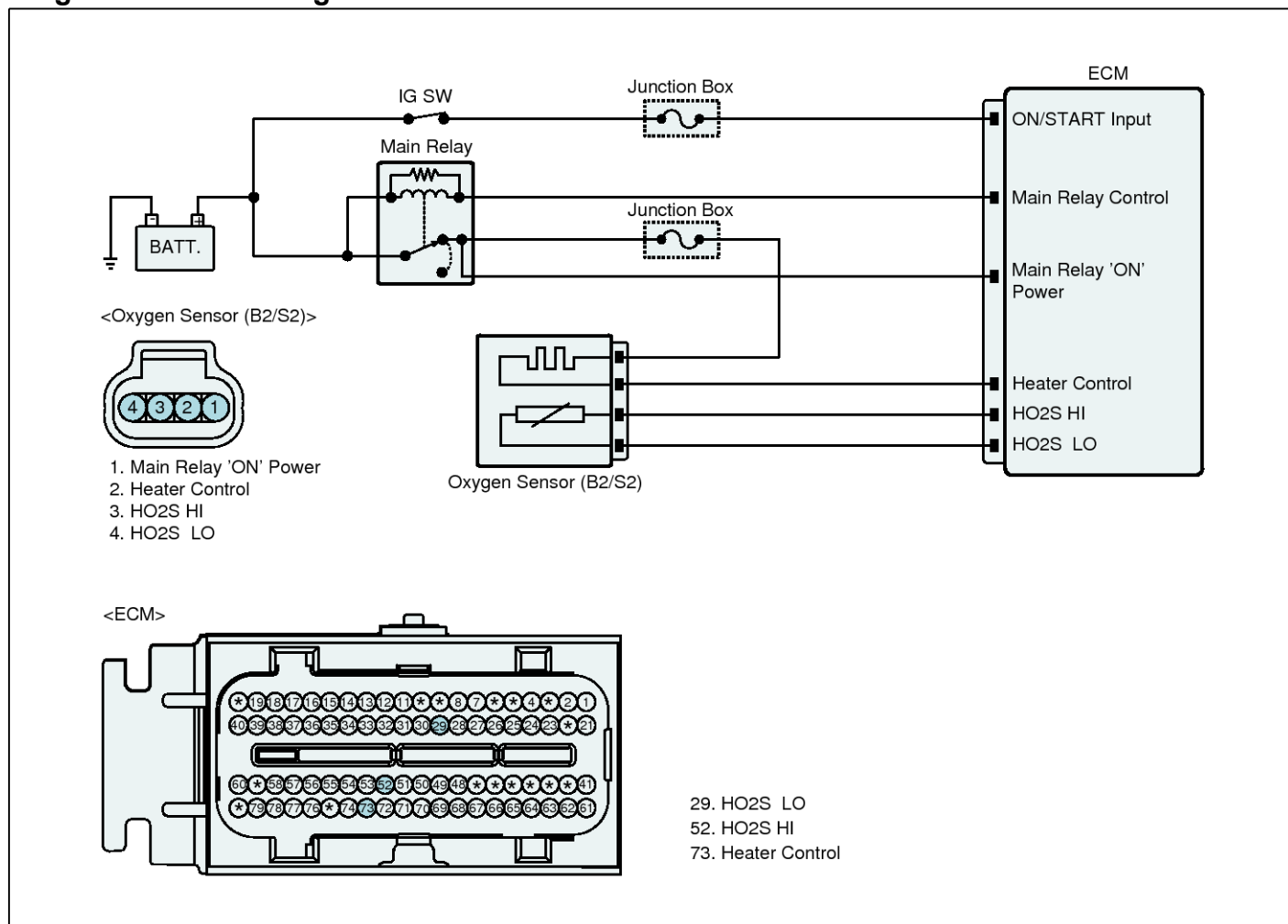
Engine Control System

FL-755

Specification (Reference only)

Test Condition	HO2S Voltage(Sensor1)	HO2S Voltage(Sensor2)
HO2S Signal at idle after warm-up	Signal is commonly switching from rich to lean more than 3 times in 10 sec.	Signal is commonly above 0.6V.
HO2S signal at open circuit (Pumping current OFF)	Approx. 0.45V	
HO2S signal at open circuit (Pumping current ON)	Approx. 3.5V	

Diagnostic Circuit Diagram



SBHFL9511L

Signal Waveform & Data

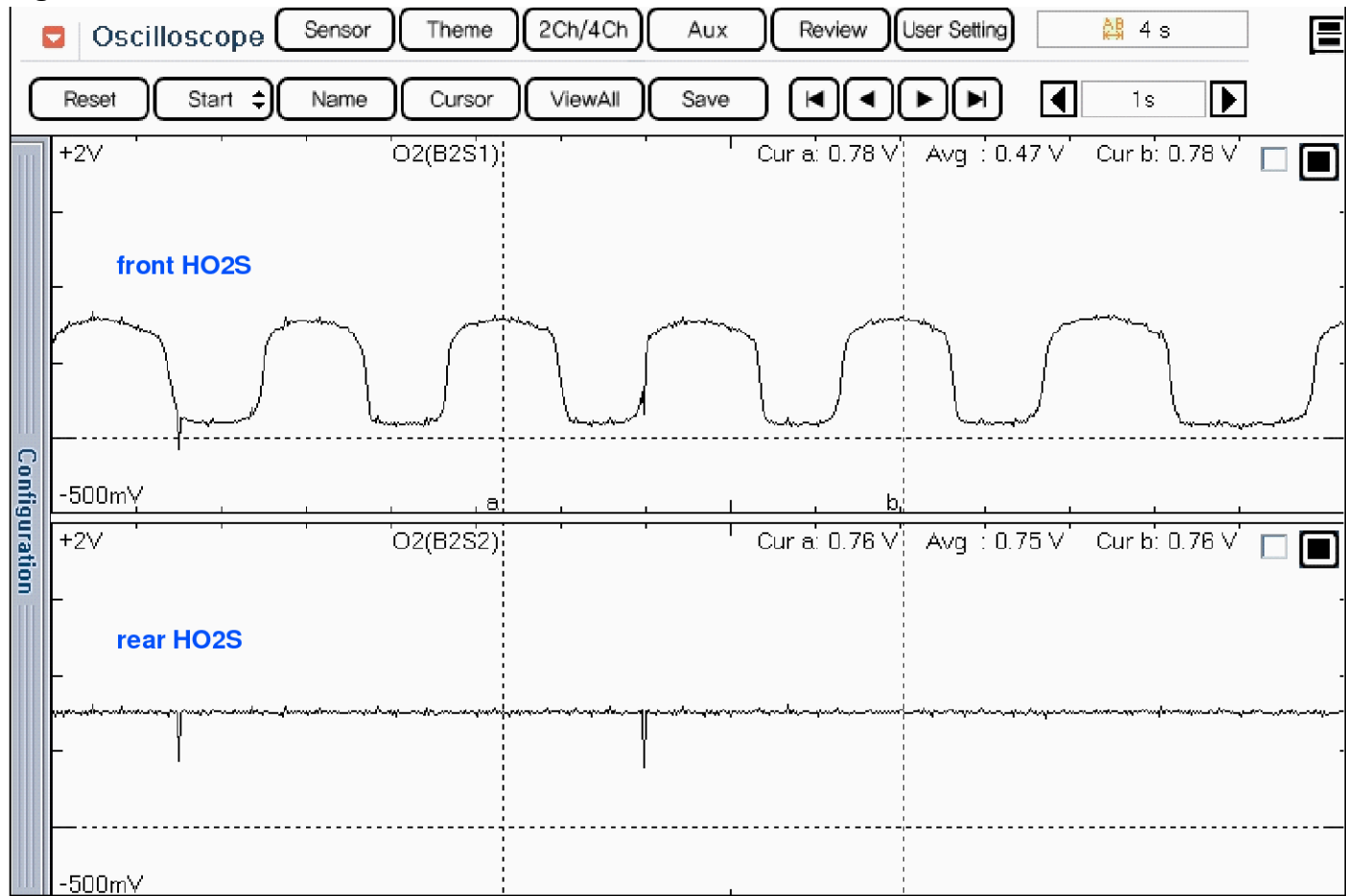


Fig.1

SBHFL9698L

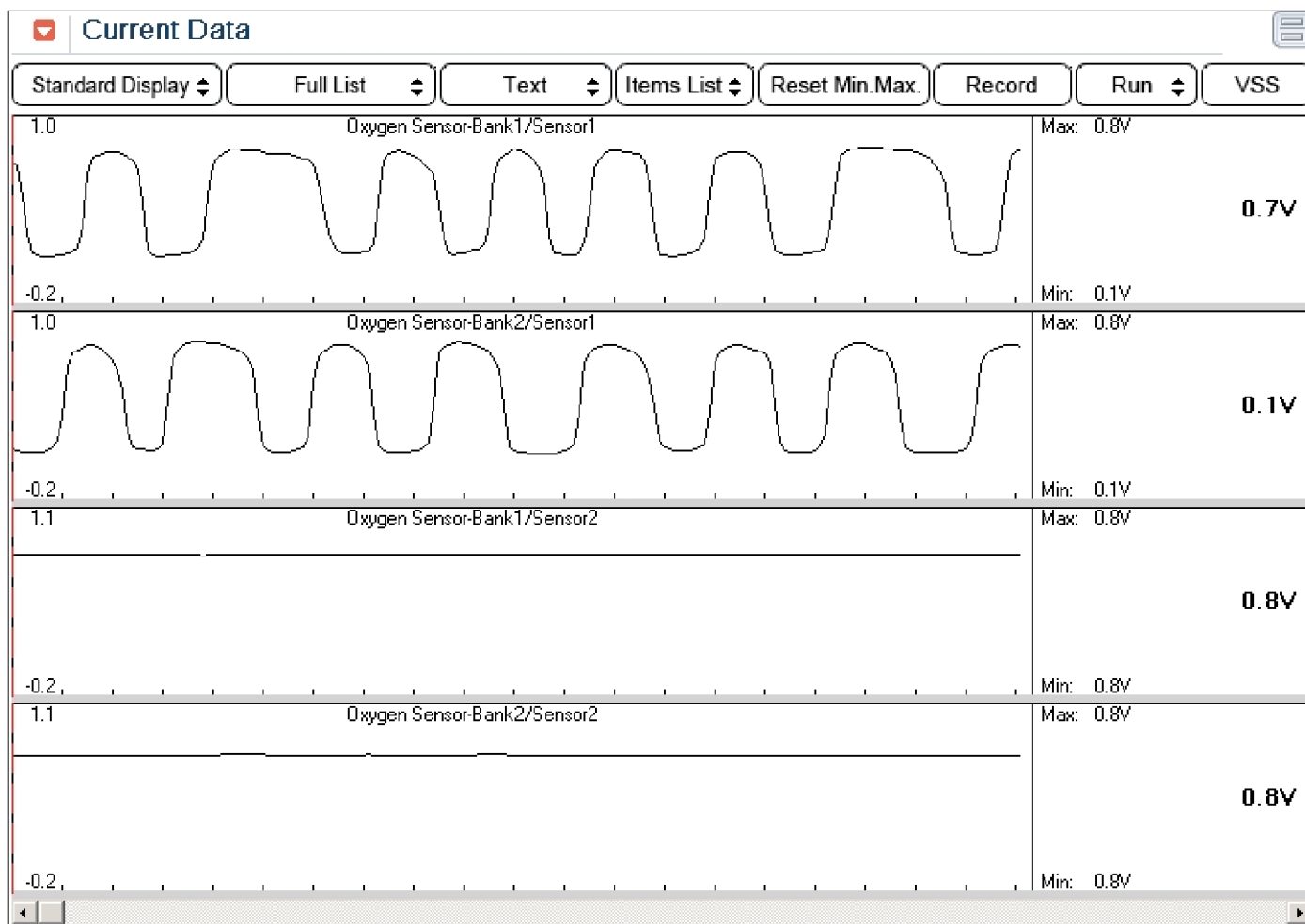


Fig.2

SBHFL9639L

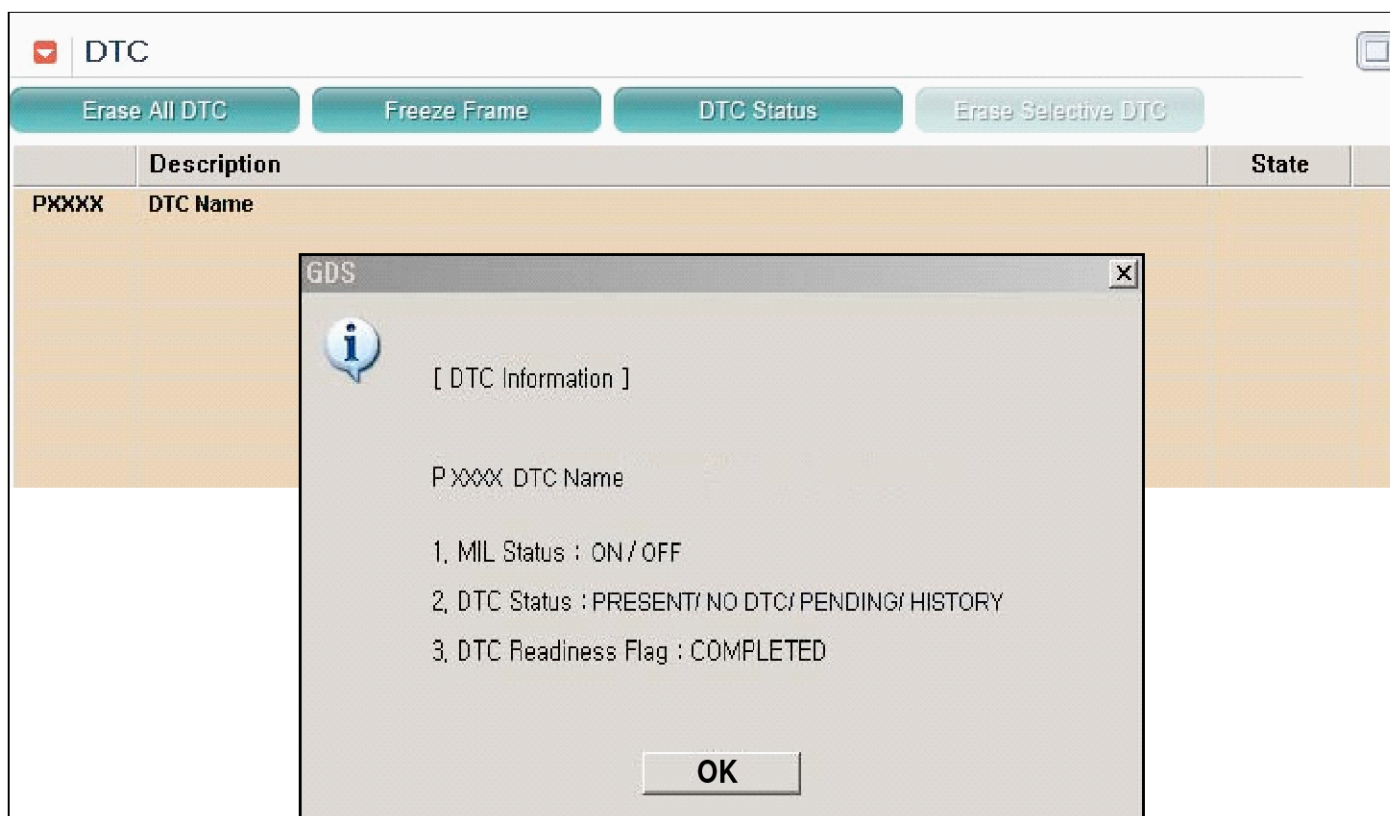
Fig 1) Normal waveforms of front HO2S(the upper) and rear HO2S(the lower)

Fig 2) Normal graph of front HO2S and rear HO2S at idle.

