D4DD ENGINE DTC(COUNTY)

DTC TROUBLE SHOOTING

DTC TROUBLESHOOTING PROCEDURES

BASIC TROUBLESHOOTING EFE2F9FE

BASIC TROUBLESHOOTING GUIDE

1	Bring Vehicle to Workshop

2	Analyze Customer's Complaint.
• 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 scan tool to Diagnostic Link Connector (DLC). • Record the DTC and freeze frame data. ***NOTE*** *To erase DTC and freeze frame data, refer to Step 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.	

4	Erase the DTC and Freeze Frame Data
(WARNING) NEVER erase DTC and freeze frme data before completing Step 2 MIL/DTC in "CUSTOMER PROBLEM ANALYSIS SHEET".	

5	Inspect Vehicle Visually
• Go to Step 10, if you recognize the problem.	

6	Recreate (Simulate) Symptoms 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.	

7	Confirm Symptoms of Problem
• If DTC(s) is/are not displayed, go to Step 8. • If DTC(s) is/are displayed, go to Step 10.	

8	Recreate (Simulate) Symptom
• Try to recreate or simulate the condition of the malfunction as described by the customer.	

9	Check the DTC
• If DTC(s) does(do) not occur, refer to BASIC INSPECTION in INTERMITTENT PROBLEM PROCEDURE. • If DTC(s) occur(s), go to Step 10.	

10	Perform troubleshooting procedure for DTC

11	Adjust or repair the vehicle

12	Confirmation test

13	END

CUSTOMER PROBLEM ANALYSIS SHEET

1. VEHICLE INFORMATION

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

2. SYMPTOMS

☐ Unable to start	☐ Engine does not turn over ☐ Incomplete combustion ☐ Initial combustion does not occur
☐ Difficult to start	☐ Engine turns over slowly ☐ Other_____
☐ Poor idle	☐ Rough idle ☐ Incorrect idle ☐ Unstable idle(High: _____ rpm, Low: _____rpm) ☐ Other _____
☐ Engine stall	☐ Soon after starting ☐ After acceleration pedal depressed ☐ After acceleration 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) ☐ Idle ☐ 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 ☐ DTC (_____) ☐ Freeze Frame Data

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℃, 68˚F), unless there is any notice.

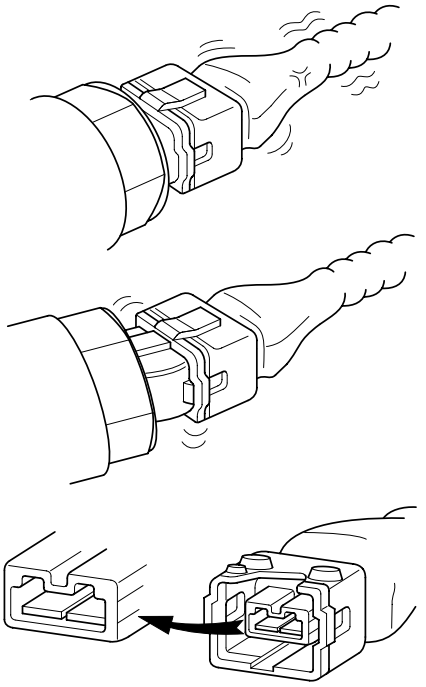
NOTE

The measured resistance in except for ambient temperature (20℃, 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, technician should thoroughly make out a "CUSTOMER PROBLEM ANALYSIS SHEET" and recreate (simulate) the environment and condition which occurred when the vehicle was having the issue.

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



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

● SIMULATING VIBRATION

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

WARNING

Strong vibration may break sensors, actuators or relays

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

● SIMULATING HEAT

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

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

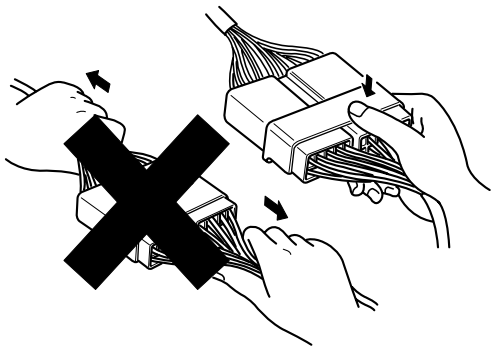
DO NOT sprinkle water directly into the engine compartment or electronic components.

● SIMULATING ELECTRICAL LOAD

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

CONNECTOR INSPECTION PROCEDURE

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



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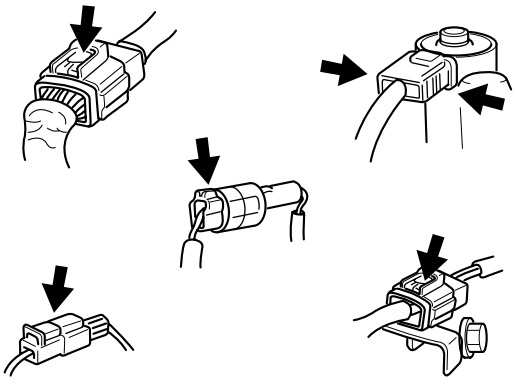
   b. When removing the connector with a lock, press or pull locking lever.



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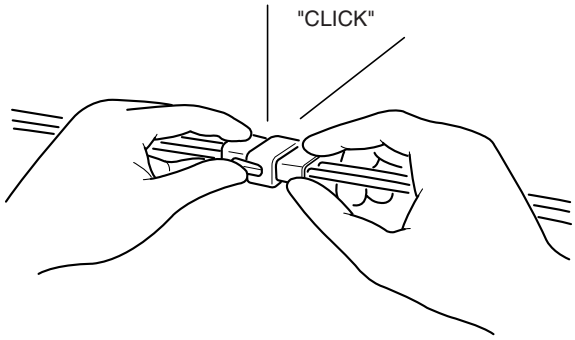
   c. Listen for a click when locking connectors. This sound indicates that they are securely locked.



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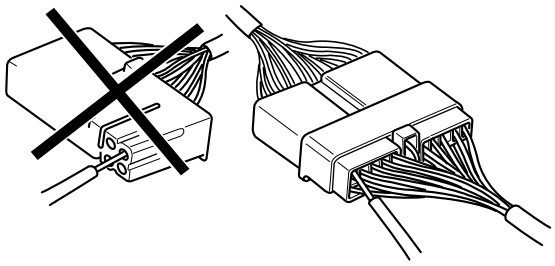
   d. When a tester is used to check for continuity, or to measure voltage, always insert tester probe from wire harness side.



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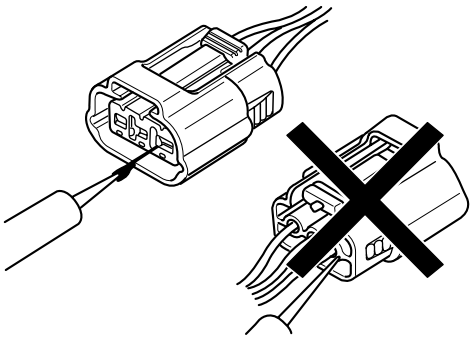
   e. Check waterproof connector terminals from the connector side. Waterproof connectors cannot be accessed from harness side.



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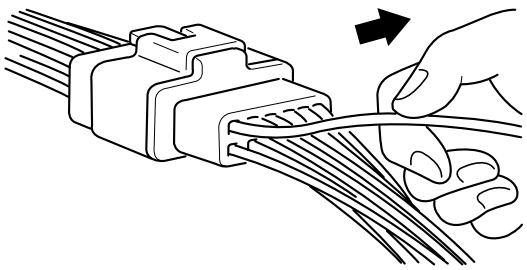
NOTE

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

2. Checking Point for Connector
   a. While the connector is connected:
      Hold the connector, check connecting condition and locking efficiency.
   b. When the connector is disconnected:
      Check missed terminal, crimped terminal or broken core wire by slightly pulling the wire harness. Visually check for rust, contamination, deformation and bend.
   c. Check terminal tightening condition:
      Insert a spare male terminal into a female terminal, and then check terminal tightening conditions.
   d. Pull lightly on individual wires to ensure that each wire is secured in the terminal.



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3. Repair Method of Connector Terminal
   a. Clean the contact points using air gun and/or shop rag.

NOTE

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

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

WIRE HARNESS INSPECTION PROCEDURE

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

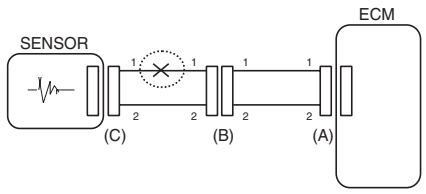
ELECTRICAL CIRCUIT INSPECTION PROCEDURE

● CHECK OPEN CIRCUIT

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

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

FIG 1



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2. Continuity Check Method

NOTE

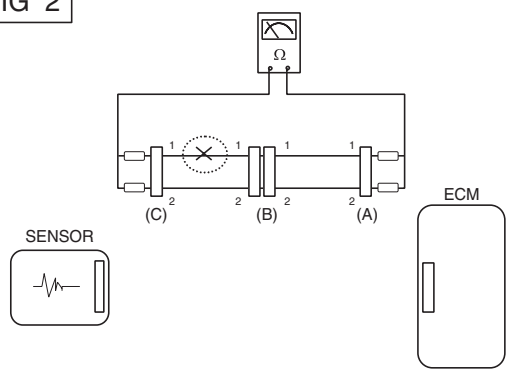
When measuring for resistance, lightly shake the wire harness above and below or from side to side.

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

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

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



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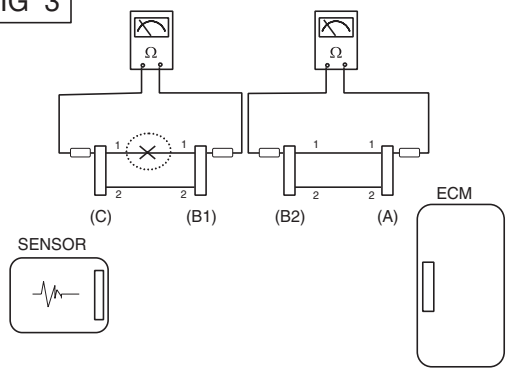
b. Disconnect connector (B), and measure for resistance between connector (C) and (B1) and between (B2) and (A) as shown in [FIG. 3].

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

FIG 3



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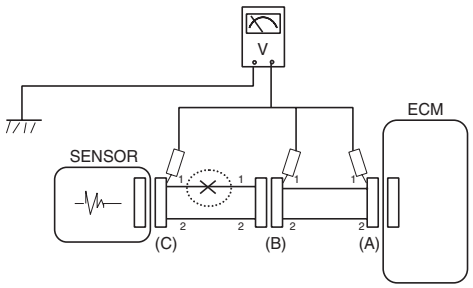
3. Voltage Check Method
   a. With each connector still connected, measure the voltage between the chassis ground and terminal 1 of each connectors (A), (B) and (C) as shown in [FIG. 4].