After warming-up, if accelerator pedal is released suddenly around 4000rpm, the HO2S signal reading will be lower than 200mV resulting from Fuel cut-off for the moment. Conversely, if suddenly accelerator pedal is depressed, HO2S signal reading will be around 0.6V ~1.0V. At idle, Normally HO2S signal will switch from lean to rich with 3 Hz. And as racing, Its frequency rises.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Component Inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Component Inspection

■ Check the condition of HO2S

1. Check HO2S for poor connection or loose terminal.
2. Check if HO2S is ensurely installed.
3. Is the conditions of HO2S normal ?

YES ► Go to "Check the Signal waveform of HO2S" as follows.

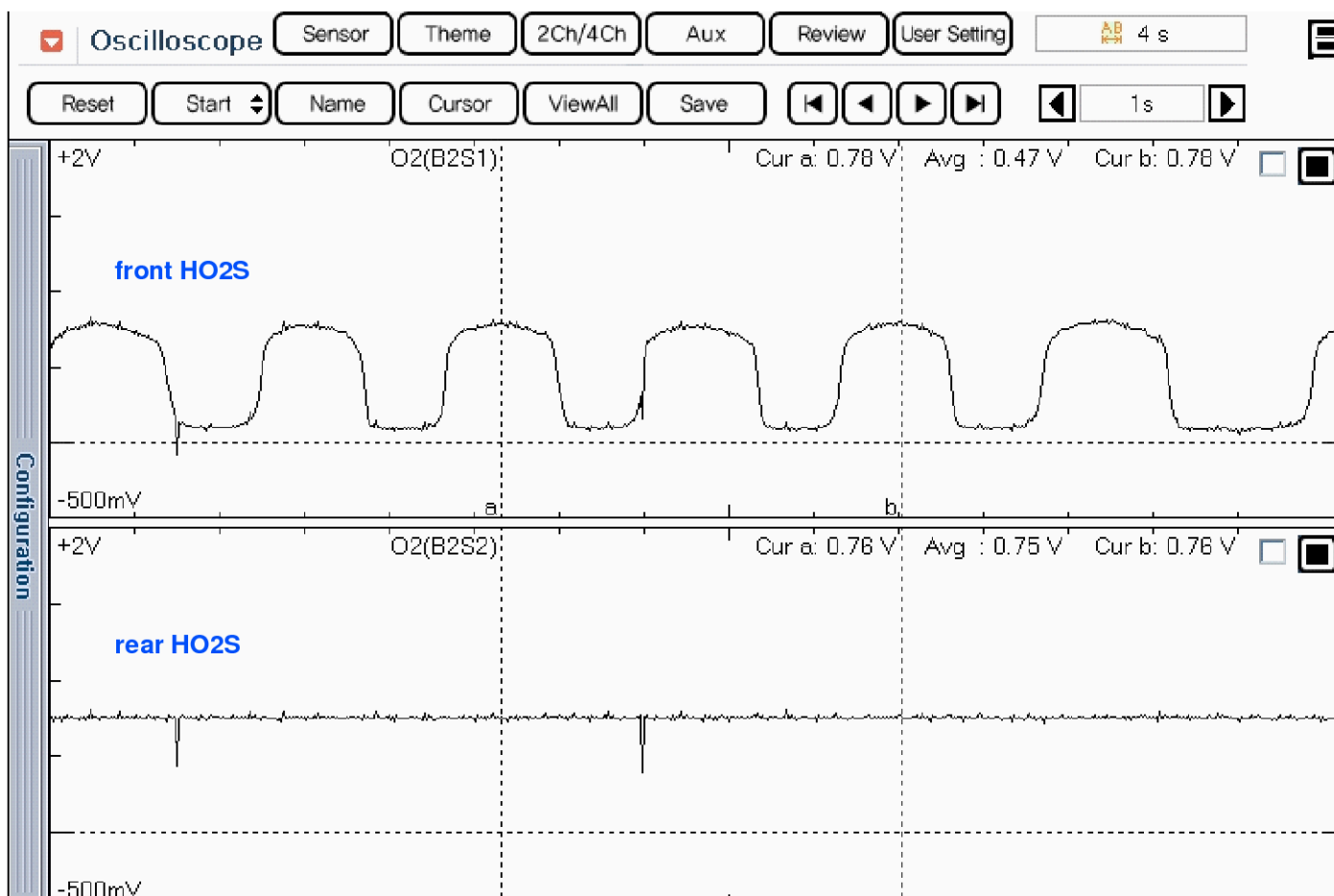
NO ► Repair it and then go to "Verification of Vehicle Repair" procedure.

■ Check the Signal waveform of HO2S

1. IG "OFF" and connect HO2S connector.
2. Engine start.
3. After warming-up, monitor signal waveform of HO2S with scantool.

Engine Control System

FL-759



SBHFL9640L

4. Is the sensor switching properly?

YES ► Go to "Check fuel filter" as follows.

NO ► Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

■ Check the fuel filter of fuel pump

1. IG "OFF" and disconnect the fuel pump connector.
2. Start the engine and wait until fuel in fuel line is exhausted. After the engine stalls, IG "OFF"
3. Remove the fuel pump assembly.
4. Check the fuel filter for clogging by dust, a foreign substance.

5. Is the fuel filter O.K.?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

⚠ NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Substitute with a known - good fuel filter and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-761

P2273 O2 Sensor Signal Stuck Rich (Bank 2 Sensor 2)

Component Location

Refer to DTC P2272 : O2 Sensor Signal Stuck Lean (Bank 2 Sensor 2)

General Description

Refer to DTC P2272 : O2 Sensor Signal Stuck Lean (Bank 2 Sensor 2)

DTC Description

Checking output signals from HO2S under detecting condition, if HO2S's signal is rich during fuel cut-off conditions, ECM sets P2273. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycles.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor HO2S's signal	- Poor Connection - Faulty HO2S - Faulty ECM
Enable Conditions	- Battery voltage $\geq 10V$ - Engine running $\geq 60\text{sec.}$ - Fuel cut-off conditions - Engine warm-up state - Not in Transient Conditions	
Threshold value	HO2S's signal $> 0.42V$	
Diagnosis Time	Continuous (More than 8 sec. failure for every 9 sec. T-test)	
MIL On Condition	2 Driving Cycles	

Specification

Refer to DTC P2272 : O2 Sensor Signal Stuck Lean (Bank 2 Sensor 2)

Diagnostic Circuit Diagram

Refer to DTC P2272 : O2 Sensor Signal Stuck Lean (Bank 2 Sensor 2)

Signal Waveform & Data

Refer to DTC P2272 : O2 Sensor Signal Stuck Lean (Bank 2 Sensor 2)

Monitor Scantool Data

Refer to DTC P2272 : O2 Sensor Signal Stuck Lean (Bank 2 Sensor 2)

Component Inspection

■ Check the condition of HO2S

1. Check HO2S for poor connection or loose terminal.
2. Check if HO2S is ensurely installed.
3. Is the conditions of HO2S normal ?

YES ► Go to "Check the Signal waveform of HO2S" as follows.

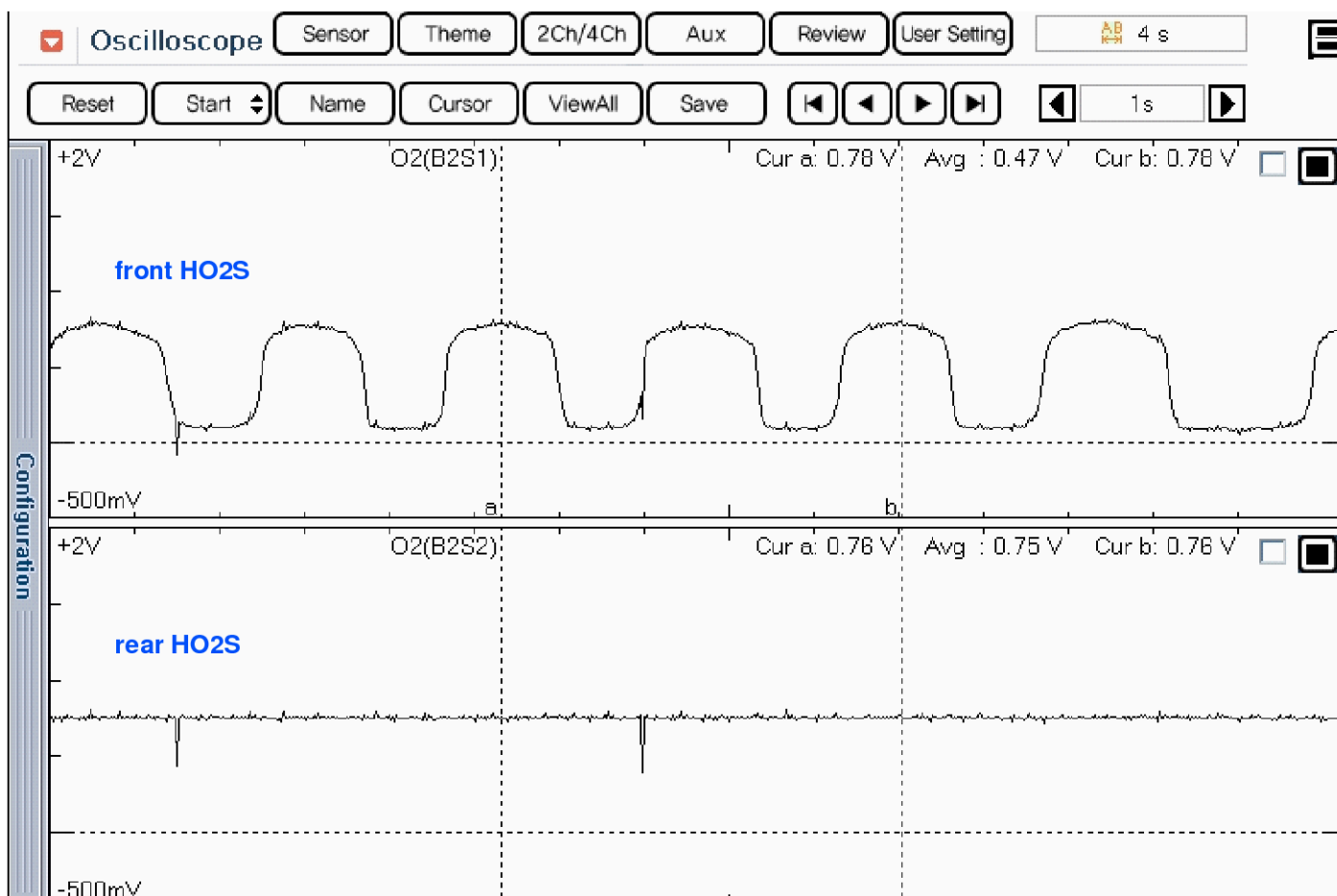
NO ► Repair it and then go to "Verification of Vehicle Repair" procedure.

■ Check the Signal waveform of HO2S

1. IG "OFF" and connect HO2S connector.
2. Engine start.
3. After warming-up, monitor signal waveform of HO2S with scantool.

FL-762

Fuel System



SBHFL9640L

4. Is the sensor switching properly?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Substitute with a known - good HO2S and check for proper operation. If the problem is corrected, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC P2272 : O2 Sensor Signal Stuck Lean (Bank 2 Sensor 2)

Engine Control System

FL-763

P2502 Battery Voltage Rationality

General Description

Many control units have applied to vehicle as it becomes more eletrolnical. These units control their own system based on information from diverse sensors. Therefore necessity of common use of diverse sensor information and importance of stable power supply are gathering strength. Battery sensor is mounted on battery (-) terminal. It transmits battery voltage, current, temperature information to ECM. ECM controls generating voltage by duty cycle based on these signals.

DTC Description

ECM sets this code when there is difference between battery voltage at power supply terminal of ECM and the voltage from battery sensor.

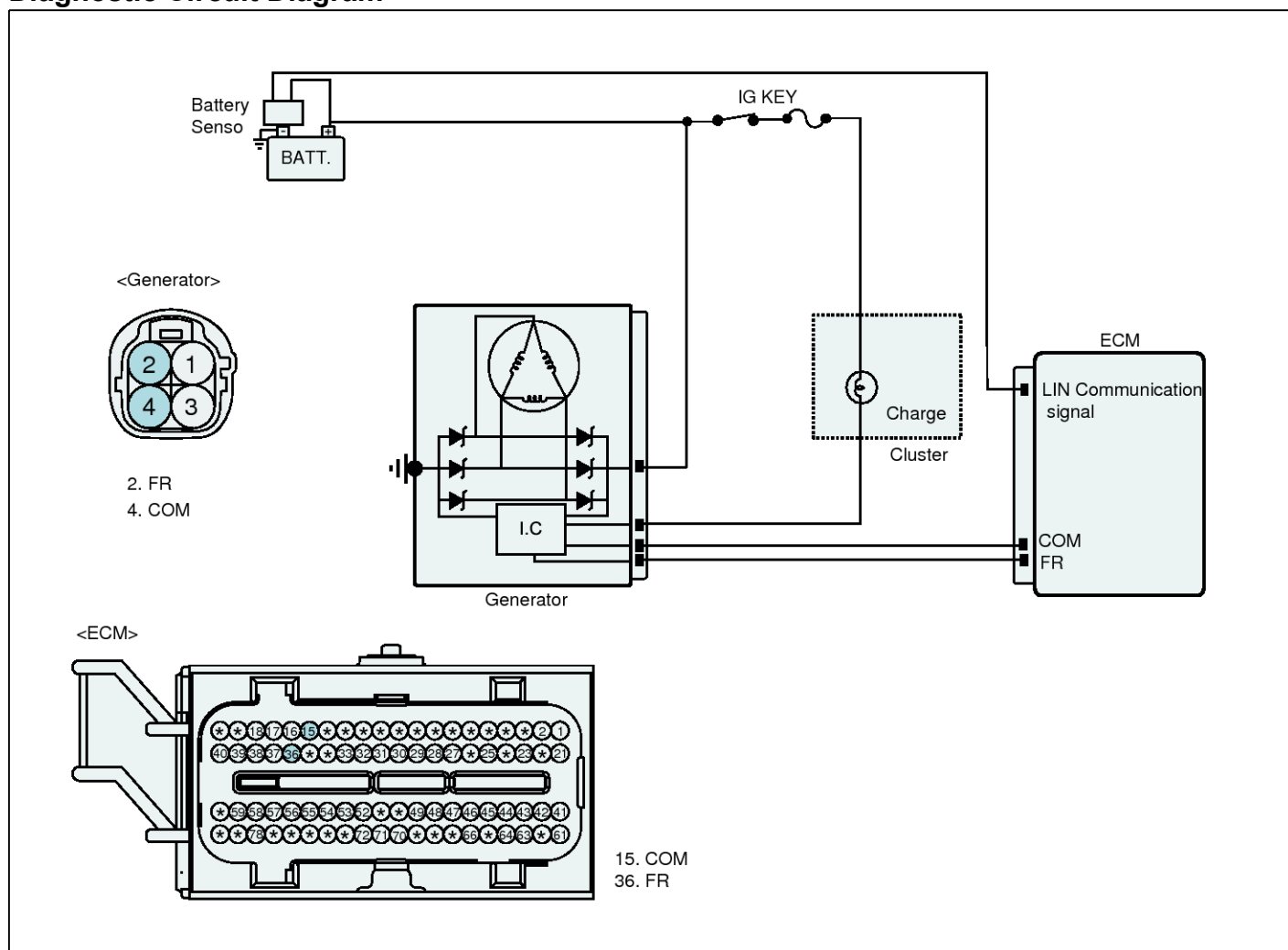
DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Signal Monitoring	- Open or short in harness - Faulty battery sensor - Poor connection
Enable Conditions	- Engine running state - No error related to LIN communication	
Threshold value	Battery voltage at power supply terminal of ECM – voltage from battery sensor > 3V	
Diagnosis Time	Continuous	
MIL On Condition	NO MIL ON(DTC only)	