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

FIG 4



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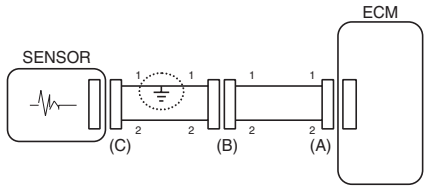
● CHECK SHORT CIRCUIT

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 below Step 2 (Continuity Check Method with Chassis Ground) as shown below.

FIG 5



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2. Continuity Check Method (with Chassis Ground)

NOTE

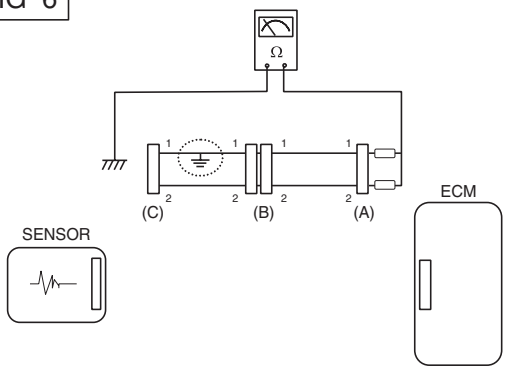
Lightly shake the wire harness above and below, or from side to side when measuring the resistance.

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

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

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

FIG 6



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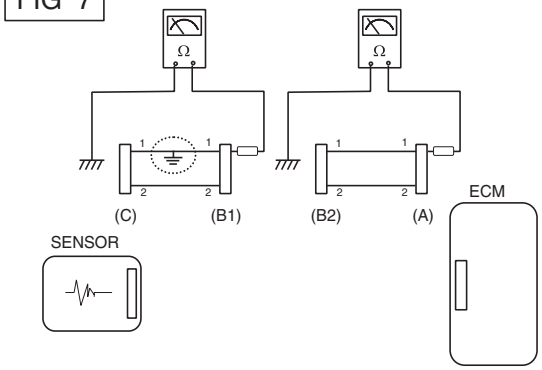
b. Disconnect connector (B), and measure the resistance between connector (A) and chassis ground, and between (B1) and chassis ground as shown in [FIG. 7].

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

FIG 7



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ECM(TICS) PROBLEM INSPECTION PROCEDURE

1. Test ECM(TICS) connector: Disconnect the ECM(TICS) connector and visually check the ground terminals on ECM(TICS) side and harness side for bent pins or poor contact pressure. If the problem is found, repair it.

2. If problem is not found step 1, the ECM(TICS) could be faulty. If so, replace the ECM(TICS) with a new one, and then check the vehicle again. If the vehicle operates normally then the problem was likely with the ECM(TICS).

3. Re-test the original ECM(TICS): Install the original ECM(TICS)(may be broken) into a known-good vehicle and check the vehicle. If the problem occurs again, replace the original ECM(TICS) with a new one. If problem does not occur, this is intermittent problem (Refer to Intermittent Problem Procedure in Basic Inspection Procedure.)

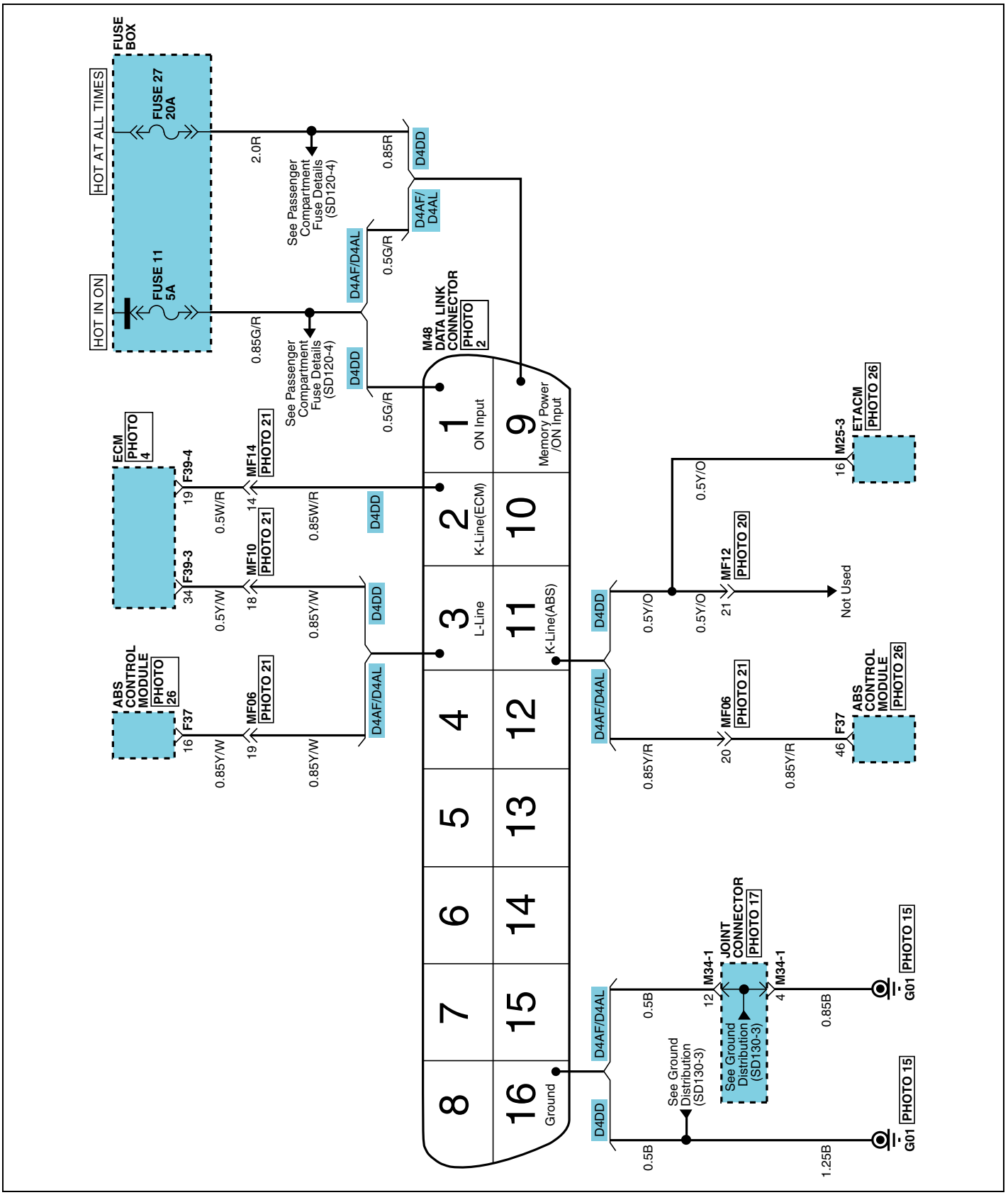
ABBREVIATION

ABS: Anti-lock brake system
APS: Accelerator pedal sensor
A/C: Air conditioning
B: Battery
BATT: Battery
Comp: Compressor
DTC : Diagnostic trouble code
ECTS: Engine coolant temperature sensor
ECU: Electronic control unit
ETCM: Electronic time control module
EUI: Electronic unit injection
IATS : Intake air temperature sensor
IG: Ignition

MIL: Malfunction indicator lamp(Check engine lamp)
NTC: Negative Temperature Coefficient
PTO: Power take-off
NC: Normal close
NO: Normal open
RPM: Revolution per minute
Sw: Switch
Sig: Signal

SCHEMATIC CIRCUIT EEFF964A

DATA LINK DETAILS (1)



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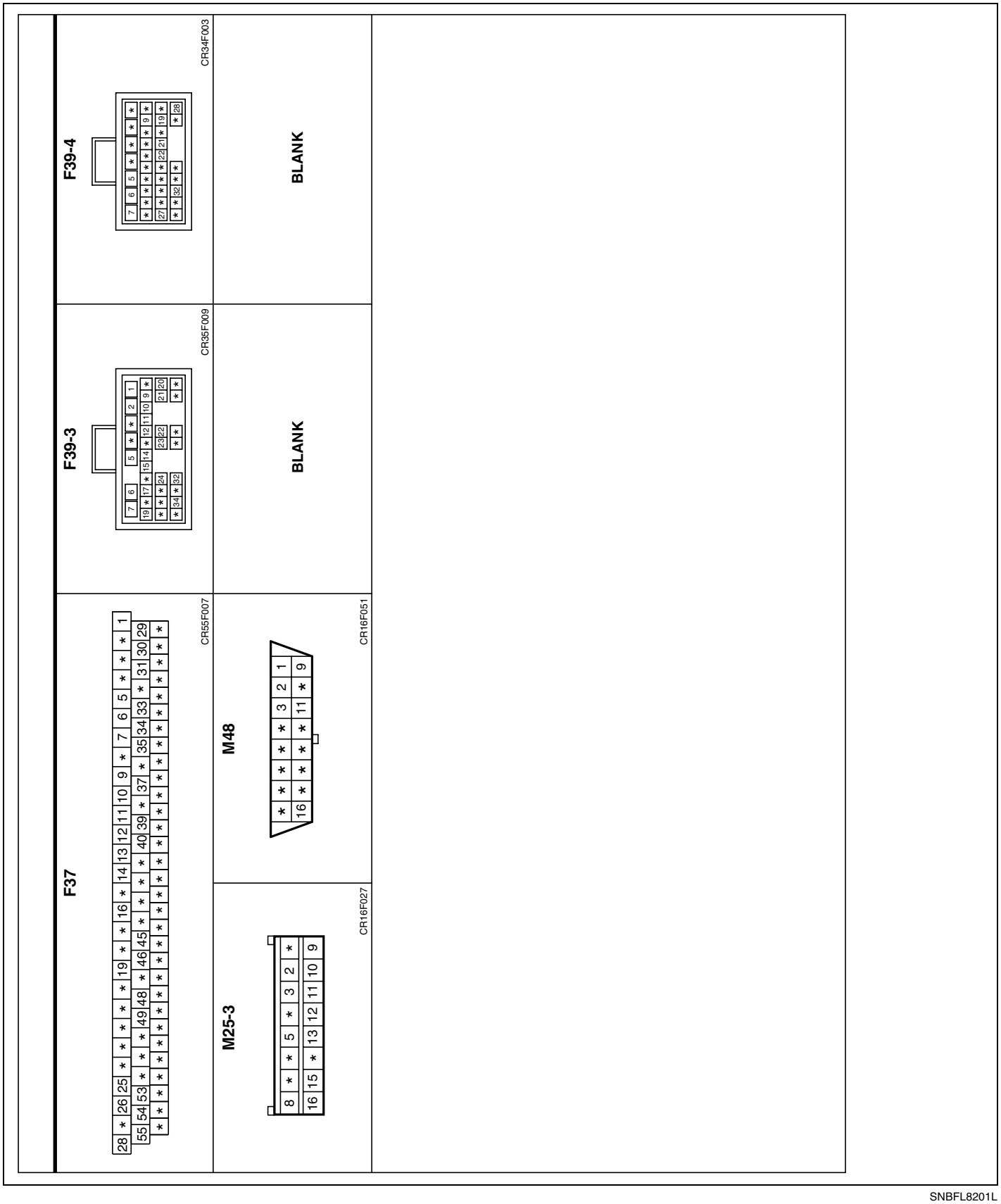
DATA LINK DETAILS (2)