FL-764

Fuel System

Diagnostic Circuit Diagram



SBHFL9538L

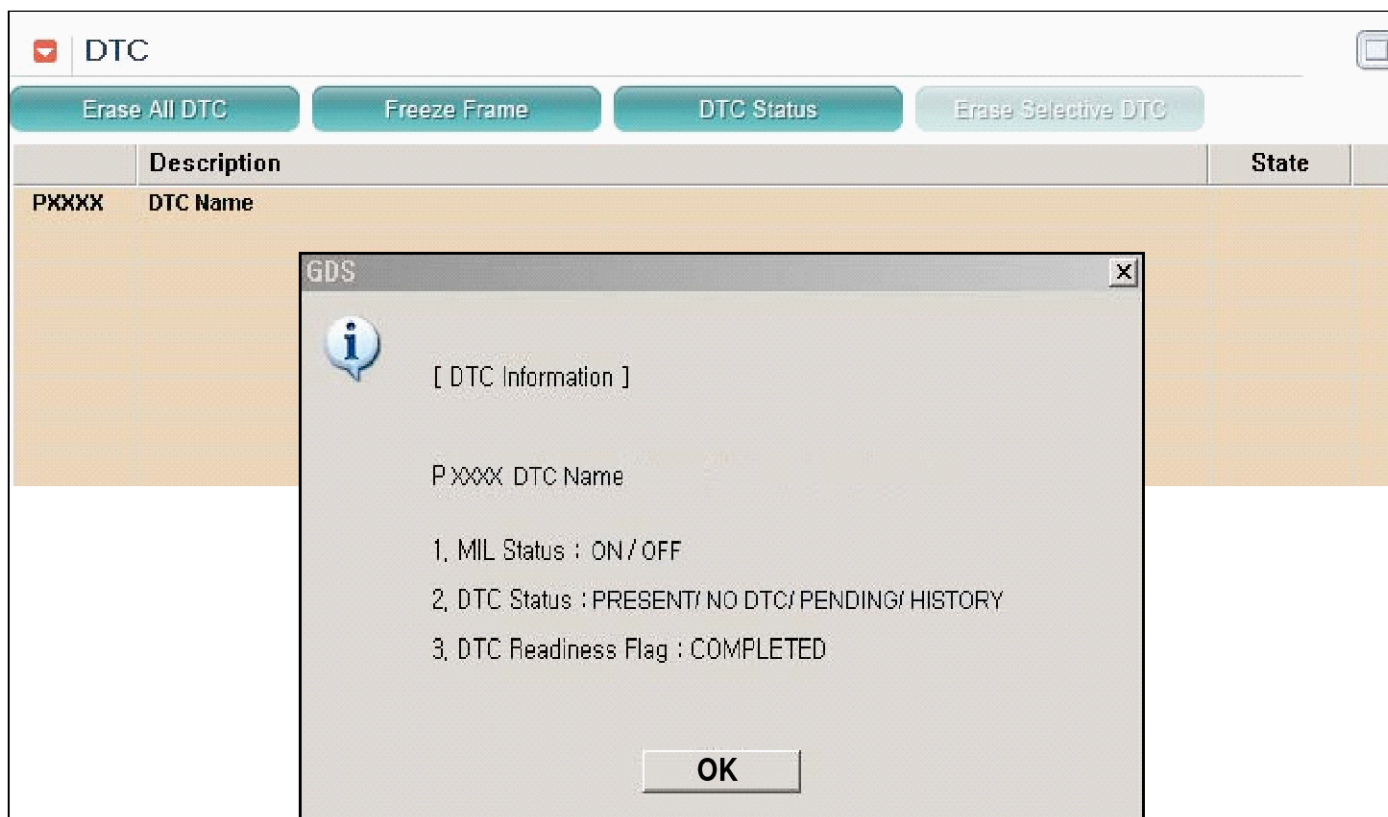
Engine Control System

FL-765

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to " Power Circuit Inspection " procedure

Power Circuit Inspection

■ Check voltage of ECM

1. Engine starts.
2. Measure the voltage between on/start input terminal of ECM and B terminal of alternator.

Specification : below 1.0V

3. Is the measured voltage within specification ?

YES ► Go to "Check Battery Voltage" as follows..

NO ► Repair open or short in harnesses and go to "Verification of Vehicle Repair".

FL-766

Fuel System

■ Check Battery Voltage

1. Engine starts.
2. Measure the voltage between + terminal of battery and B terminal of alternator.

Specification : below 1.0V

3. Is the measured voltage within specification ?

YES ► Go to "Component Inspection" as follows.

NO ► Repair open or short in harnesses and go to "Verification of Vehicle Repair".

Component Inspection

1. Replace battery sensor.
2. IG "OFF".
3. Connect scantool to Data Link Connector(DLC).
4. Clear DTC and Test-drive under enable conditions above-mentioned.
5. Does the scantool show DTC "P2502"?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Substitute with a known - good battery sensor and check for proper operation. If the problem is corrected, replace battery sensor and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

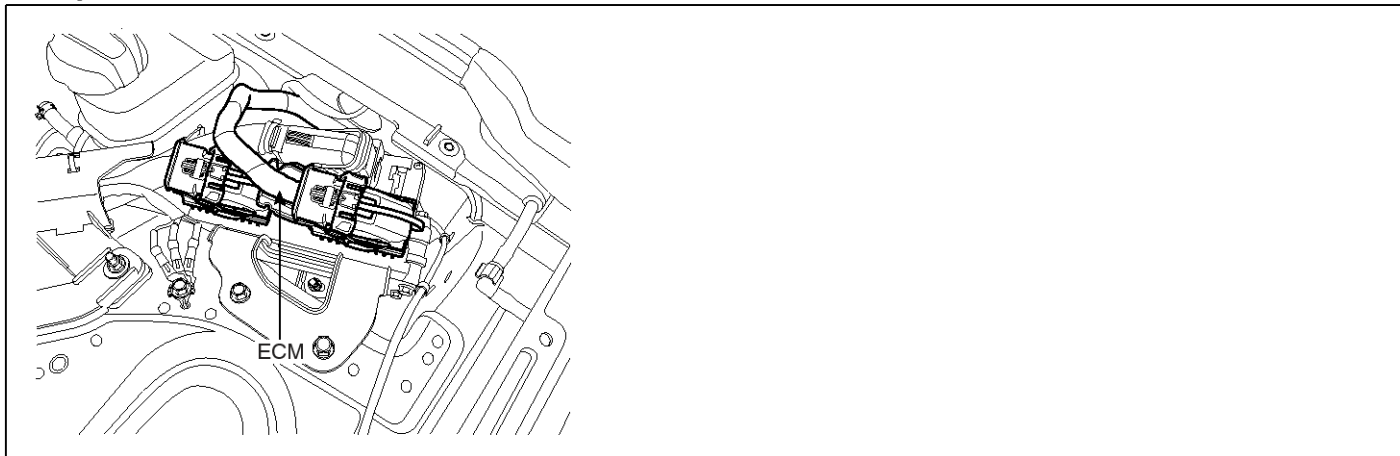
NO ► Go to the applicable troubleshooting procedure.

Engine Control System

FL-767

P2507 ECM/PCM power Input Signal Low

Component Location



SBHFL9300L

General Description

When the ignition switch is turned "ON", battery voltage is applied from the battery to the ECM through the main relay. In case that the ignition switch is turned "OFF", the ECM is supplied with power through the battery power input line to control the basic operation of vehicle.

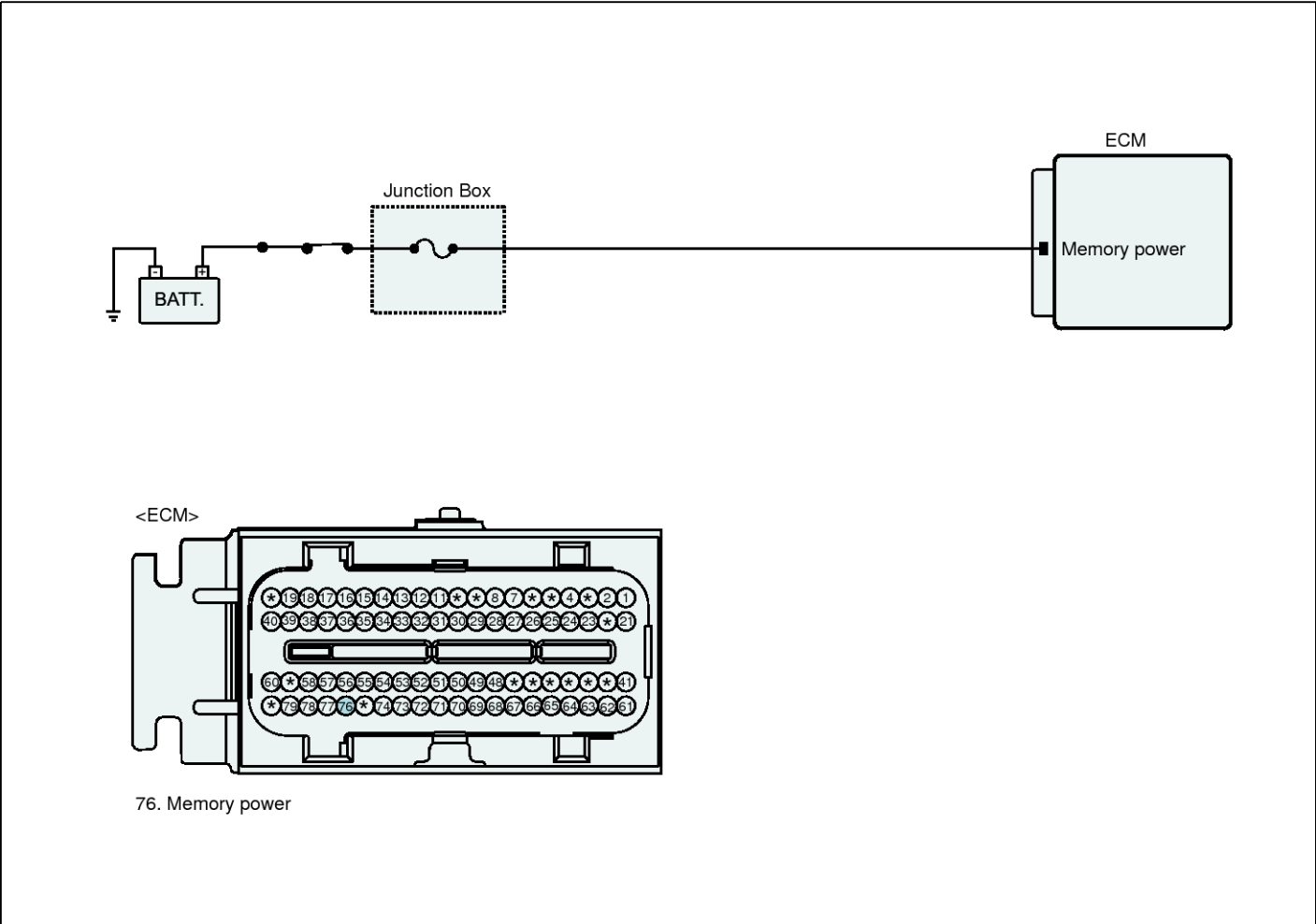
DTC Description

If the battery power input line has a problem, ECM sets P2507 and MIL(Malfunction Indication Lamp) turns on.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Monitor the battery power input line	- Poor connection - Open or short to ground in line - Faulty ECM
EnableConditions	-	
Threshold value	Open or short to ground in line	
Diagnosis Time	Continuous (More than 5 sec.failure for every 10 sec.test)	
MIL On Condition	1 driving cycle	

Diagnostic Circuit Diagram



SBHFL9540L

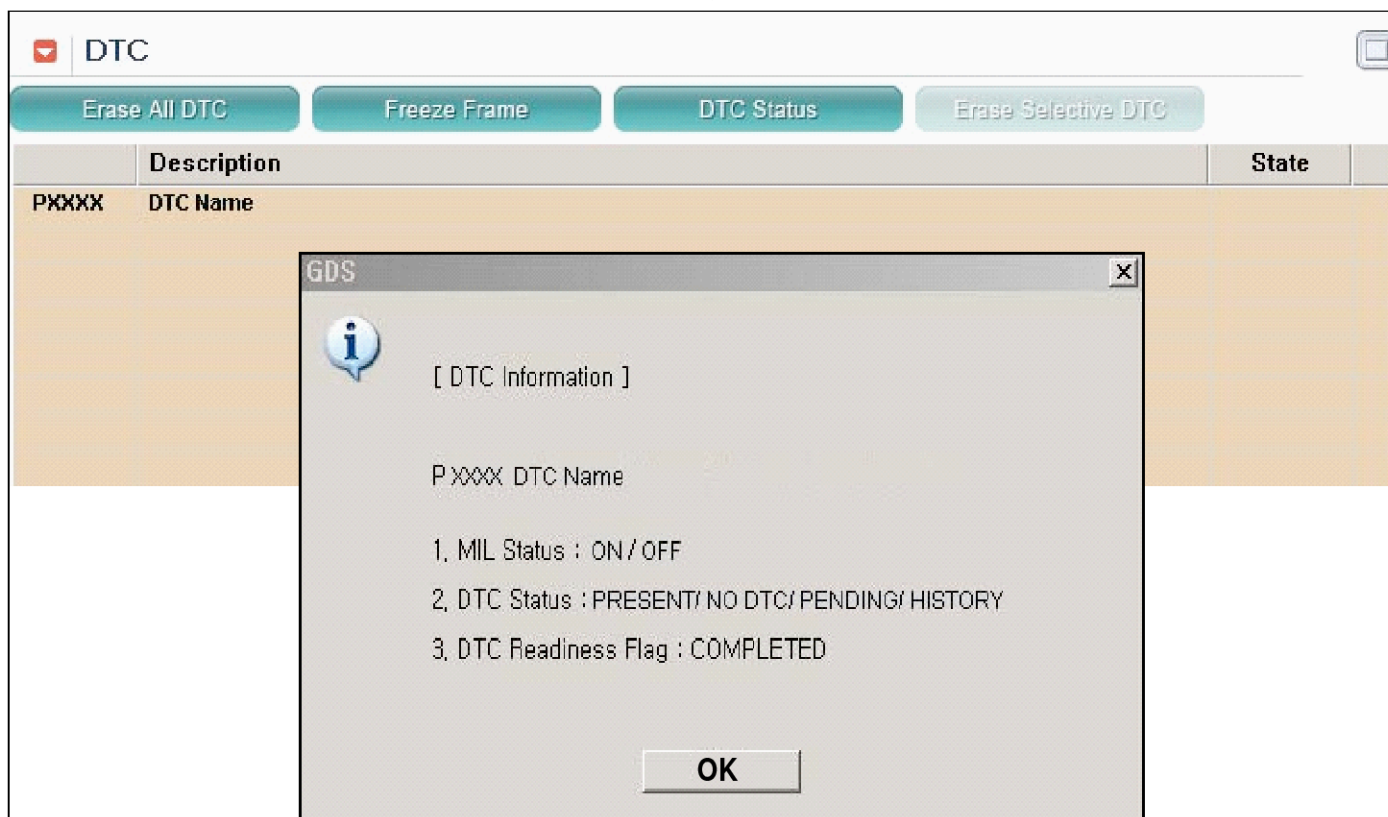
Engine Control System

FL-769

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to " Power Circuit Inspection " procedure

Power Circuit Inspection

■ Check voltage

1. IG "OFF" and disconnect ECM connector
2. IG "ON"
3. Measure voltage between memory power terminal of ECM harness connector and chassis ground

Specification : Approx. B+

FL-770

Fuel System

4. Is the measured voltage within specification ?

YES ▶ Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

 NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ▶ Check for open or short to ground in harness.
▶ Check whether fuse is installed or blown off.
▶ Repair or replace as necessary and then, go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ▶ System performing to specification at this time. Clear the DTC.