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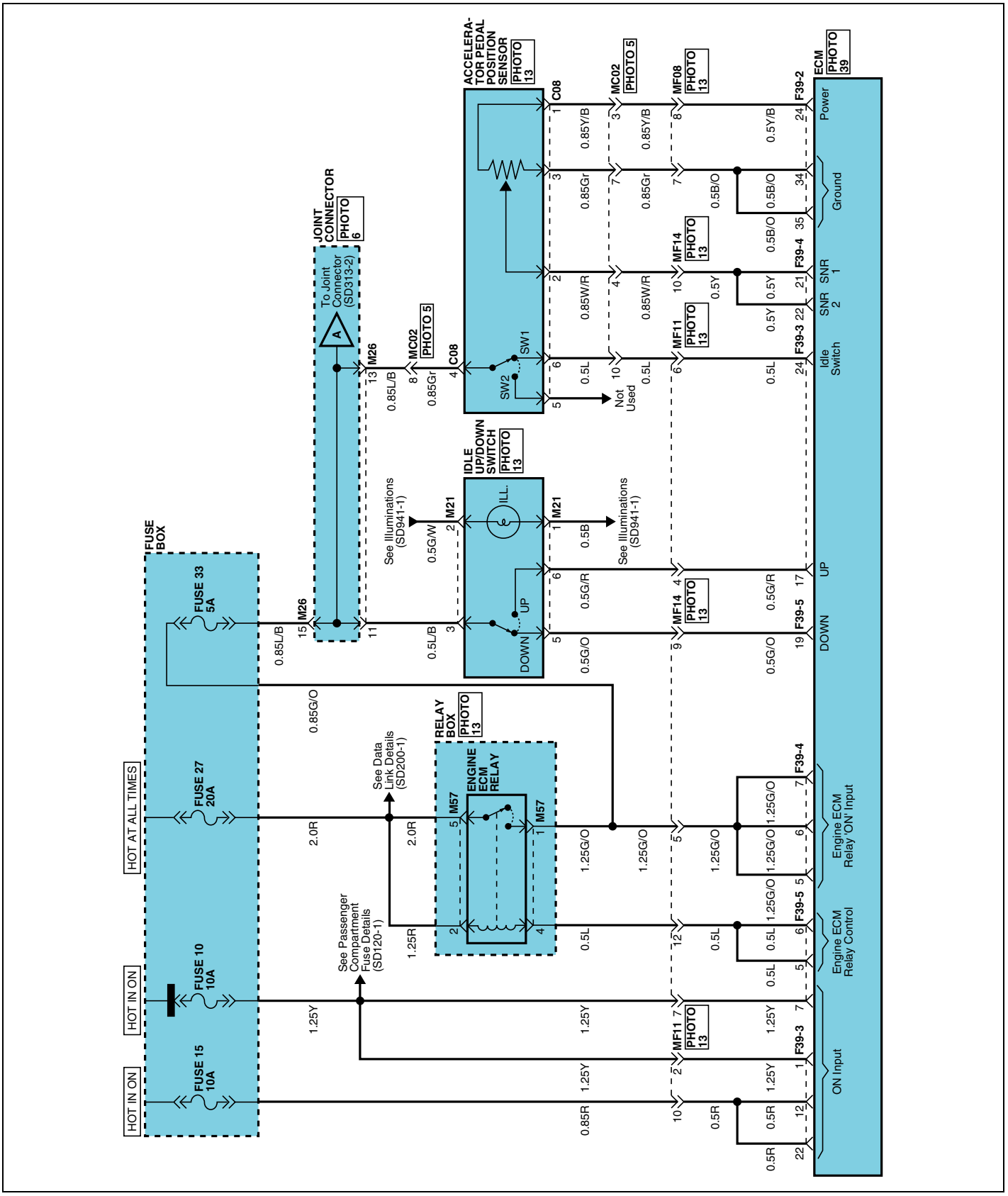
MFI CONTROL SYSTEM (D4DD) (1)



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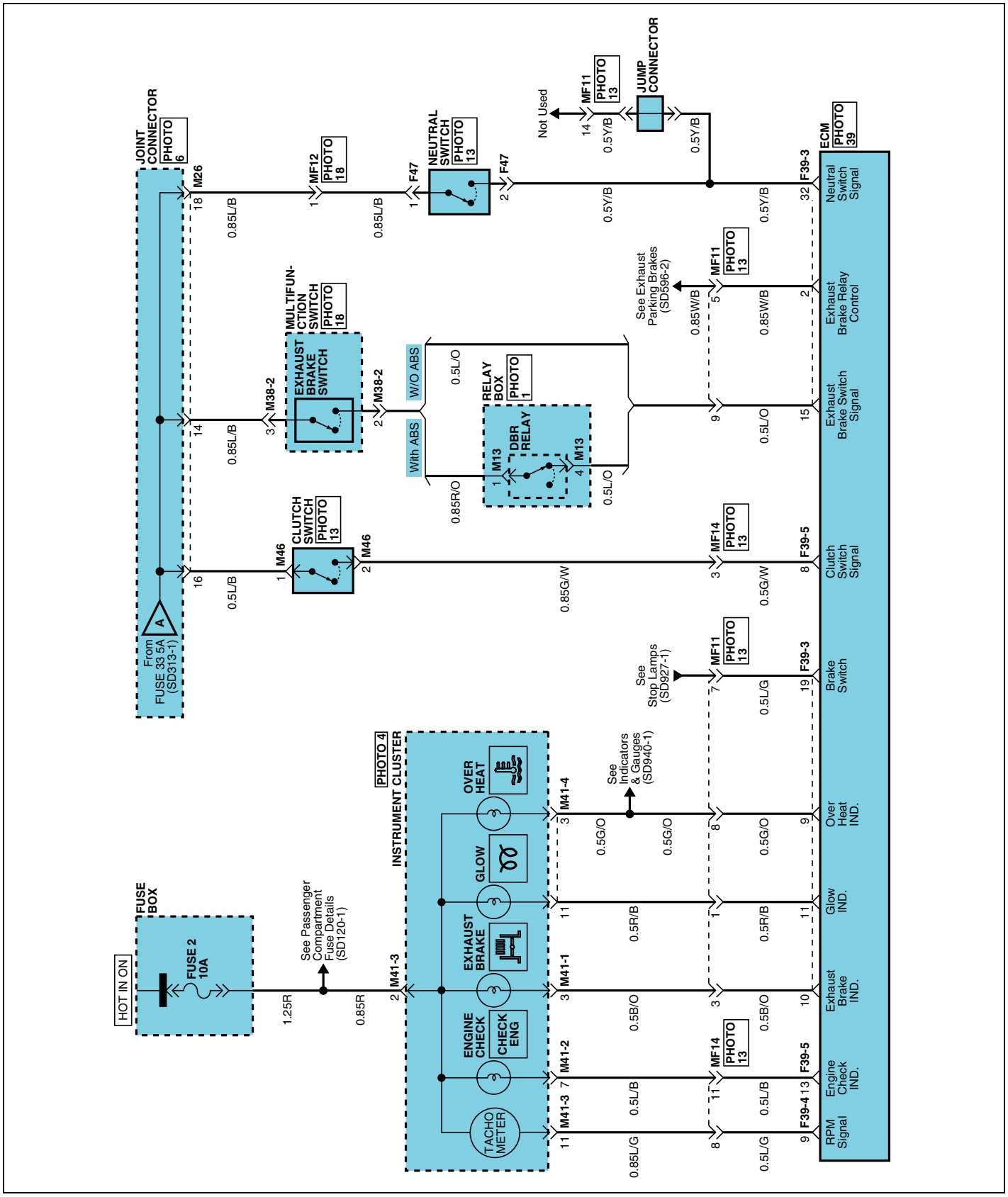
MFI CONTROL SYSTEM (D4DD) (2)



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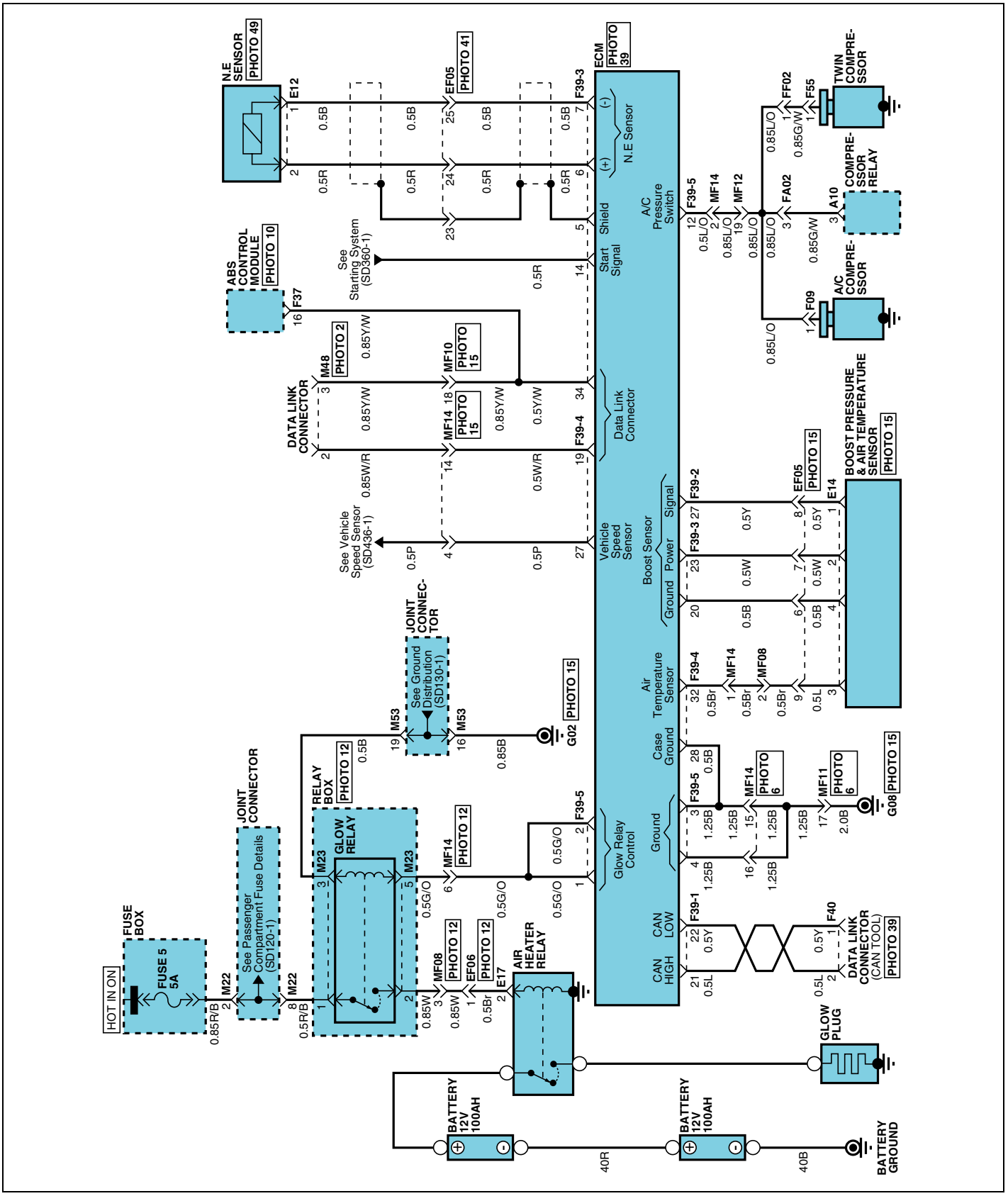
MFI CONTROL SYSTEM (D4DD) (3)



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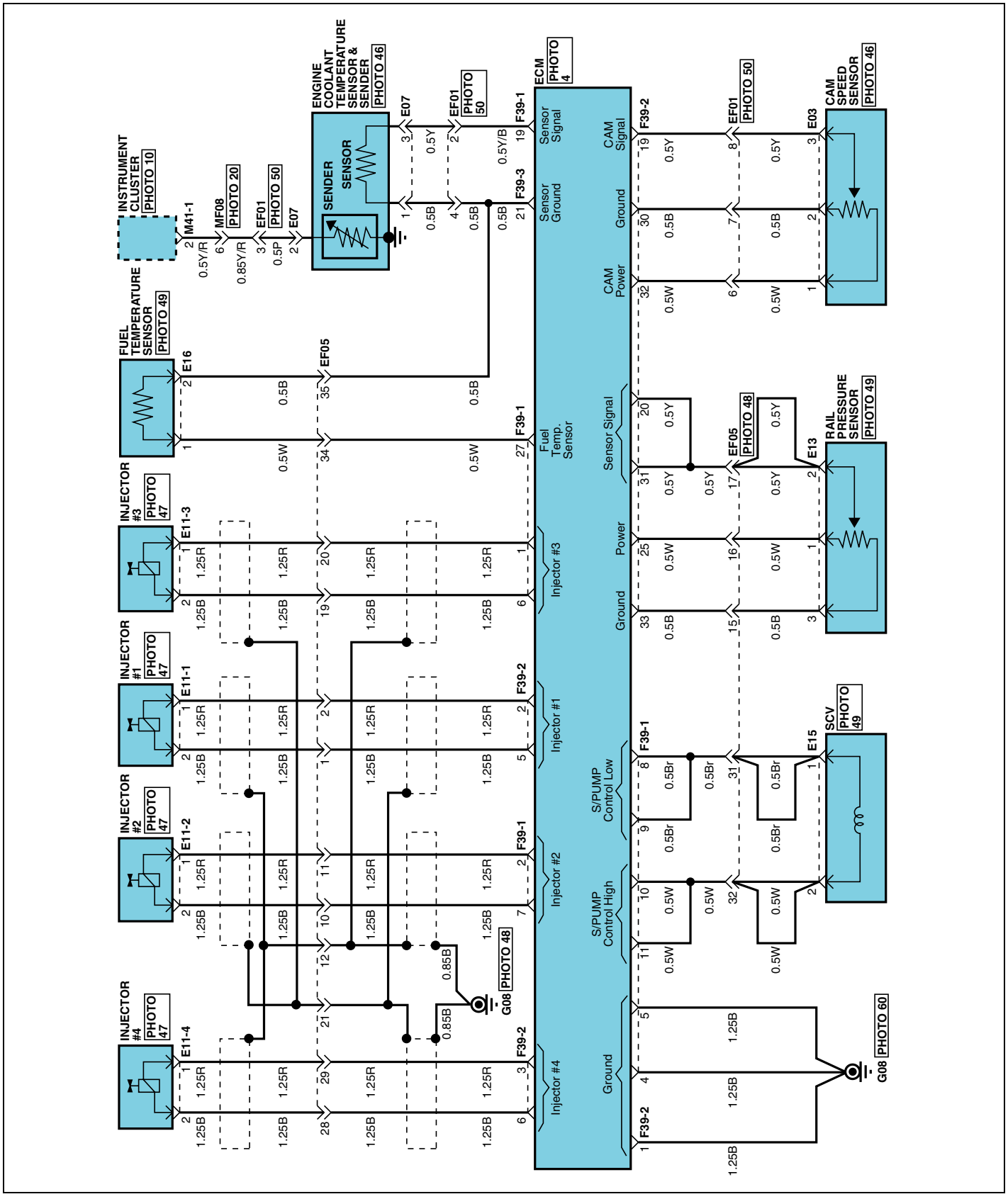
MFI CONTROL SYSTEM (D4DD) (4)



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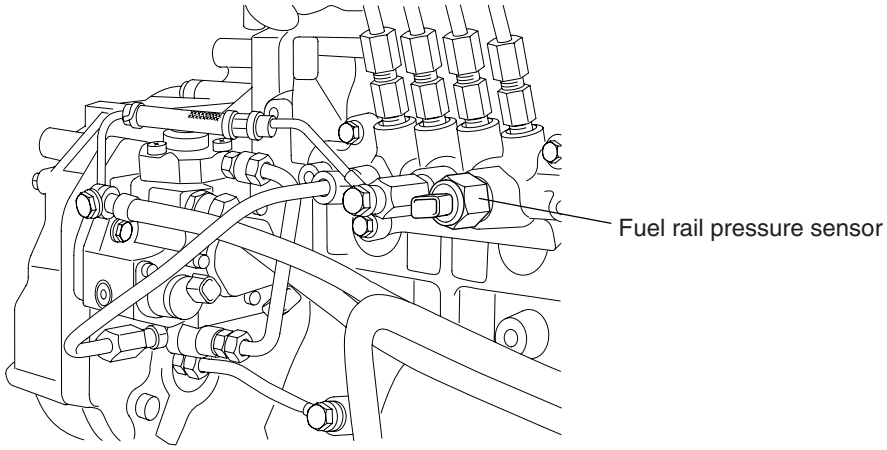
DTC LIST ED87EA08

NO	DTC	DESCRIPTION	Page
1	P0088	COMMON RAIL PRESSURE EXCEEDS LIMIT	
2	P0093	FUEL SYSTEM LEAK DETECTED	
3	P0107	BAROMETRIC PRESSURE SENSOR -LOW VOLTAGE	
4	P0108	BAROMETRIC PRESSURE SENSOR -HIGH VOLTAGE	
5	P0112	INTAKE AIR TEMPERATURE SENSOR - LOW VOLTAGE	
6	P0113	INTAKE AIR TEMPERATURE SENSOR - HIGH VOLTAGE	
7	P0117	ENGINE COOLANT TEMPERATURE SENSOR-LOW VOLTAGE	
8	P0118	ENGINE COOLANT TEMPERATURE SENSOR-HIGH VOLTAGE	
9	P0120	PEDAL SENSOR NO.1 NOT OPEN	
10	P0121	PEDAL SENSOR NO.1 NOT CLOSE	
11	P0122	PEDAL SENSOR NO.1 SIGNAL LOW	
12	P0123	PEDAL SENSOR NO.1 SIGNAL HIGH	
13	P0182	FUEL TEMP. SENSOR LOW INPUT	
14	P0183	FUEL TEMP. SENSOR HIGH INPUT	
15	P0192	C/RAIL PRESSURE SENSOR SIGNAL LOW	
16	P0193	C/RAIL PRESSURE SENSOR SIGNAL HIGH	
17	P0194	C/RAIL PRESSURE SENSOR INTERMITTENT	
18	P0201	INJECTOR #1 COIL OPEN	
19	P0202	INJECTOR #2 COIL OPEN	
20	P0203	INJECTOR #3 COIL OPEN	
21	P0204	INJECTOR #4 COIL OPEN	
22	P0217	ENGINE COOLANT OVER TEMPERATURE	
23	P0219	ENGINE OVERSPEED CONDITION	
24	P0220	PEDAL SENSOR NO.2 NOT OPEN	
25	P0221	PEDAL SENSOR NO.2 NOT CLOSE	
26	P0222	PEDAL SENSOR NO.2 SIGNAL LOW	
27	P0223	PEDAL SENSOR NO.2 SIGNAL HIGH	
28	P0225	IDLE SWITCH STUCK CLOSED	
29	P0226	IDLE SWITCH STUCK OPENED	
30	P0236	BOOST PRESSURE SENSOR INVALID	
31	P0237	BOOST PRESSURE SENSOR SIGNAL LOW	
32	P0238	BOOST PRESSURE SENSOR SIGNAL HIGH	
33	P0301	CYLINDER 1 MISFIRE DETECTED	
34	P0302	CYLINDER 2 MISFIRE DETECTED	
35	P0303	CYLINDER 3 MISFIRE DETECTED	
36	P0304	CYLINDER 4 MISFIRE DETECTED	
37	P0335	CRANK SENSOR NO PULSE	

NO	DTC	DESCRIPTION	Page
38	P0340	CAM SENSOR NO PULSE	
39	P0385	CRANK & CAM SENSOR NO PULSE	
40	P0501	VEHICLE SPEED SENSOR(VSS) SIGNAL INVALID	
41	P0502	VEHICLE SPEED SENSOR(VSS) INPUT OPEN / SHORT	
42	P0503	VEHICLE SPEED SENSOR(VSS) FREQUENCY TOO HIGH	
43	P0562	SYSTEM VOLTAGE LOW	
44	P0563	SYSTEM VOLTAGE HIGH	
45	P0601	CHECK SUM ERROR - FLASH AREA	
46	P0602	QR CODE ERROR	
47	P0606	CPU FAULT; MAIN CPU FAULT	
48	P0607	CPU FAULT; WATCHDOG IC FAULT	
49	P0615	START SWITCH SHORT TO BATTERY	
50	P0627	FUEL PUMP CONTROL CIRCUIT - OPEN	
51	P0629	FUEL PUMP SHORT TO BATTERY	
52	P0704	CLUTCH SWITCH MALFUNCTION (M/T)	
53	P0850	PARK/NEUTRAL SWITCH MALFUNCTION	
54	P1091	FUEL SYSTEM #1 CYLINDER LEAK DETECT	
55	P1092	FUEL SYSTEM #2 CYLINDER LEAK DETECT	
56	P1093	FUEL SYSTEM #3 CYLINDER LEAK DETECT	
57	P1094	FUEL SYSTEM #4 CYLINDER LEAK DETECT	
58	P1120	PEDAL SENSOR SIGNAL INVALID	
59	P1190	SUPPLY PUMP CONTROL VALVE(SCV) STUCK	
60	P1217	SUPPLY PUMP PROTECTION	
61	P1218	SUPPLY PUMP EXCHANGE	
62	P1219	SUPPLY PUMP MULFUNCTION	
63	P1231	EXHAUST BRAKE SHORT TO GROUND	
64	P1232	EXHAUST BRAKE SHORT TO BATTERY	
65	P1383	GLOW RELAY SHORT TO POWER	
66	P1384	GLOW RELAY SHORT TO GROUND	
67	P1616	MAIN RELAY MALFUNTION	
68	P2146	INJECTION COMMON #1 OPEN CIRCUIT	
69	P2147	INJECTION COMMON #1 VOLTAGE - LOW	
70	P2148	INJECTION COMMON #1 VOLTAGE - HIGH	
71	P2149	INJECTION COMMON #2 OPEN CIRCUIT	
72	P2150	INJECTION COMMON #2 VOLTAGE - LOW	
73	P2151	INJECTION COMMON #2 VOLTAGE - HIGH	
74	P2293	FUEL PRESSURE REGULATOR 2 PERFORMANCE	
75	P2503	CHARGING SYSTEM VOLTAGE LOW	
76	P2504	CHARGING SYSTEM VOLTAGE HIGH	