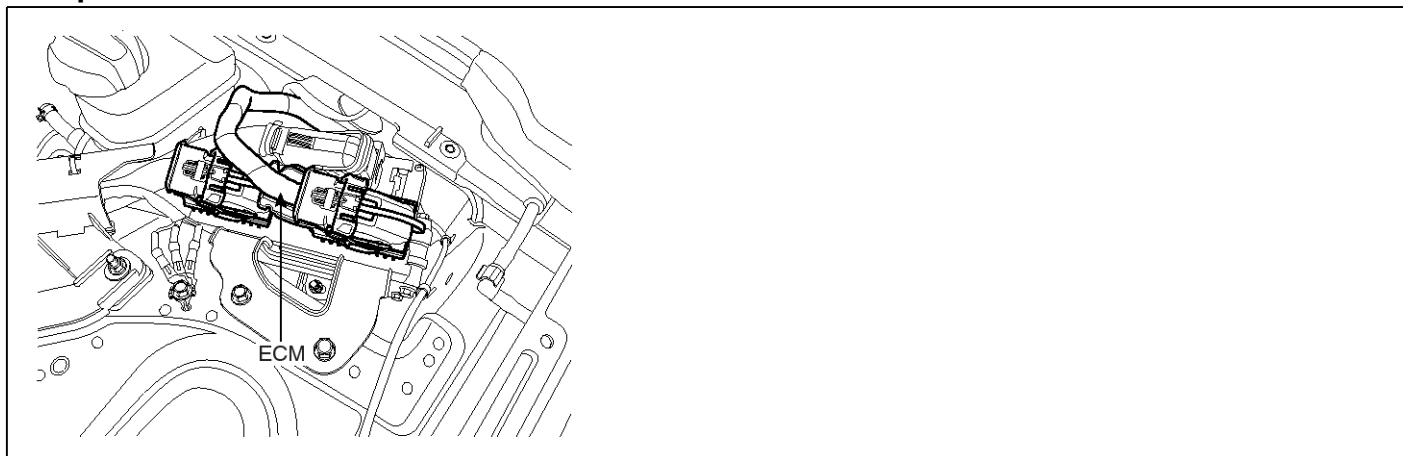
NO ▶ Go to the applicable troubleshooting procedure.

Engine Control System

FL-771

P2610 ECM / PCM-Engine Off Timer Performance

Component Location



SBHFL9300L

General Description

Continuing to calculate data of several sensor despite turning ignition OFF, when ignition turns ON, ECM enables turning ignition ON to be easy using calculated data.

DTC Description

If abnormal countdown is detected for a calibratable time, ECM sets P2610. And then MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycles.

DTC Detecting Condition

Item		Detecting Condition	Possible cause
DTC Strategy	Case1	• Compares the time elapsed recorded by the LPC(Low Power Counter) against that recorded by the test timer	• ECM • Poor Battery Condition • Connecting condition
	Case2	• Checks for abnormal resets of the LPC	
Enable Conditions	Case1	• Engine running > 10sec. • Battery voltage > 8V	
	Case2	• No Memory Failure Occurred	
Threshold value	Case1	• The difference between the counter the LPC and the calibration the test timer clocks up > 20sec.	
	Case2	• The LPC is reset to zero abnormally	
Diagnosis Time		• -	
MIL On Condition		• 2 Driving Cycles	

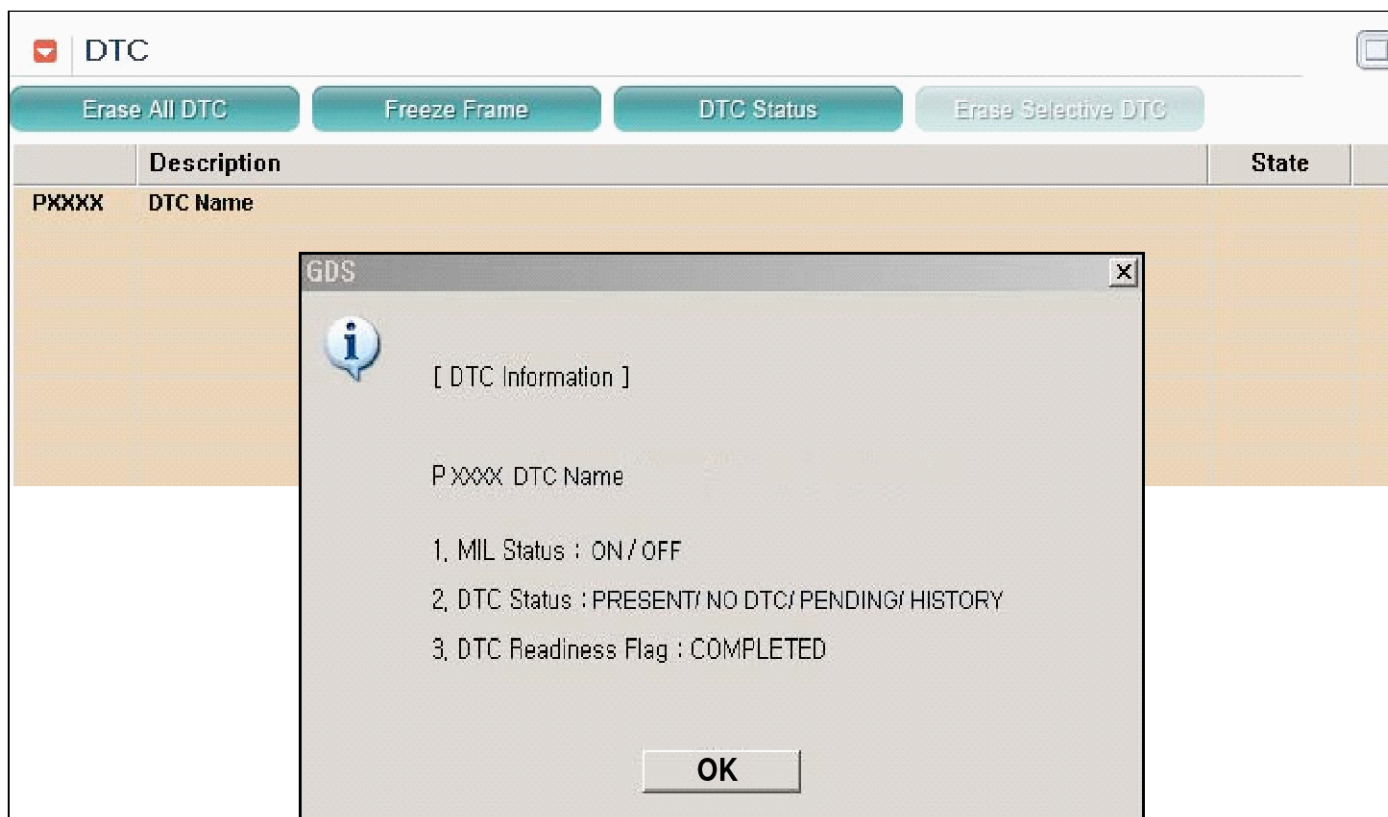
FL-772

Fuel System

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.

3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to "Component Inspection" procedure

Component Inspection

■ Battery Voltage Check

1. IG "ON"
2. Measure the voltage between + and - terminal of battery.

Specification : Above 11V

Engine Control System

FL-773

3. Is the measured voltage within specification ?

YES ► Substitute with a known - good ECM and check for proper operation. If the problem is corrected, replace ECM and go to "Verification of Vehicle Repair" procedure.

 NOTICE

There is a memory reset function on scantool that can erase optional parts automatically detected and memorized by ECM. Before or after testing ECM on the vehicle, use this function to reuse the ECM on the others

NO ► Repair as necessary and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

FL-774

Fuel System

U0001 High Speed CAN Communication Bus off

General Description

Several control units are applied to electronically controlled vehicles. These units perform each control with informations from various sensors. Thus, sharing signal information from sensors is needed, so CAN communication type whose communication speed is high and insensitive to electrical noise by spark generation is adopted to controlling power-train(ECM, TCM,ESP ECM, ABS ECM) As sharing signals of engine speed, APS, gear shifting, torque reduction in ESP and various modules, active control is performed.

DTC Description

Checking CAN communication, under detecting condition, if an error within the detecting condition is detected for more than 1.5 sec., ECM sets U0001. MIL(Malfunction Indication Lamp) turns on when the malfunction lasts till consecutive 2 driving cycles.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Detects failures in communication between the ECM and another or modules in the vehicle which are on the CAN serial bus.	- CAN BUS - CAN communication module component
EnableConditions	- Engine Run Time $\geq$ 2sec. - Ignition Voltage $\geq$ 11V	
Threshold value	CAN communicatin error	
Diagnosis Time	Continuous	
MIL On Condition	2 driving cycle	

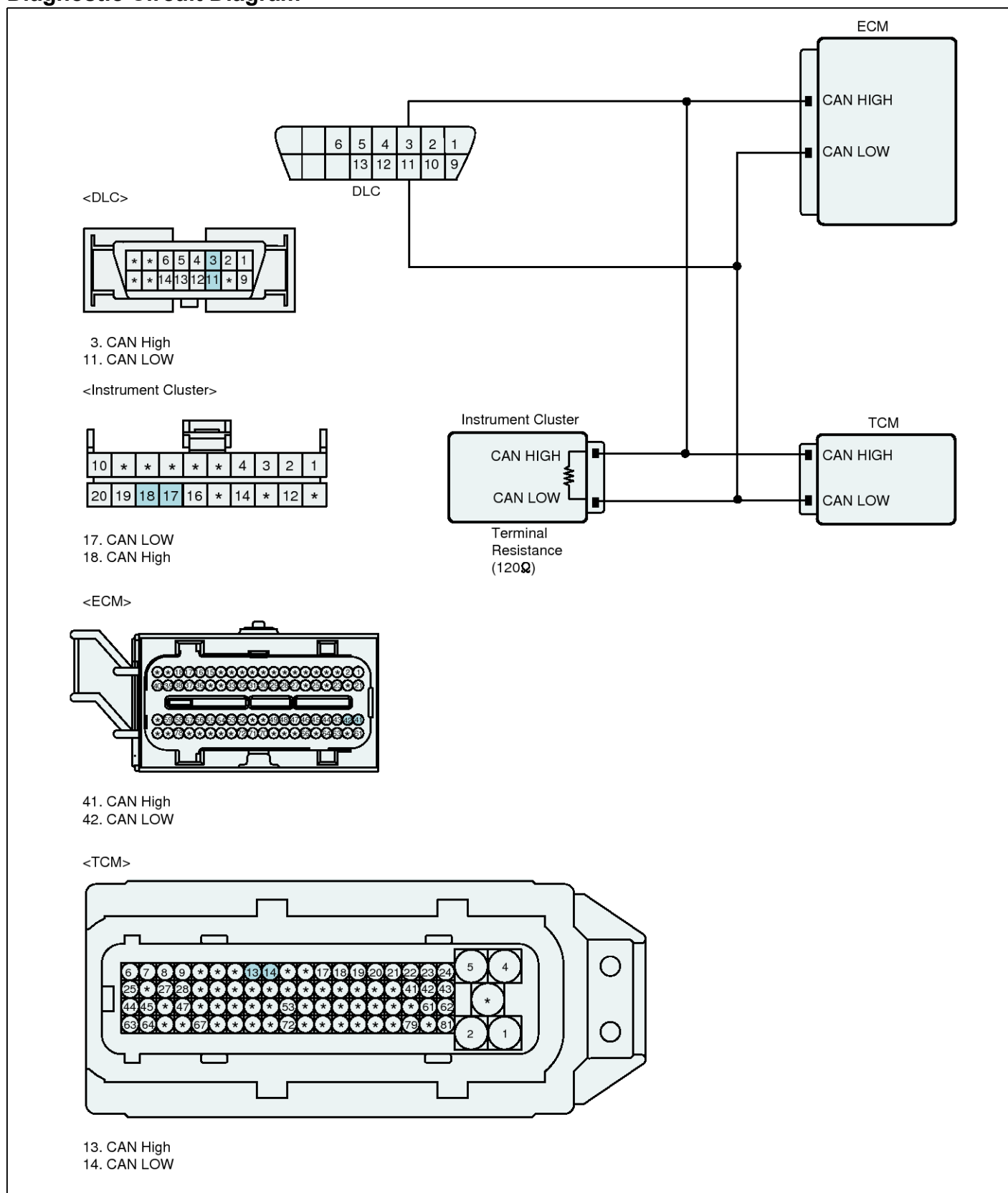
Specification

Communicati-on Format	DIGITAL "0"		DIGITAL "1"(BUS IDLE)		CAN Communication Line Resistance	
	HIGH	LOW	HIGH	LOW	ECM	Cluster
CAN 2.0B	3.5V	1.5V	2.5V	2.5V	120 Ω (20 $^{\circ}$ C)	120 Ω (20 $^{\circ}$ C)

Engine Control System

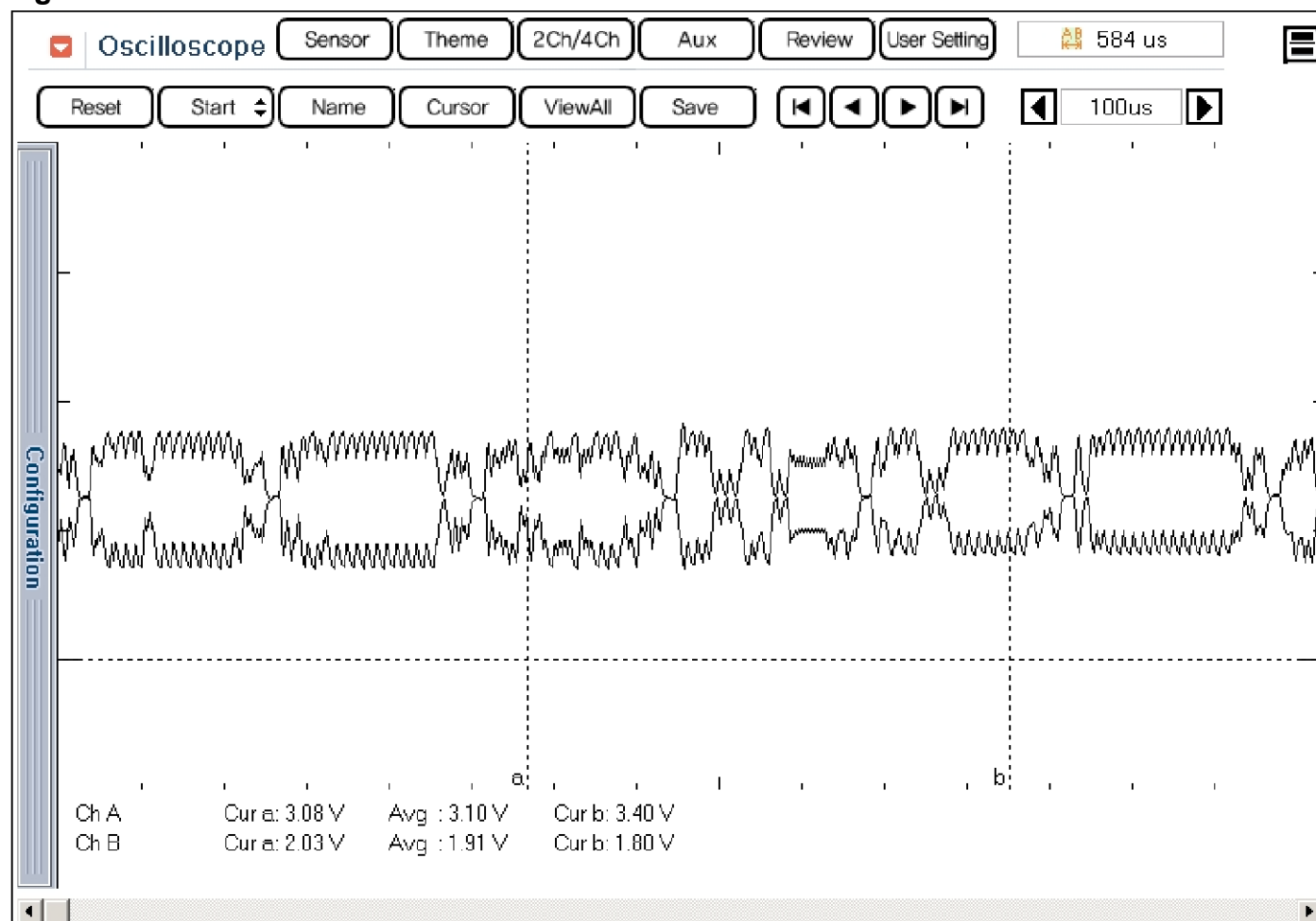
FL-775

Diagnostic Circuit Diagram



SBHFL9541L

Signal Waveform & Data



SBHFL9696L

Fig 1) Can communication waveform at idle

Monitoring CAN HIGH and LOW simultaneously is important in monitoring CAN communication waveform. When CAN HIGH signal rise to 3.5V and LOW signal drops to 1.5V - voltage difference between HIGH and LOW signal is 2V - at BUS IDLE state(DIGITAL "1") whose reference voltage is 2.5V, "0" is recognized. Besides, comparing HIGH and LOW signal if opposite waveform is detected with the reference voltage of 2.5V, Check if current cam signal transfers correctly.

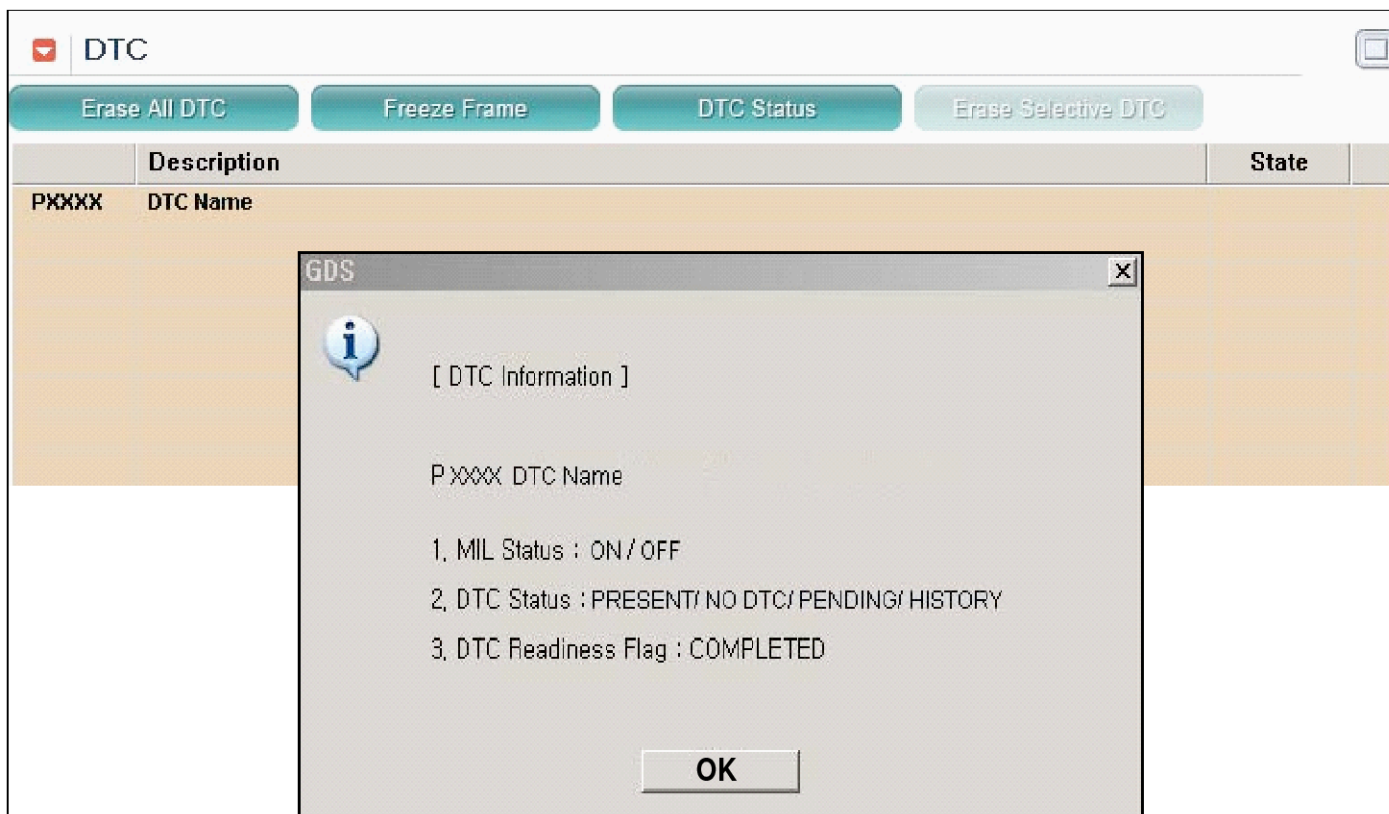
Continuous "0" signal above 6BIT means the occurrence of error in CAN communication. 1BIT is easily distinguished as calculating the time when "SOF"(START OF FRAME) which notifies the start of frame occurs. Check if "0" signal above 6BIT is detected continuously when monitoring CAN communication waveform.

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".
3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.

Engine Control System

FL-777



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. .
3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to " Signal Circuit Inspection " procedure

Signal Circuit Inspection

■ Check CAN BUS resistance in Data Link Connector

1. IG "OFF"
2. Measure the resistance between CAN-HIGH and CAN-LOW terminals of data link connector (Measurement "A")
3. Disconnect ECM, Instrument Cluster, and ABS/ESC ECU connector.
4. Measure the resistance between CAN-HIGH and CAN-LOW terminals of data link connector (Measurement "B")

Specification : ECM, Instrument Cluster and ABS/ESC ECU connected : $60 \pm 3\Omega$ (Measurement "A"), ECM disconnected : $120 \pm 3\Omega$ (Measurement "B")

FL-778

Fuel System

5. Is the measured resistance within specification ?

YES ▶ Go to "Check short to ground in CAN BUS" as follows.

NO ▶ Below 10Ω for both conditions(disconnected , connected) : Repair short between CAN BUS lines and go to "Verification of Vehicle Repair".
▶ 120Ω for both conditions(disconnected, connected) : Go to "Check CAN BUS continuity".
▶ Infinite Ω for both conditions(disconnected, connected) :Repair open in CAN communication circuit between DLC terminal and In-panel junction box.

■ Check short to ground in CAN BUS

1. IG "OFF" and disconnect ECM, Instrument Cluster and ABS/ESC ECU connector.
2. Check resistance between CAN-HIGH terminal of Data Link Connector and chassis ground. (CAN HIGH line)
3. Check resistance between CAN-LOW terminal of Data Link Connector and chassis ground. (CAN LOW line)

Specification : Infinite

4. Is the measured resistance within specification ?

YES ▶ Go to "Check short to battery in CAN BUS".

NO ▶ Repair short to ground in circuit and go to "Verification of Vehicle Repair".

■ Check short to battery in CAN BUS

1. IG "OFF" and disconnect ECM, Instrument Cluster and ABS/ESC ECU connector.
2. IG "ON"
3. Measure the voltage between CAN-HIGH terminal of Data Link Connector and chassis ground. (CAN HIGH line)
4. Measure the voltage between CAN-LOW terminal of Data Link Connector and chassis ground. (CAN LOW line)

Specification : 0.0V~0.1V

5. Is the measured voltage within specification ?

YES ▶ Go to "Check CAN BUS continuity" as follows.

NO ▶ Repair short to battery and go to "Verification of Vehicle Repair".

■ Check open in CAN BUS line

1. IG "OFF" and disconnect ECM, Instrument Cluster and ABS/ESC ECU connector.
2. Check resistance between CAN-HIGH terminal of Data Link Connector and CAN-HIGH terminal of each module.(Measurement "A")
3. Check resistance between CAN-LOW terminal of Data Link Connector and CAN-LOW terminal of each module.(Measurement "B")

Specification : Below 1.0Ω

4. Is the measured resistance within specification ?

YES ▶ Go to "Component Inspection".

NO ▶ Repair open in CAN BUS line and go to "Verification of Vehicle Repair".

Component Inspection

■ Check CAN communication waveform generation

1. IG "OFF" and connect each channel scope to CAN-HIGH terminal and CAN-LOW terminal.
2. IG "ON" after disconnecting only ECM to CAN BUS.
3. IG "ON" after disconnecting only ABS/ESC ECU to CAN BUS.
4. IG "ON" after disconnecting only Instrument Cluster to CAN BUS.

Specification : At Ignition "ON", the waveform is same as the one of "Signal Waveform & Data".

※ Different from "Signal Waveform & Data", if 1) both CAN HIGH and LOW signal are fixed at 2.5 V or 2) HIGH and LOW signal are fixed at 3.5 V and 1.5 V, respectively, it is due to communication error between modules.

5. Is the measured waveform normal ?

YES ▶ Go to "Verification of Vehicle Repair".

NO ▶ Replace the module which generates poor communication waveform, and go to "Verification of Vehicle Repair".

Engine Control System

FL-779

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

FL-780

Fuel System

U0101 Lost Communication With TCM

General Description

Refer to DTC U0001 : High Speed CAN Communication Bus off

DTC Description

Checking CAN communication, under detecting condition, if an CAN communication error between ECM and TCM is detected . ECM sets U0101.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Check CAN message from TCM	• TCM faulty • CAN communication line between ECM and TCM
EnableConditions	• Engine Run Time $\geq$ 2sec. • Ignition Voltage $\geq$ 11V	
Threshold value	• CAN communicatin error with TCM	
Diagnosis Time	• Continuous	
MIL On Condition	• 2 driving cycle	

Specification

Refer to DTC U0001 : High Speed CAN Communication Bus off

Diagnostic Circuit Diagram

Refer to DTC U0001 : High Speed CAN Communication Bus off

Signal Waveform & Data

Refer to DTC U0001 : High Speed CAN Communication Bus off

Monitor Scantool Data

Refer to DTC U0001 : High Speed CAN Communication Bus off

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. .
3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to " Signal Circuit Inspection " procedure

Signal Circuit Inspection

■ Check open in harness

1. IG "OFF" and disconnect ECM and TCM connector.
2. Check resistance between CAN-HIGH terminal of ECM harness Connector and CAN-HIGH terminal of TCM harness connector.
3. Check resistance between CAN-LOW terminal of ECM harness Connector and CAN-LOW terminal of TCM harness connector.

Specification : Below 1.0Ω

4. Is the measured resistance within specification ?

YES ► Go to "Component Inspection".

NO ► Repair open in CAN BUS line and go to "V-erification of Vehicle Repair".

Verification of Vehicle Repair

Refer to DTC U0001 : High Speed CAN Communication Bus off

Engine Control System

FL-781

U1111 Battery Sensor fault detected by ECU

General Description

Many control units have applied to vehicle as it becomes more eletrolnical. These units control their own system based on information from diverse sensors. Therefore necessity of common use of diverse sensor information and importance of stable power supply are gathering strength. Battery sensor is mounted on battery (-) terminal. It transmits battery voltage, current, temperature information to ECM. ECM controls generating voltage by duty cycle based on these signals.

DTC Description

ECM sets this code when error bit in LIN messages from battery sensor indicates "1"

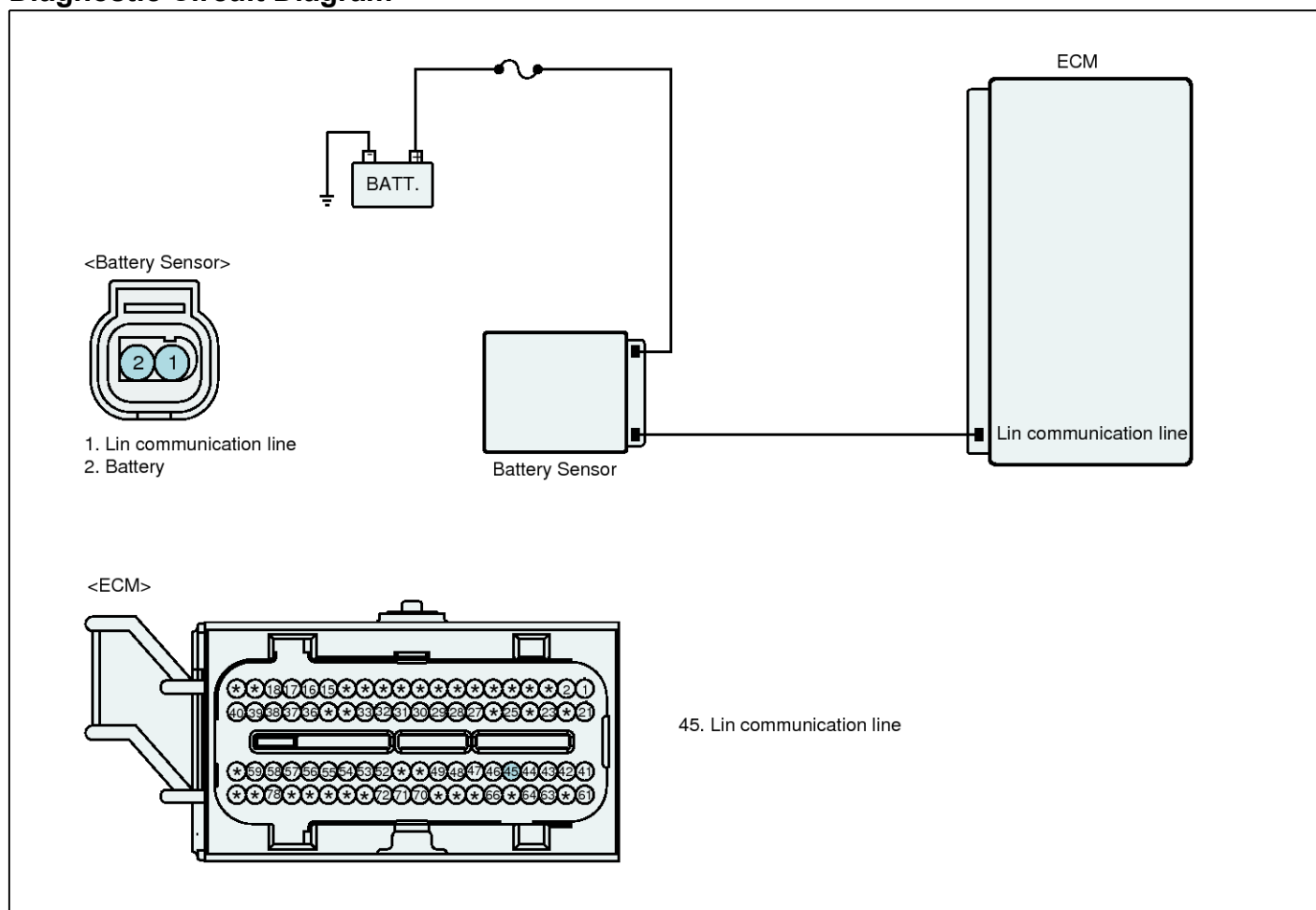
DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	Signal Monitoring	Faulty battery sensor
EnableConditions	- Engine Run Time $\geq$ 2sec. - Ignition Voltage $\geq$ 11V	
Threshold value	Battery sensor error	
Diagnosis Time	Continuous	
MIL On Condition	NO MIL ON(DTC only)	