DTC P0088 COMMON RAIL PRESSURE EXCEEDS LIMIT

COMPONENT LOCATION EBFB21BB



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DESCRIPTION E1C448DE

1. GENERAL DESCRIPTION
   The rail pressure sensor is installed on the common rail assembly and is composed of piezo-electricity. It is used to control rail pressure by governing fuel amount to equal pressure measured by the rail pressure sensor and pressure required by ECM.
   The common rail pressure regulator valve is controlled by ECM and is usually opened if fuel is not supplied. The ECM decides current value to be sent to pressure regulator valve according to engine revolution, fuel amount and rail pressure etc.

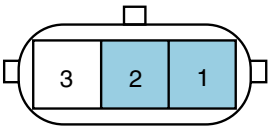
2. DTC DESCRIPTION
   If common rail pressure is continued above 2,000 bar or more, that is, the sensor is detected above 4.2V for 2,097.1 ms even though common rail pressure is abnormal, the ECM judges this as a fault and DTC is set. The possible causes may be overflow valve malfunction, poor rail pressure, faulty fuel rail pressure sensor.
   In case of fail safe, lack of engine power will occur since fuel pressure is limited to 450 bar and fuel amount is limited to below 60mm³/st.

DTC DETECTING CONDITION ED0EC562

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="5">• Overflow valve malfunction
• Poor rail pressure
• Faulty fuel rail pressure sensor</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• When common rail pressure is continued above 2,000 bar or more, even though common rail pressure is abnormal</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 2,097.1ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• Fuel amount is limited to below 60mm³/st
• Fuel pressure is fixed to 450 bar.
• Lack of engine power</td></tr>
<tr><td>Fuel Limit</td><td>Yes</td></tr>
<tr><td>MIL</td><td>ON</td></tr>
</table>

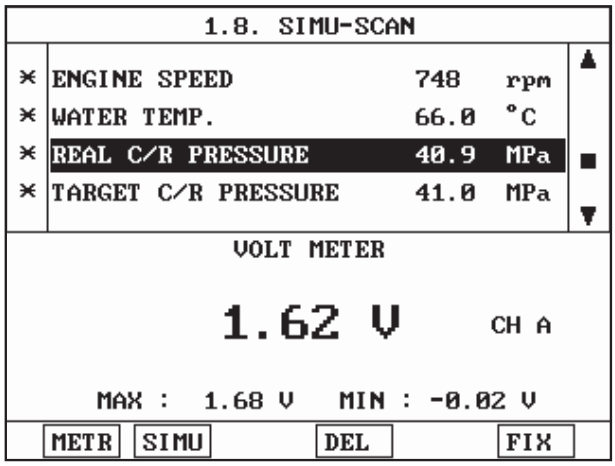
SPECIFICATION E7601390

Rail pressure sensor	Specification
Output voltage	Below 1.7V (At idle after engine warming-up)
Rail pressure	350~500 bar(Engine idling)



Sensor connector

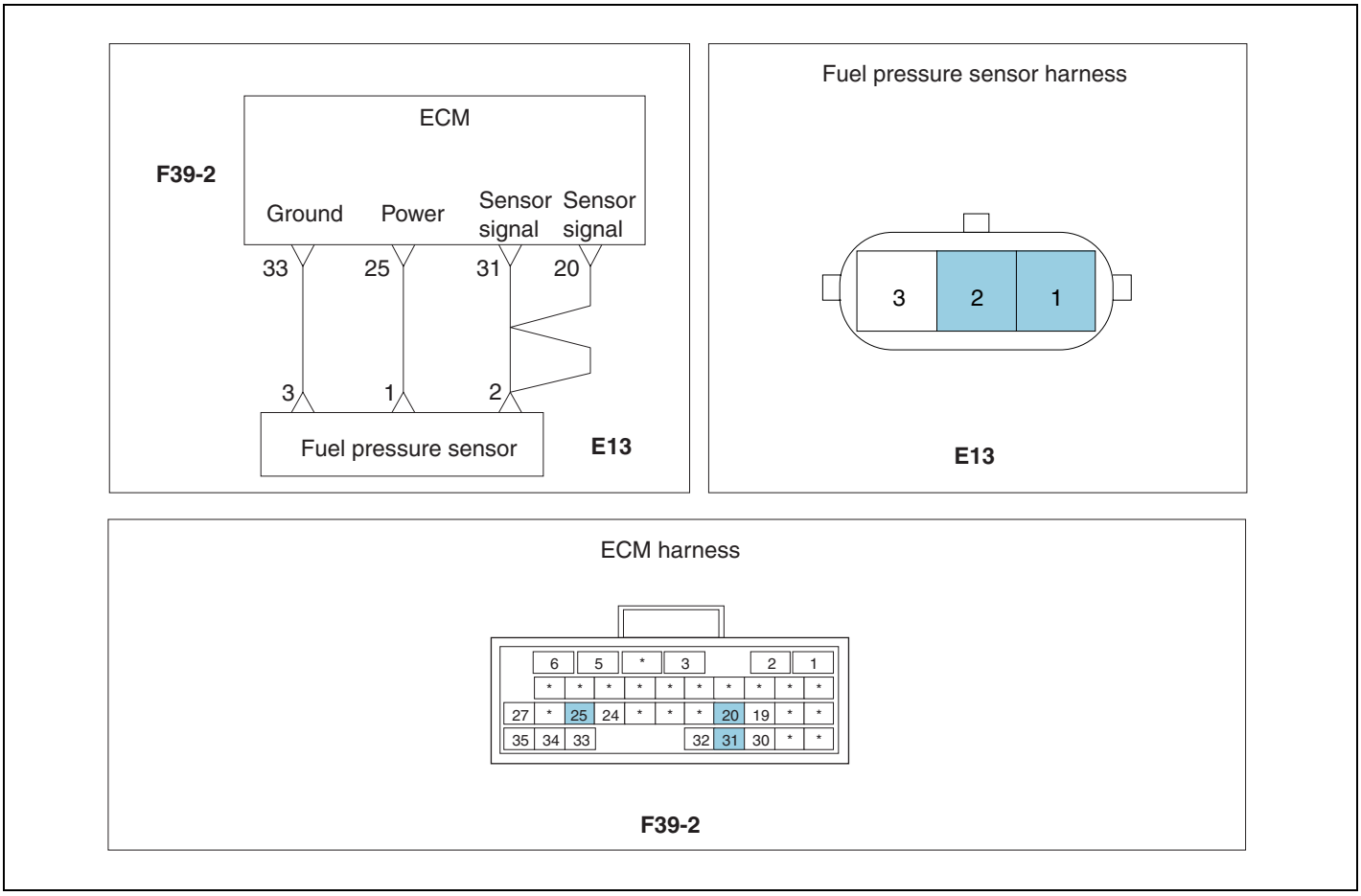
Terminal 1: Power
Terminal 2: Sensor signal
Terminal 3: Ground



Resistance	Specification
1, 2번	3 KΩ
1, 3번	13 KΩ
2, 3번	16.4 KΩ

SNBFL8001L

SCHEMATIC DIAGRAM E0F30ED7



SNBFL8002L

WAVEFORM E398C198

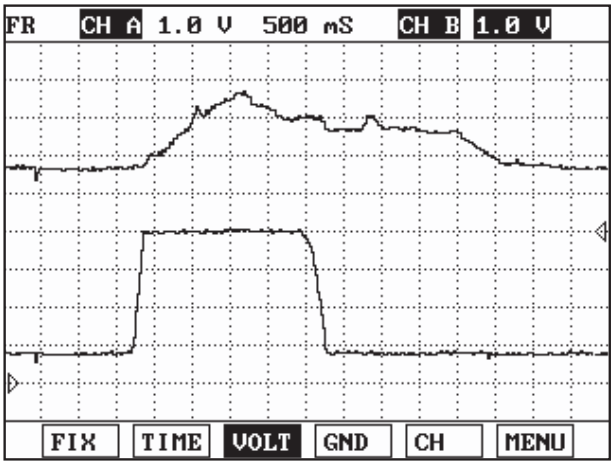
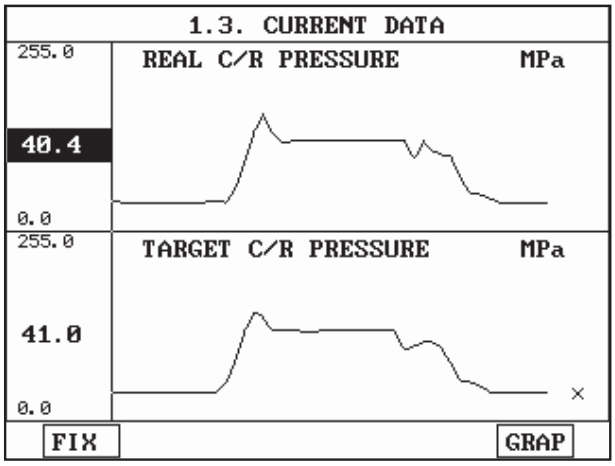


Fig. 1 Check with oscilloscope waveform



Reference Check with control information

Fig1) This is waveform checked together with accelerator pedal position sensor 1 and rail pressure sensor and it is confirmable that rail pressure sensor output is increased at sudden acceleration.

SUDFL8003L

MONITOR SCAN TOOL DATA E180E657

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Rail Pressure" parameter on the scan tool.

NOTE

The rail pressure changes with driving conditions depending on DTC detecting condition. In case of fail safe, be sure to check that fuel pressure is fixed to 450 bar and fuel amount is limited to below 60㎣/st.

■ Specification: 400±20 bar at idle

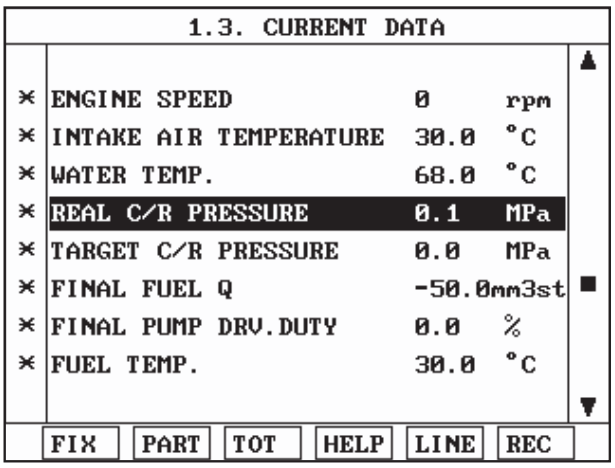


Fig. 1 Fuel pressure sensor data at ignition ON

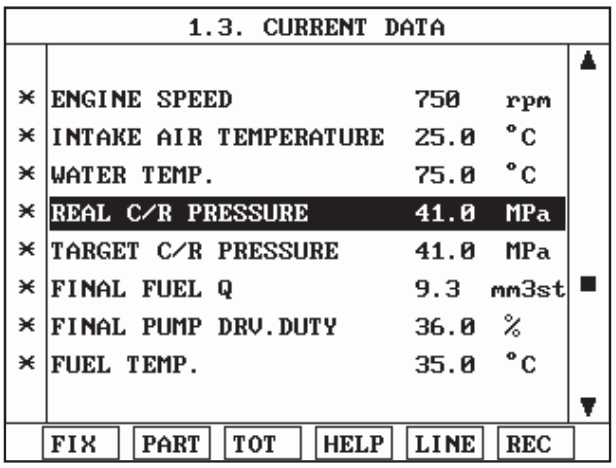


Fig. 2 Fuel pressure sensor data at idle

SUDFL8004L

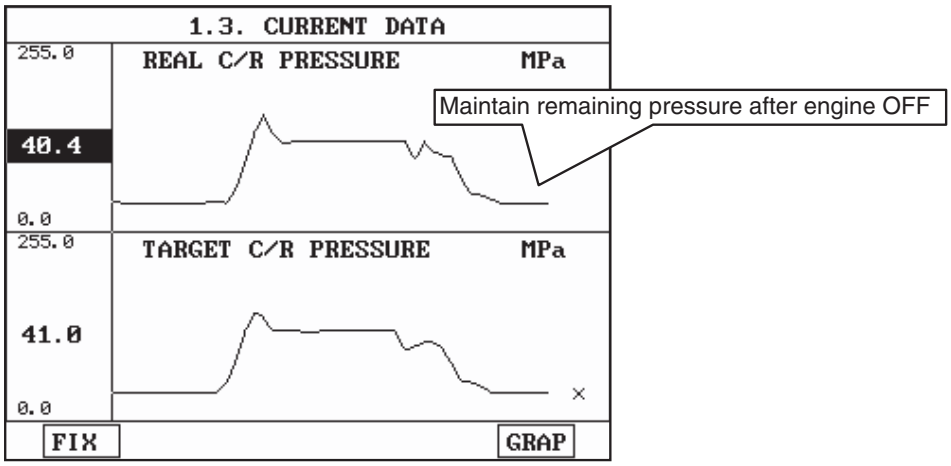
Fig. 1)~2) Check "Rail pressure" item at idle after engine warming-up.
Monitor pressure change of rail pressure sensor after starting the engine. Approx. 400 bar of pressure occurs at hot idle(750rpm) and it is important to check duty of rail pressure regulator. Check that duty ratio of 36.5% shown above service data is displayed. The service data increase depending on acceleration and load condition and rail pressure increases to max. 1,400bar, duty of rail pressure regulator increases up to 95%.

TROUBLESHOOTING AID EDB7DC76

It is necessary for DTC related to rail pressure to diagnose high pressure fuel system(poor formation of high pressure in high pressure fuel pump, bad air tightness or stuck of ball valve in rail pressure regulator, clogging of overflow valve, fuel leak of injector nozzle and return system) high pressure fuel pump and low pressure fuel system(poor fuel supply of low pressure fuel pump, clogging of fuel filter) comprehensively.

NOTE

Overflow valve plays a role to return fuel to fuel tank by opening valve to protect fuel system when common rail fuel pressure is generated excessively more than 2,210 bar.



SUDFL8005L

Above waveform indicates pressure change of rail pressure at starting and engine OFF. It is possible to diagnose fuel system by checking that internal pressure of common rail maintains at engine OFF and how long pressure of approx. 400 bar in common rail will take at starting.

1. It is important for rail pressure to rise rapidly at starting.
   ▶ It is easy to diagnose what condition supply of low pressure fuel pump is, how high pressure of high pressure fuel pump is made, that air tightness of rail pressure regulator remains, and that air tightness of injector nozzle and return side remains.

2. It is important to maintain air tightness at below 101 bar of common rail pressure regulator and decrease fuel pressure little by little at engine OFF.
   ▶ It is easy to diagnose that air tightness of rail pressure regulator remains, and that air tightness of injector nozzle and return side remains.

   NOTE

   Check after the ignition is in ON again not to lose data due to communication cut-off between scan tool and ECM since main relay turns OFF at engine OFF.

TERMINAL & CONNECTOR INSPECTION EDD95478

Refer to DTC P0112.

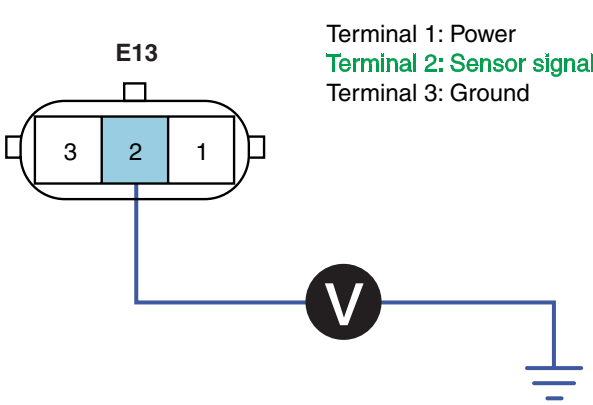
SIGNAL CIRCUIT INSPECTION E1A731EE

1. Signal Voltage Inspection

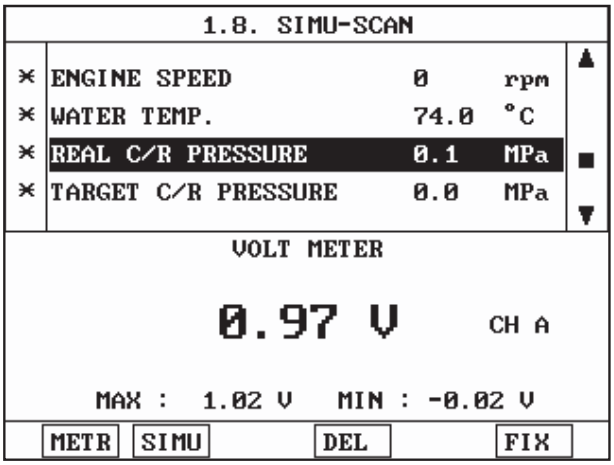
   1) Leave fuel pressure sensor connector(E13) connected.

   2) Turn ignition ON. The engine stops.

   3) Measure voltage between terminal 2 of fuel pressure sensor harness connector and chassis ground.



Terminal 1: Power
Terminal 2: Sensor signal
Terminal 3: Ground



▶ With fuel pressure connector connected at ignition ON

SNBFL8003L

■ Specification: Fuel pressure sensor signal power approx. 1.0V
Note : Signal power can be measured differently depending on rail pressure change.

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Go to "Signal Open Inspection" procedure.

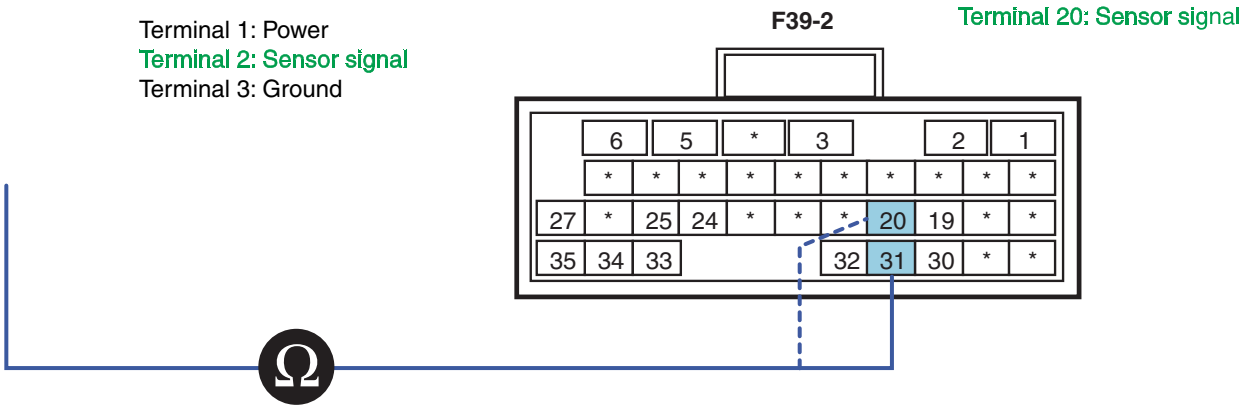
2. Signal Open Inspection

1) Turn the ignition OFF.

2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

3) Measure resistance between terminal 2 of fuel pressure sensor harness connector and terminals 20,31 of ECM connector(F39-2).

Terminal 1: Power
Terminal 2: Sensor signal
Terminal 3: Ground



YES

▶ Go to "Signal Short to Ground Inspection" procedure.

NO

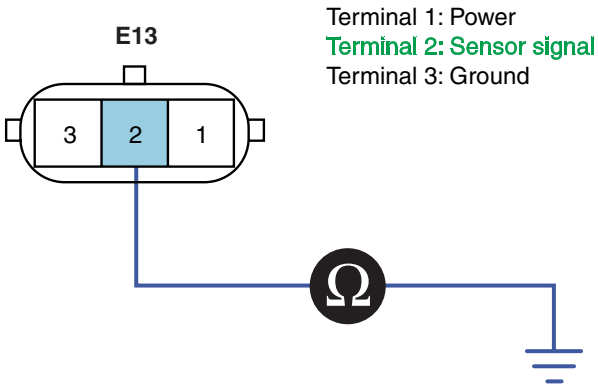
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Signal Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

3) Measure resistance between terminal 2 of fuel pressure sensor harness connector and chassis ground.



SNBFL8005L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Power Inspection" procedure.