FL-782

Fuel System

Diagnostic Circuit Diagram



SBHFL9542L

Signal Waveform & Data

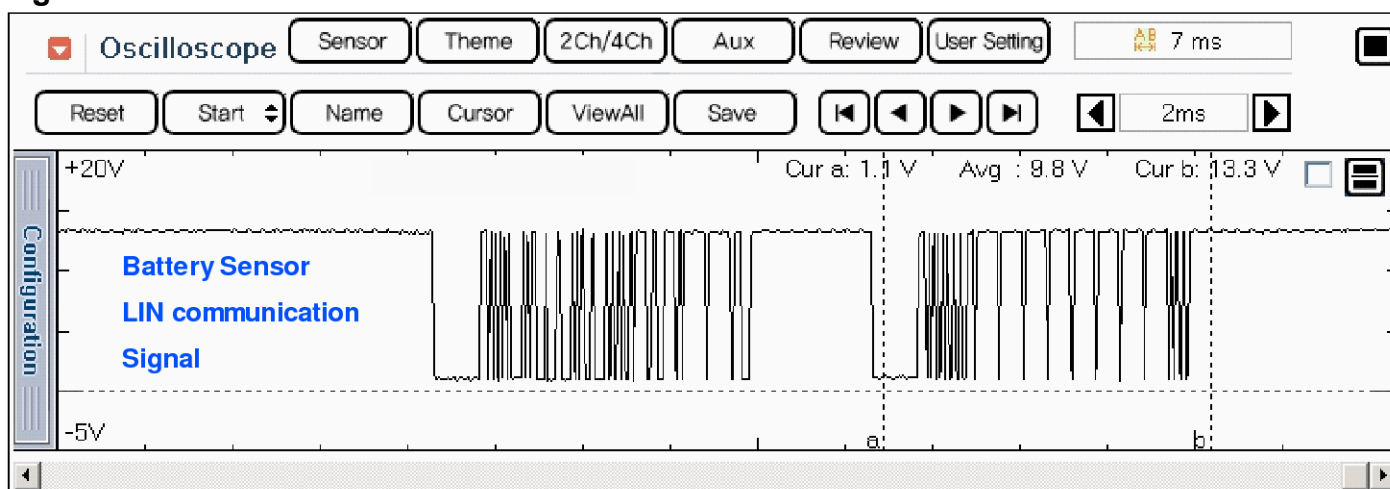


Fig.1

SBHFL9697L

Fig 1) Signal waveforms of battery sensor

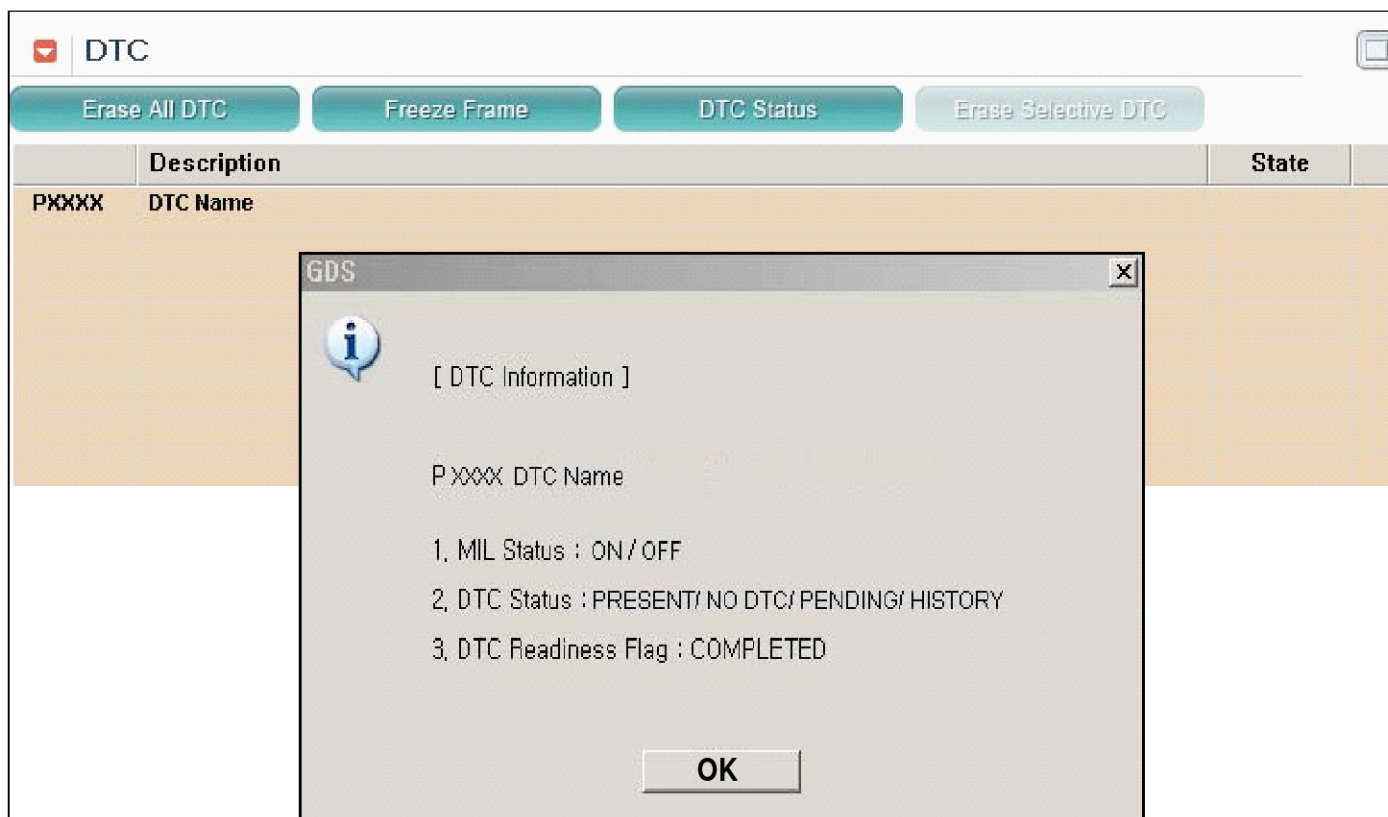
Engine Control System

FL-783

Monitor Scantool Data

1. Connect scantool to Data Link Connector(DLC).
2. IG "ON".

3. Select "DTC" button, and then Press "DTC Status" to check DTC's information from the DTCs menu.
4. Read "DTC Status" parameter.



SBHFL9605L

5. Is parameter displayed "Present fault"?

YES ► Go to "Terminal and Connector inspection" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, ending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of Vehicle Repair" procedure.

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Substitute with a known - good battery sensor and check for proper operation. If the problem is corrected, replace battery sensor and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect scantool and select "DTC" button.
2. Press "DTC Status" button and confirm that "DTC Readiness Flag" indicates "Completed". If not, drive the vehicle within conditions noted in the freeze frame data or enable conditions.
3. Read "DTC Status" parameter.
4. Is parameter displayed "History(Not Present) fault"?

YES ► System performing to specification at this time. Clear the DTC.

NO ► Go to the applicable troubleshooting procedure.

FL-784

Fuel System

U1112 LIN Communication Error

General Description

Refer to DTC U1111 : Battery Sensor fault detected by ECU

DTC Description

ECM sets this code when there is an error in LIN communication line.

DTC Detecting Condition

Item	Detecting Condition	Possible cause
DTC Strategy	• Signal Monitoring	• Open or short in LIN communication line
EnableConditions	• Engine Run Time $\geq$ 2sec. • Ignition Voltage $\geq$ 11V	
Threshold value	• LIN communication error	
Diagnosis Time	• Continuous	
MIL On Condition	• NO MIL ON(DTC only)	

Diagnostic Circuit Diagram

Refer to DTC U1111 : Battery Sensor fault detected by ECU

Signal Waveform & Data

Refer to DTC U1111 : Battery Sensor fault detected by ECU

Monitor Scantool Data

Refer to DTC U1111 : Battery Sensor fault detected by ECU

Terminal and Connector inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
3. Has a problem been found?

YES ► Repair as necessary and go to "Verification of Vehicle Repair" procedure

NO ► Go to "Signal Circuit Inspection" procedure

Signal Circuit Inspection

■ Check open in harness

1. IG "OFF" and disconnect battery sensor and ECM connector.
2. Check resistance between LIN terminal of battery sensor harness Connector and ECM harness connector.

Specification : Below 1.0Ω

3. Is the measured resistance within specification ?

YES ► Go to "Check short to battery in harness" as follows.

NO ► Repair open in harnesses and go to "Verification of Vehicle Repair".

■ Check short to battery in harness

1. IG "OFF" and disconnect battery sensor and ECM connector.
2. IG "ON"
3. Measure the voltage between LIN terminal of battery sensor harness connector and chassis ground.

Specification : Approx. 0V

4. Is the measured voltage within specification ?

YES ► Go to "Check short to ground in harness" as follows.

NO ► Repair short to battery in harnesses and go to "Verification of Vehicle Repair".

■ Check short to ground in harness

1. IG "OFF" and disconnect battery sensor and ECM connector.
2. Check resistance between LIN terminal of battery sensor harness Connector and chassis ground.

Specification : Infinity

3. Is the measured resistance within specification ?

YES ► Go to "Component Inspection" as follows.

NO ► Repair short to ground in harnesses and go to "Verification of Vehicle Repair".

Engine Control System

FL-785

Component Inspection

■ LIN communication line waveform check

1. IG "OFF"
2. Connect probe to battery sensor to check signal waveform by using oscilloscope function.
3. IG "ON" and monitor signal waveform.

Specification : Signal waveform will be displayed as Signal Waveform & Data

4. Is the measured signal waveform O.K ?

YES ► Go to "Verification of Vehicle Repair" procedure.

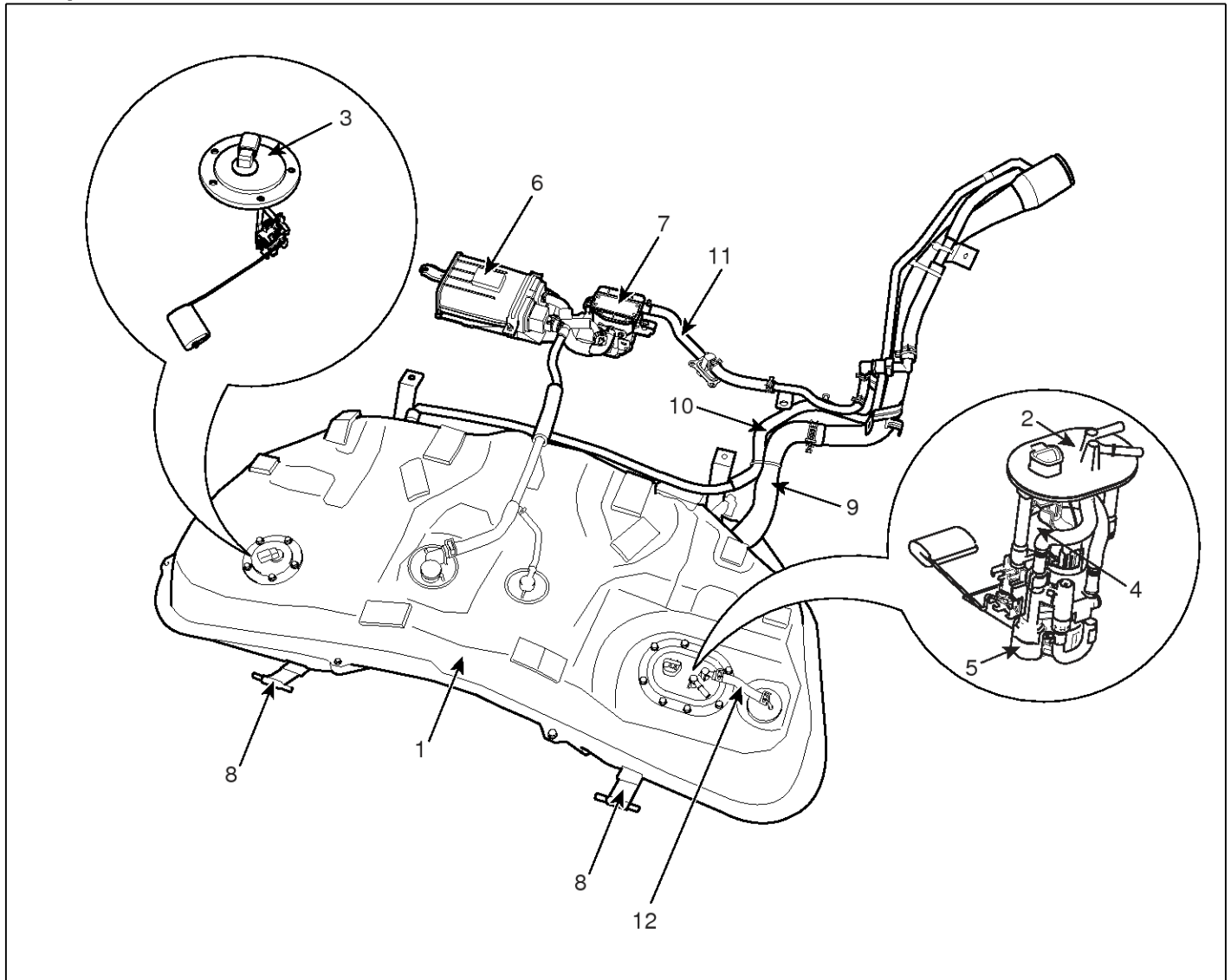
NO ► Substitute with a known - good battery sensor and check for proper operation. If the problem is corrected, replace battery sensor and go to "Verification of Vehicle Repair" procedure.