NO

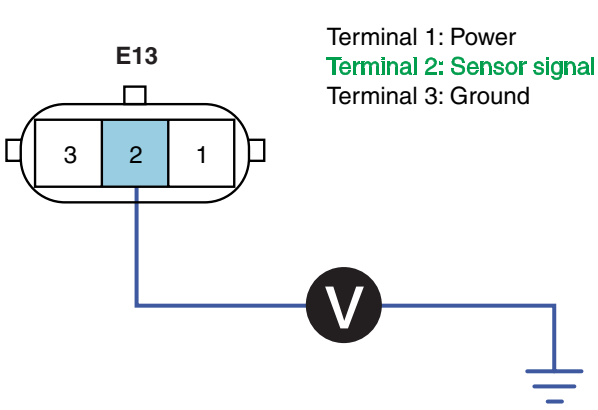
▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

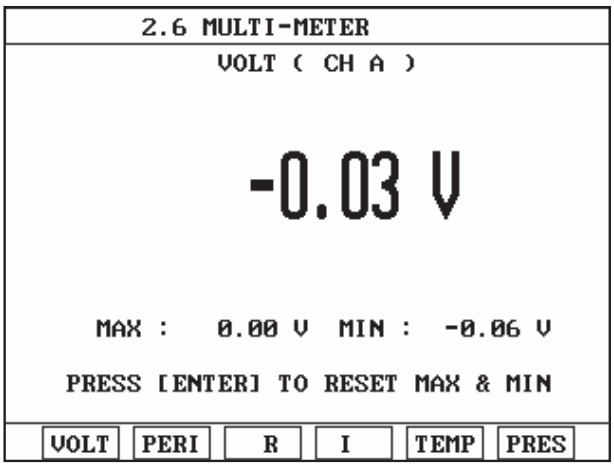
4. Signal Short to Power Inspection

1) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 2 of fuel pressure sensor harness connector and chassis ground.





SNBFL8006L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

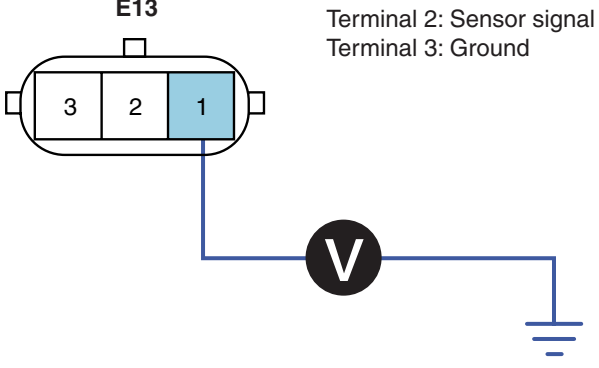
POWER SUPPLY INSPECTION EDE8D561

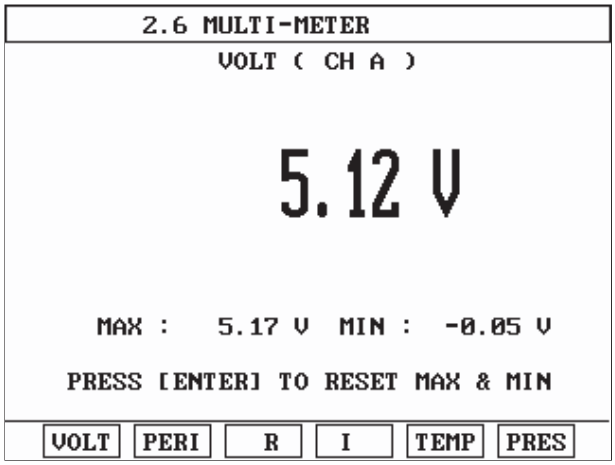
1. Power Supply Voltage Inspection

   1) Disconnect fuel pressure sensor connector(E13).

   2) Stop the engine and turn the ignition ON.

   3) Measure voltage between terminal 1 of fuel pressure sensor harness connector and chassis ground.





SNBFL8007L

■ Specification: ECM output approx. 5.27V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

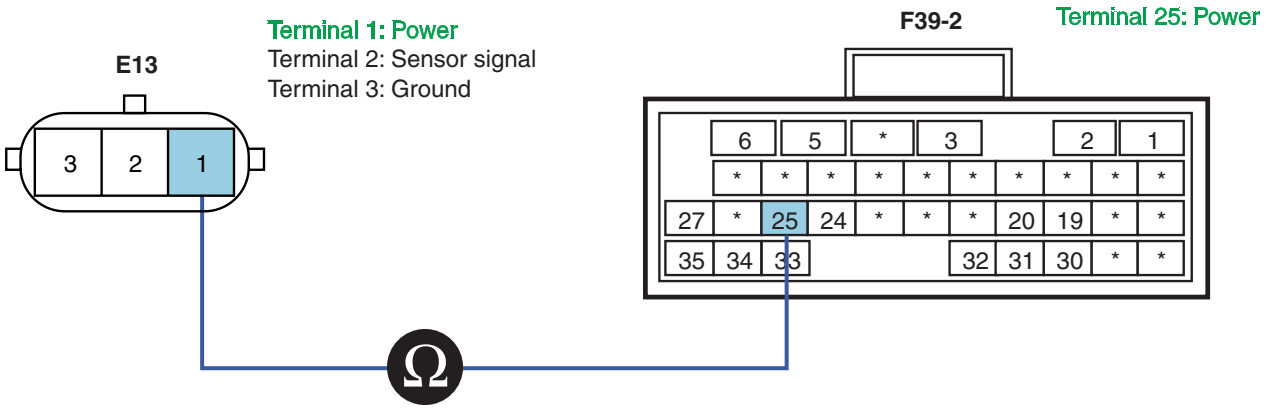
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn the ignition OFF.

2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of fuel pressure sensor harness connector and terminal 25 of ECM connector(F39-2).



SNBFL8008L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

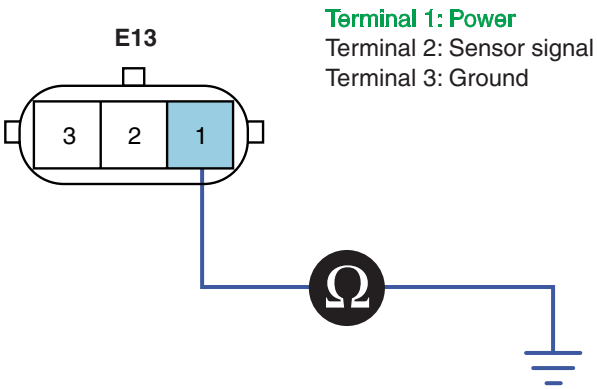
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Power Supply Short to Ground Inspection

1) Turn ignition OFF.

2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of fuel pressure sensor harness connector and chassis ground.



SNBFL8009L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

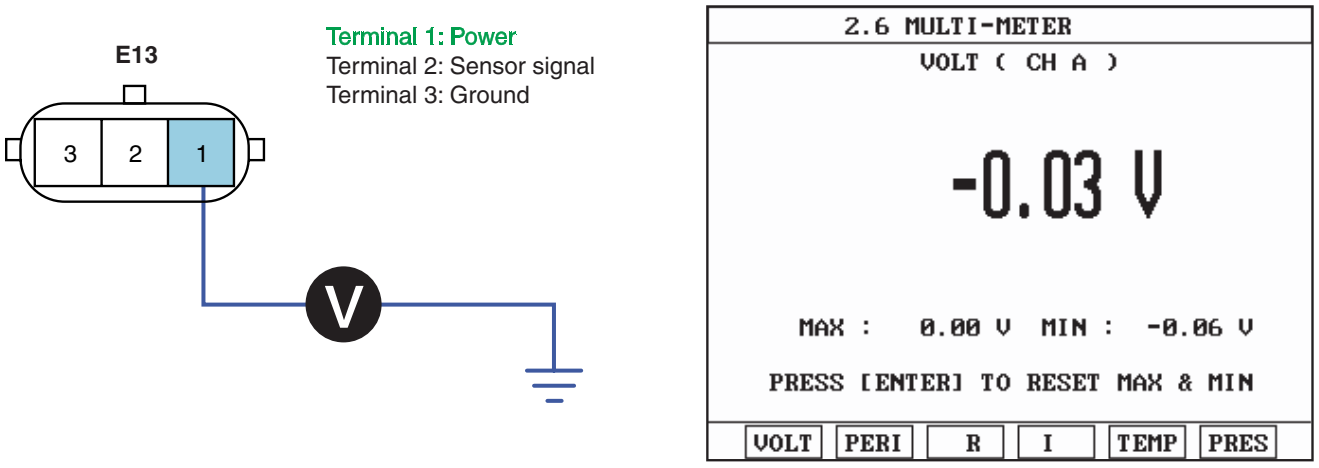
▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

4. Power Supply Short to Power Inspection

1) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of fuel pressure sensor harness connector and chassis ground.



SNBFL8010L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

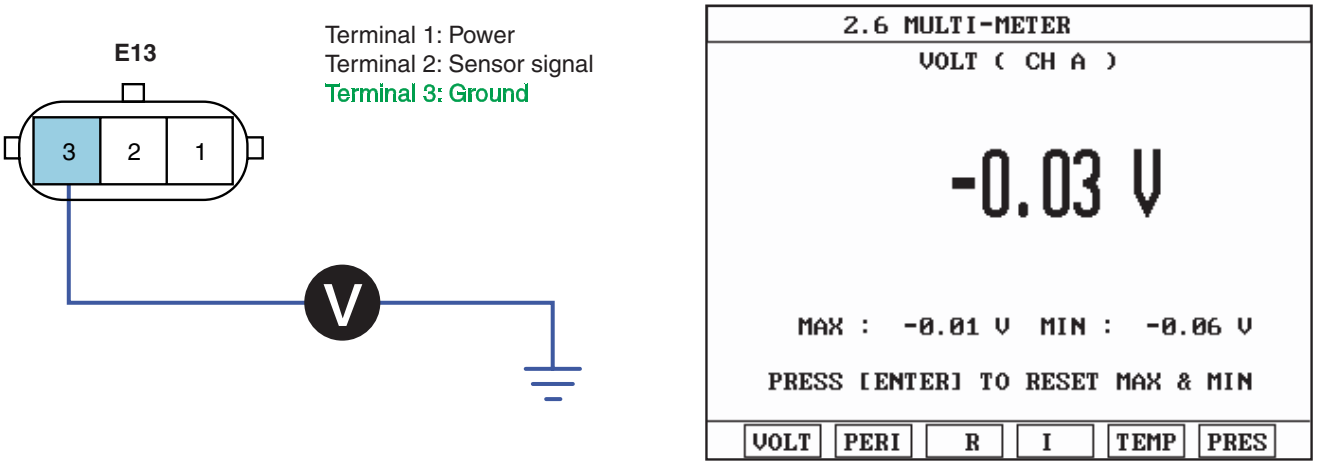
GROUND CIRCUIT INSPECTION E3DA0C3C

1. Ground Voltage Drop Inspection

   1) Disconnect fuel pressure sensor connector(E13).

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage drop between terminal 3 of fuel pressure sensor harness connector and chassis ground.