Verification of Vehicle Repair

Refer to DTC U1111 : Battery Sensor fault detected by ECU

Fuel Delivery System

Components Location



SBHFL9124L

1. Fuel Tank	7. Fuel Tank Air Filter
2. Fuel Pump	8. Fuel Tank Band
3. Sub Fuel Sender	9. Fuel Filler Hose
4. Fuel Filter	10. Leveling Hose
5. Fuel Pressure Regulator	11. Ventilation Hose
6. Canister	12. Suction Hose

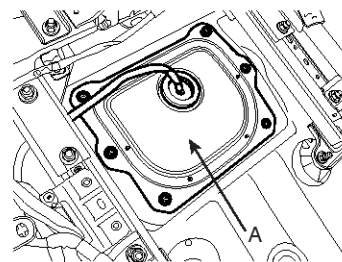
Fuel Delivery System

FL-787

Fuel Pressure Test

1. PREPARING

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



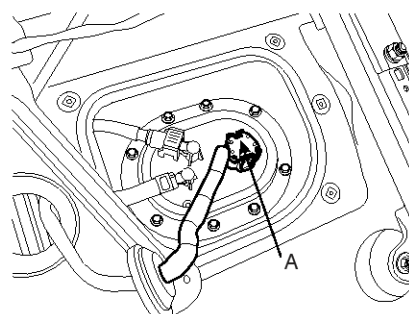
2. RELEASE THE INTERNAL PRESSURE

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

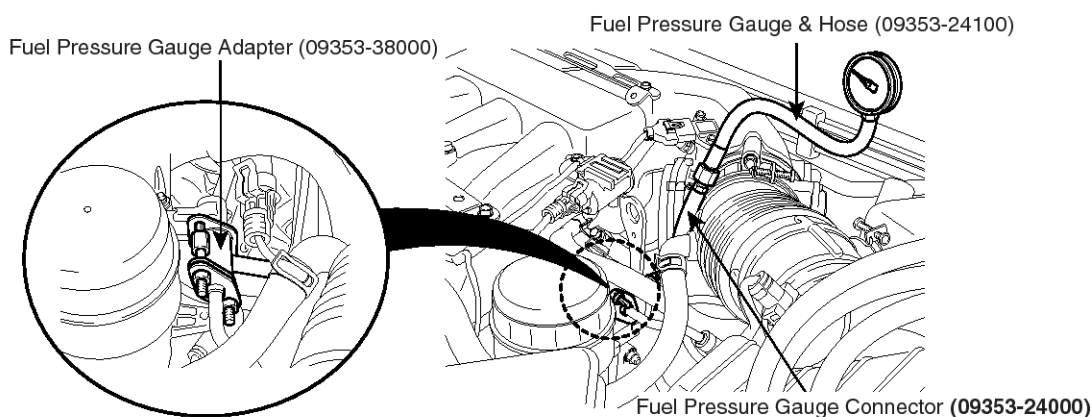
1. Disconnect the fuel feed hose from the delivery pipe.



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).



SBHFL9125L

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: 379.5kPa (3.87kgf/cm², 55.0psi)

- 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 gage reading should hold for about 5 minutes

- Observing the declination of the fuel pressure when the gage 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

Fuel Delivery System

FL-789

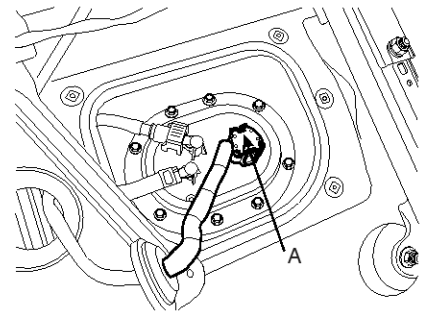
6. RELEASE THE INTERNAL PRESSURE

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.

SBHFL9127L

FL-790

Fuel System

Fuel Tank

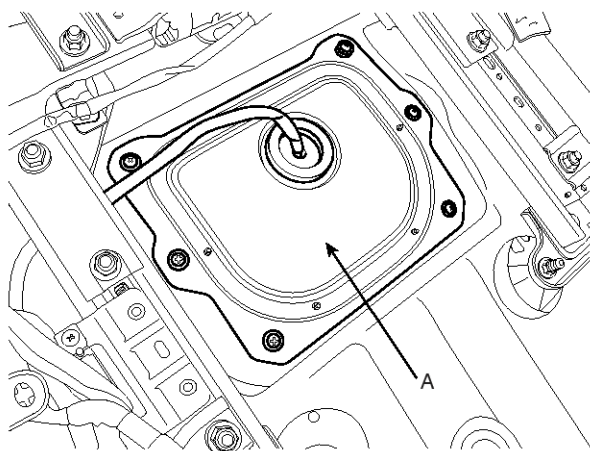
Removal

1. Preparation

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

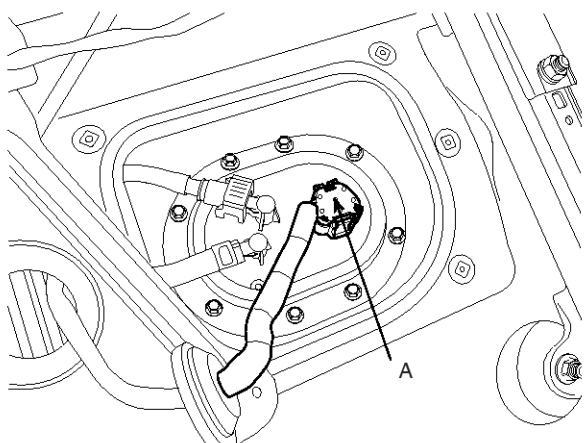
NOTICE

In case of power rear seat, the service cover may be interfered with the seat frame in accordance with its position. So let the rear seat in the forefront position when repairing the fuel pump or the sub fuel sender.



SBHFL8167D

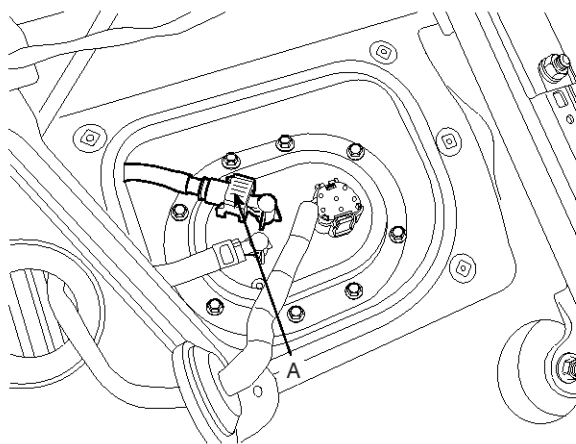
- 3) Disconnect the fuel pump connector (A).



SBHFL8168D

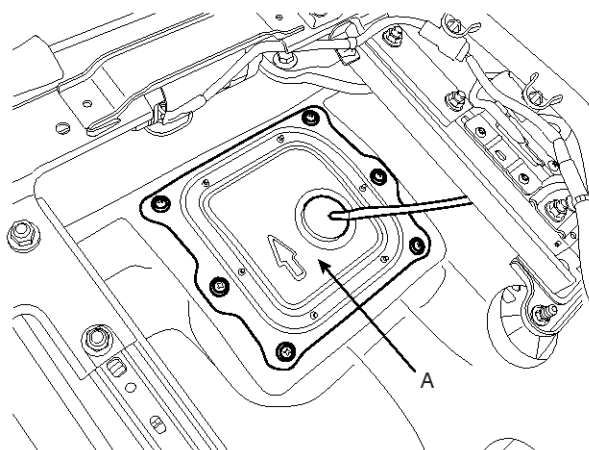
- 4) Idle the engine and wait until fuel in feed line is exhausted.
- 5) After engine stops, turn the ignition switch OFF.

2. Disconnect the fuel feed tube quick-connector (A).



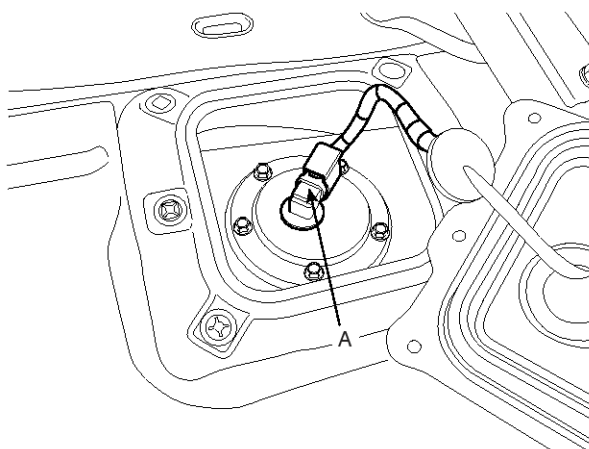
SBHFL8169D

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



SBHFL8178D

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

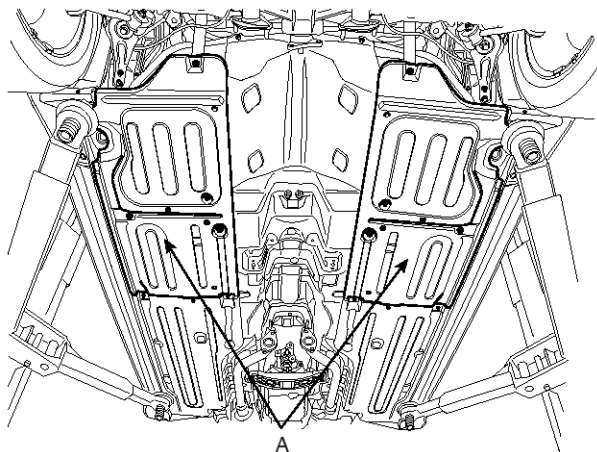


SBHFL8171D

Fuel Delivery System

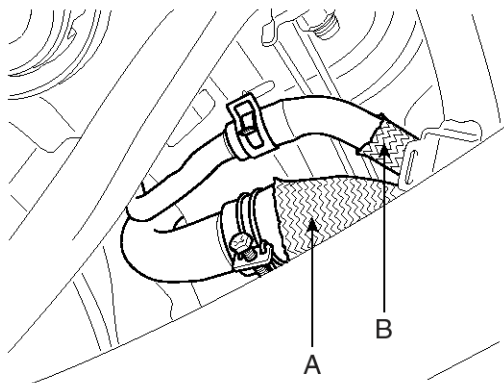
FL-791

5. Lift the vehicle.
6. Remove the center muffler assembly (Refer to "Intake And Exhaust System" in EM group).
7. Remove the propeller shaft (Refer to "Propeller Shaft Assembly" in DS group).
8. Remove the under cover (A).



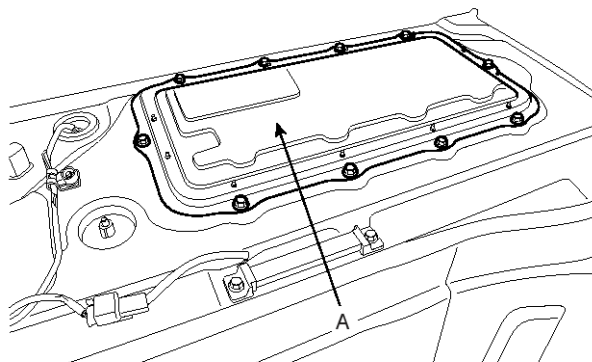
SBHFL8172D

9. Support the fuel tank with a jack.
10. Disconnect the fuel filler hose (A) and the leveling hose (B).



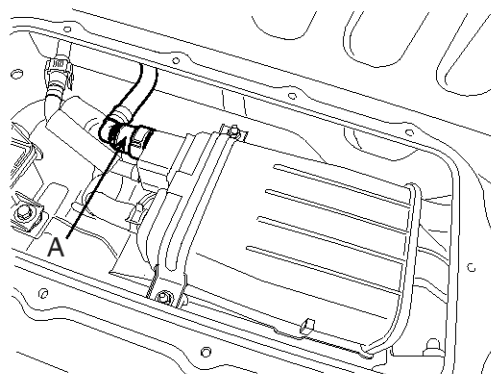
SBHFL9128L

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



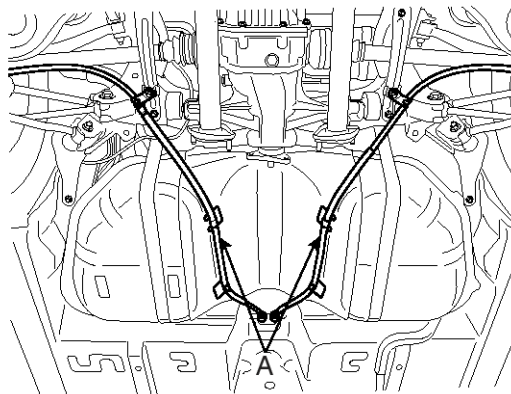
SBHFL8174D

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



SBHFL9129L

13. Detach the parking brake cable (A) from the fuel tank [Except Electric Parking Brake system].

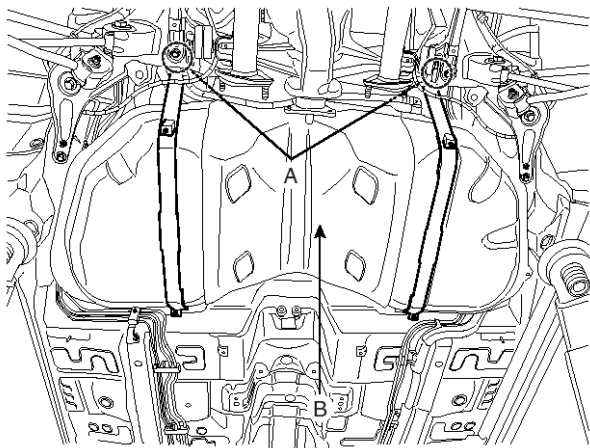


SBHFL9130L

FL-792

Fuel System

14. Remove the fuel tank (B) from the vehicle after removing the mounting nuts (A).



SBHFL8176D

Installation

1. Installation is reverse of removal.

Fuel tank band installation nut:

39.2 ~ 54.0 N.m (4.0 ~ 5.5 kgf.m, 28.9 ~ 39.8 lbf.ft)

Fuel Delivery System

FL-793

Fuel Pump

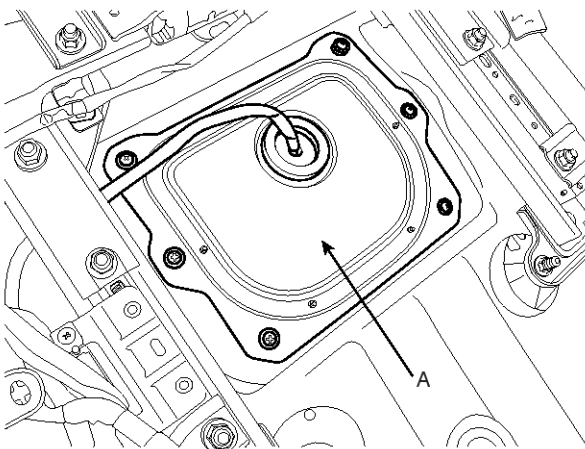
Removal

1. Preparation

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

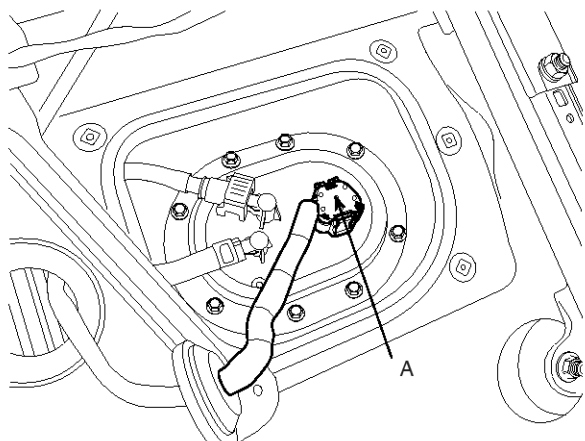
NOTICE

In case of power rear seat, the service cover may be interfered with the seat frame in accordance with its position. So let the rear seat in the forefront position when repairing the fuel pump or the sub fuel sender.



SBHFL8167D

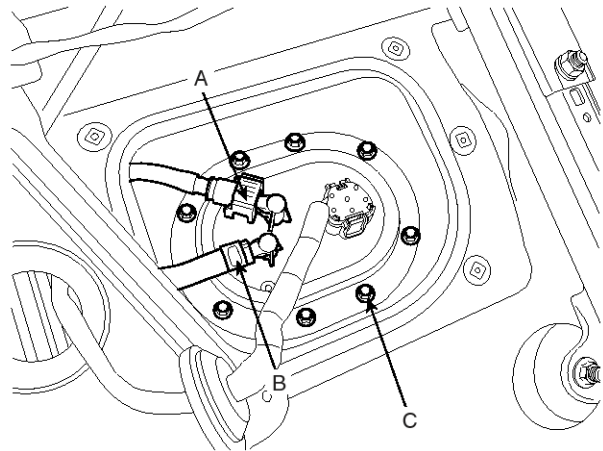
- 3) Disconnect the fuel pump connector (A).



SBHFL8168D

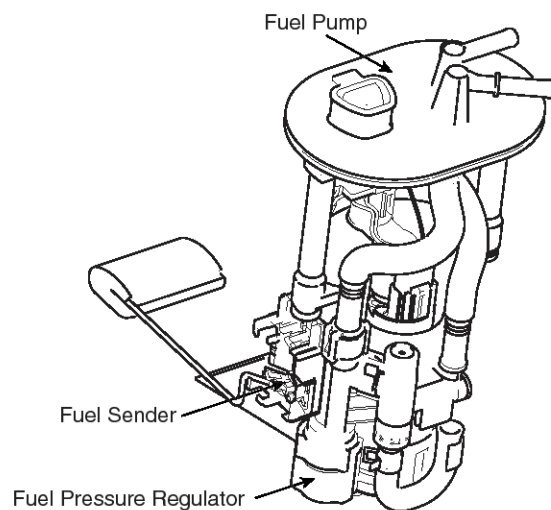
- 4) Idle the engine and wait until fuel in feed line is exhausted.
- 5) After engine stops, turn the ignition switch OFF.

2. Disconnect the fuel feed tube quick-connector (A) and the suction hose (B).



SBHFL8177D

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



SBHFL9131L

Installation

1. Installation is reverse of removal.

Fuel pump installation bolt :

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

CAUTION

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

Sub Fuel Sender

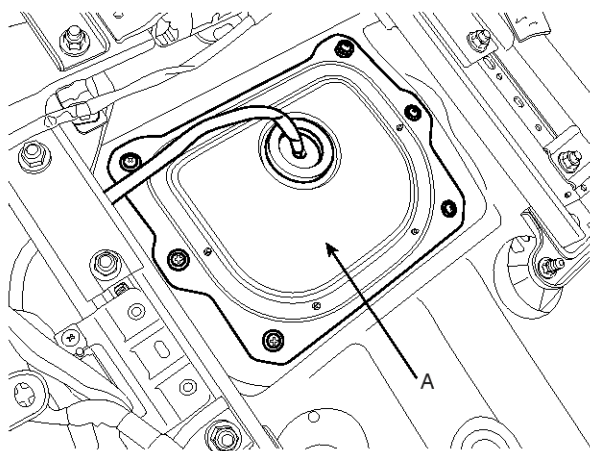
Removal

1. Preparation

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

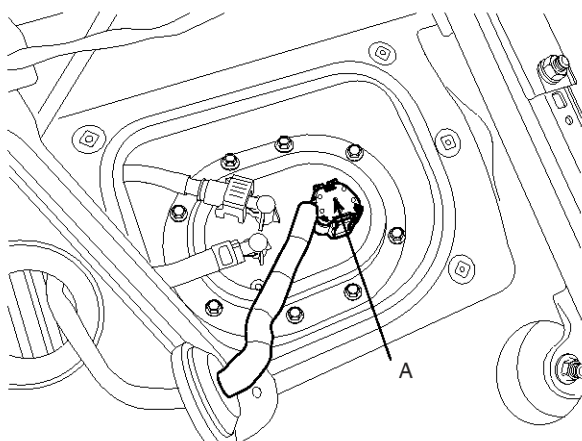
NOTICE

In case of power rear seat, the service cover may be interfered with the seat frame in accordance with its position. So let the rear seat in the forefront position when repairing the fuel pump or the sub fuel sender.



SBHFL8167D

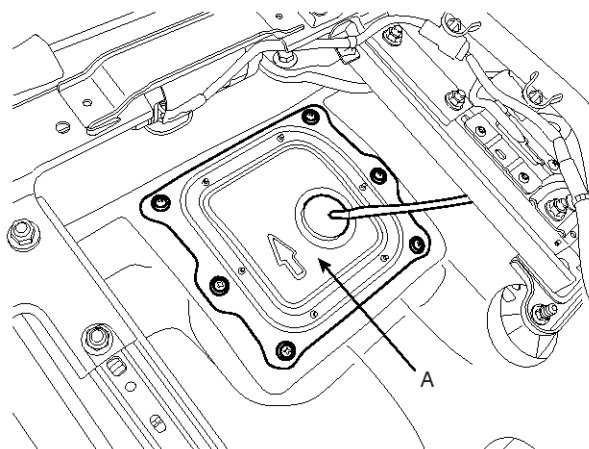
- 3) Disconnect the fuel pump connector (A).



SBHFL8168D

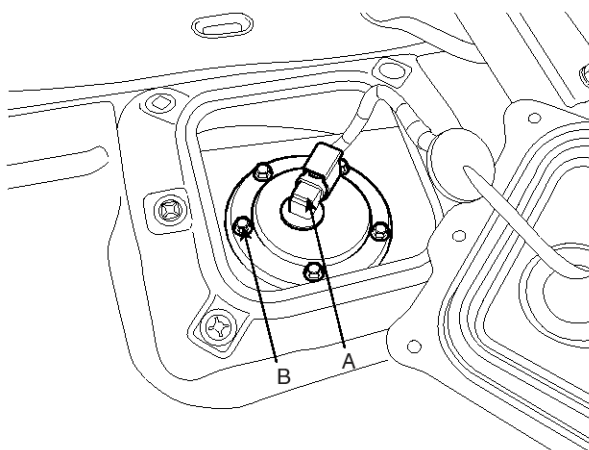
- 4) Idle the engine and wait until fuel in feed line is exhausted.
- 5) After engine stops, turn the ignition switch OFF.

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



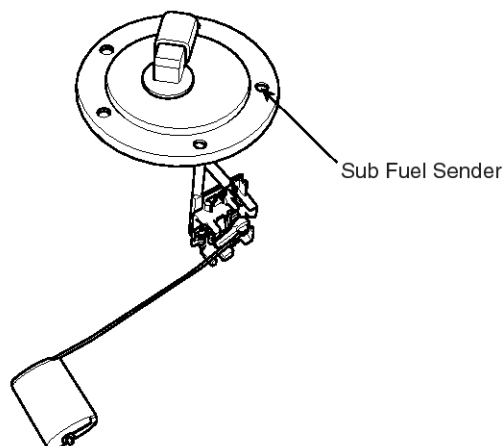
SBHFL8178D

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



SBHFL8179D

4. Remove the sub fuel sender from the fuel tank after removing the installation bolts (B).



Fuel Delivery System

FL-795

SBHFL9132L

Installation

1. Installation is reverse of removal.

Sub fuel sender installation bolt :

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

CAUTION

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

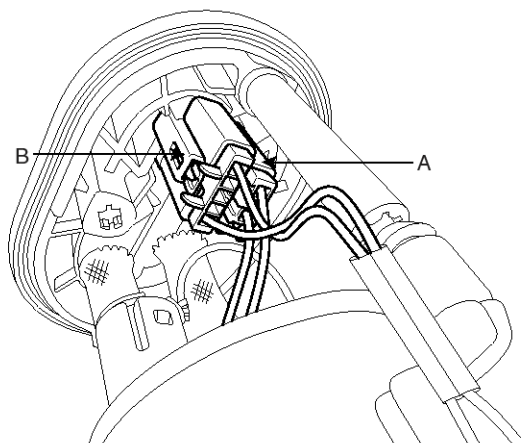
FL-796

Fuel System

Fuel Filter

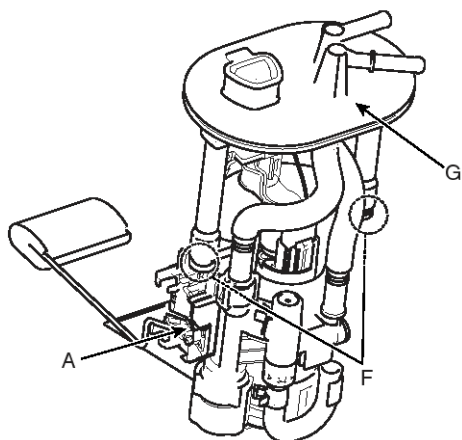
Replacement

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

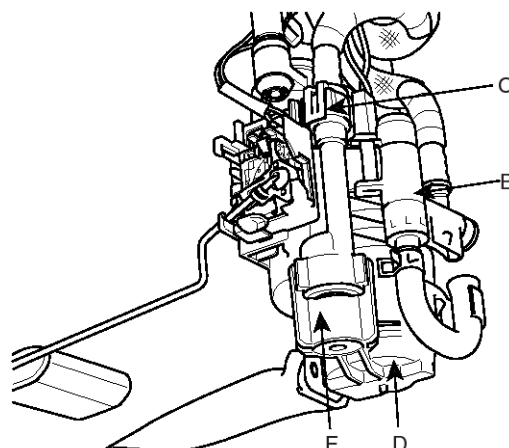


SBHFL8180D

3. Remove the fuel sender (A).

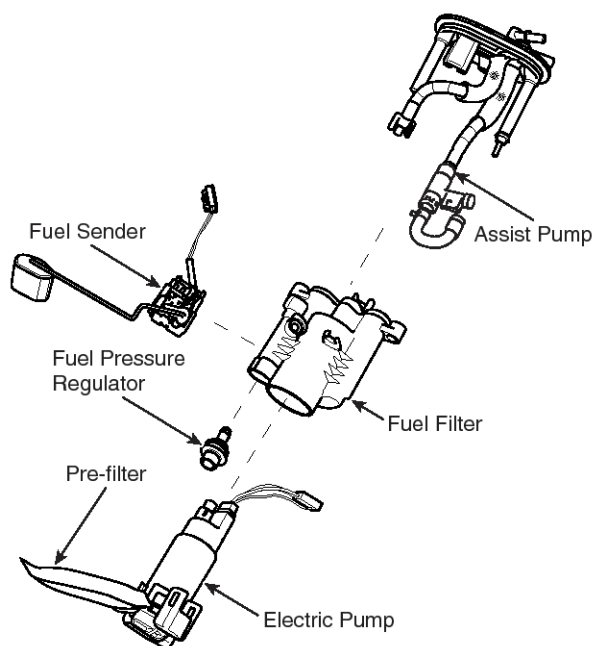


SBHFL8181D



SBHFL8182D

4. Remove the assist pump (B).
5. Disconnect the fuel feed tube (C).
6. Remove the electric pump & pre-filter assembly (D) and the fuel pressure regulator (E).
7. Remove the plate assembly (G) after removing the cushion pipe fixing clip (F).



SBHFL9133L

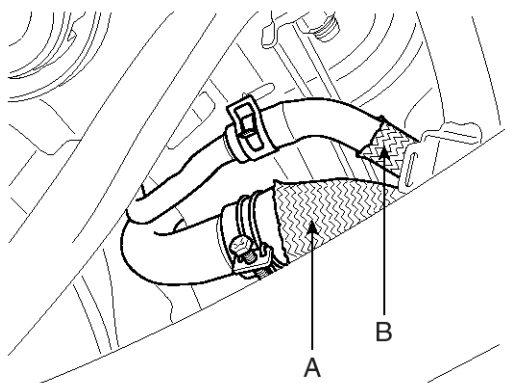
Fuel Delivery System

FL-797

Filler-Neck Assembly

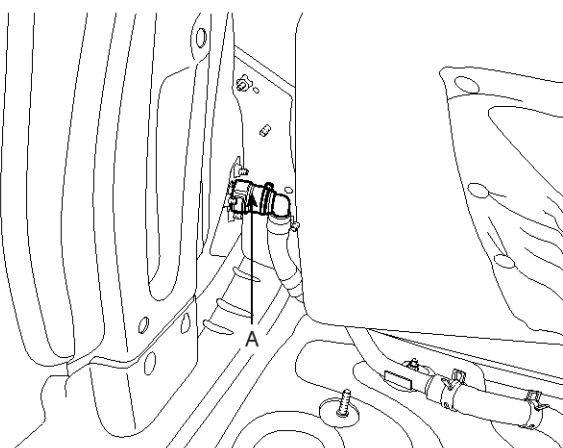
Removal

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



SBHFL9128L

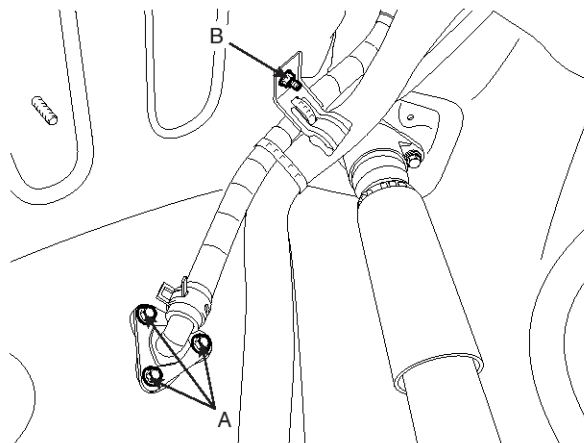
2. Disconnect the vapor hose quick-connector (A) after removing the trunk luggage trim.



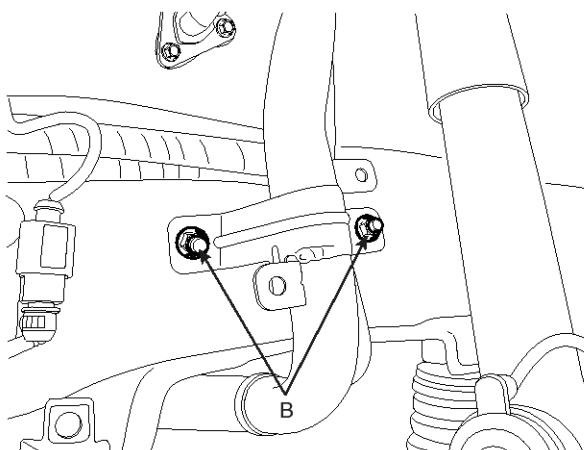
SBHFL8184D

3. Remove the rear-LH wheel, tire, and the inner wheel house.

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



SBHFL8185D



SBHFL8190D

Installation

1. Installation is reverse of removal.

Filler-neck assembly installation bolt :

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

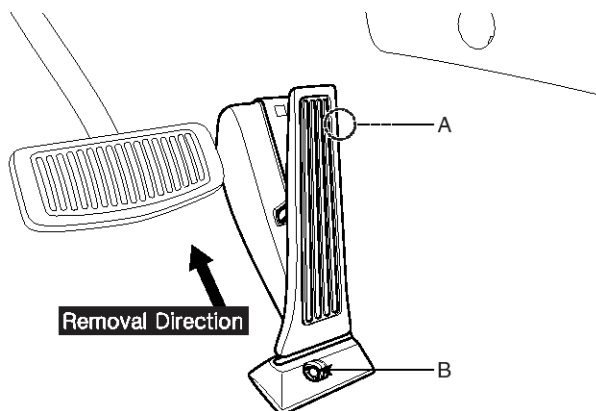
Filler-neck assembly installation nut :

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

Accelerator Pedal

Removal

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



SBHFL9134L

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

Installation

1. Installation is reverse of removal.

Accelerator pedal module installation bolt :

8.8 ~ 13.7 N.m (0.9 ~ 1.4 kgf.m, 6.5 ~ 10.1 lbf.ft)