SNBFL8011L

■ Specification: Ground voltage drop- Within 200mV

   4) Is the resistance measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

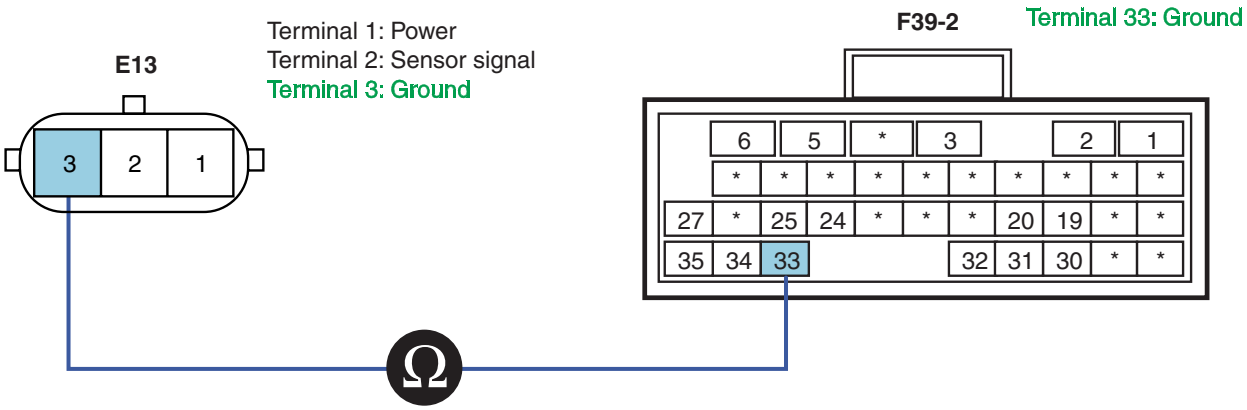
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

   1) Turn the ignition OFF.

   2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

   3) Measure resistance between terminal 3 of fuel pressure sensor harness connector and terminal 33 of ECM connector(F39-2).



SNBFL8012L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E50C6282

1. Fuel Pressure Sensor Inspection

1) Turn the ignition OFF.

2) Leave the fuel pressure sensor connector(E13) installed.

3) Start the engine and compare fuel pressure and fuel pressure signal voltage according to detecting condition.

NOTE

The rail pressure changes with driving conditions depending on DTC detecting condition. In case of fail safe, be sure to check that fuel pressure is fixed to 400 bar and fuel amount is limited to below 60㎣/st.

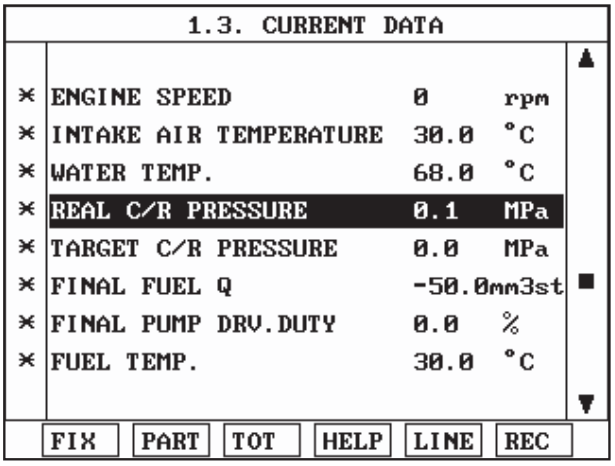


Fig. 1 Fuel pressure sensor data at IG ON

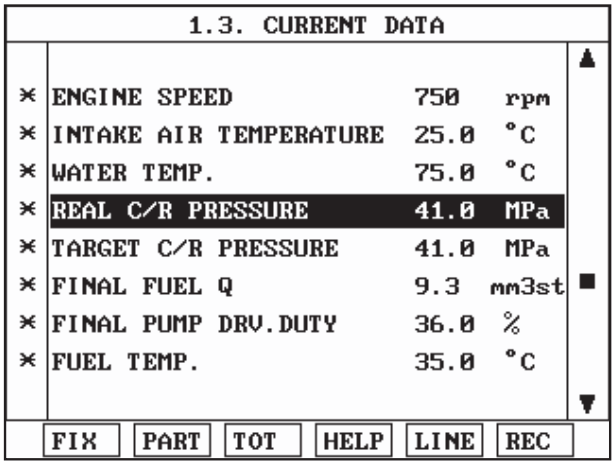


Fig. 2 Fuel pressure sensor data at idle

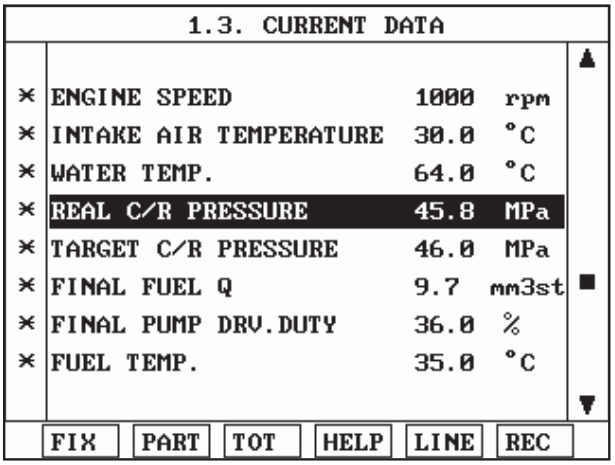


Fig. 3 Fuel pressure sensor data at 1,000rpm

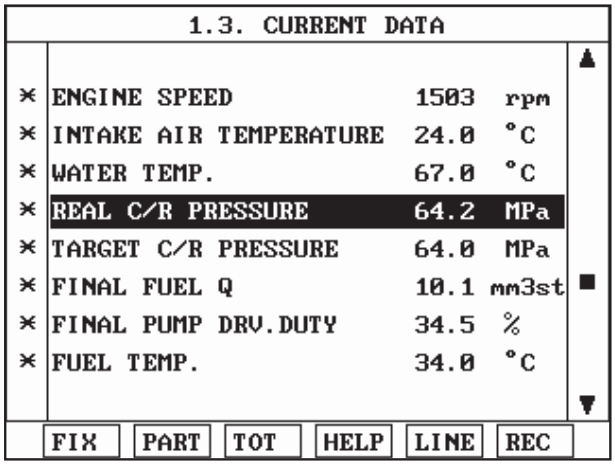


Fig. 4 Fuel pressure sensor data at 1,500rpm

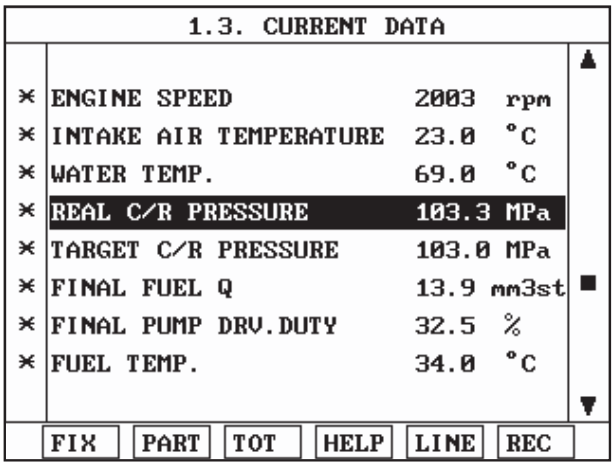


Fig. 5 Fuel pressure sensor data at 2,000rpm

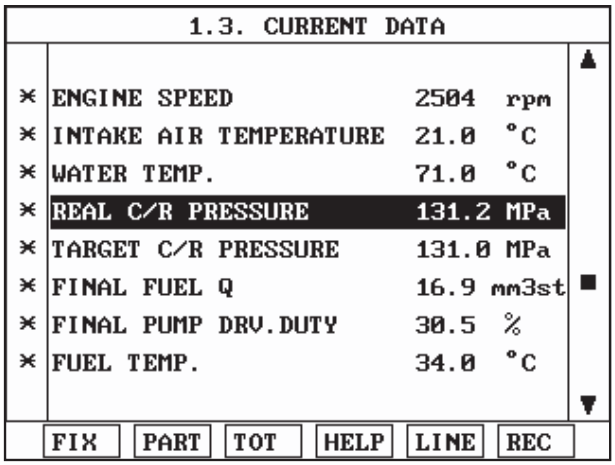


Fig. 6 Fuel pressure sensor data at 2,500rpm

■ **SPECIFICATION:**

Pressure(Mpa)	Output voltage(V)
40	1.64
60	1.96
100	2.60
160	3.56
200	4.20

4) Is the output value measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

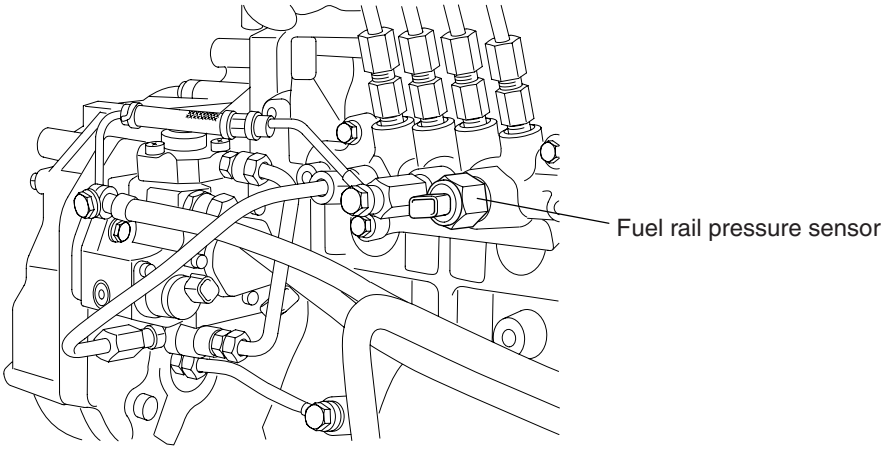
▶ Replace the fuel pressure sensor and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EAAB85CB

Refer to DTC P0112.

DTC P0093 FUEL SYSTEM LEAK DETECTED

COMPONENT LOCATION EE4D25FB



SUDFL8017L

DESCRIPTION E30664E8

1. GENERAL DESCRIPTION
   The rail pressure sensor should detect the instant pressure in common rail to send the voltage signal commensurate with pressure applied to the ECM.
   If fuel flows to rail pressure through rail inlet, its end part is sealed-off with sensor diaphragm. The pressurized fuel reaches diaphragm of sensor through blind hole, sensor factor(semiconductor device) to convert pressure into electric signal is connected to this diaphragm, the signal produced by the sensor amplifies the measuring signal and is input to the review circuit to send to the ECM.
   The signal plays a very important role not only to decide fuel amount and injection timing in the ECM but also to feedback rail pressure regulator to control the target fuel pressure in the ECM.

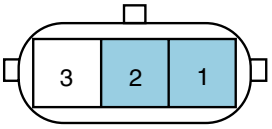
2. DTC DESCRIPTION
   When the common rail pressure sensor is abnormal , the common rail and the fuel leak of high pressure system coming from common rail is detected above 180 degrees or more of crank angle, the ECM judges this as a fault and DTC is set. The possible causes may be faulty fuel rail pressure sensor and high pressure fuel line leak. The ECM will stop the engine when fuel leak is detected.

DTC DETECTING CONDITION ED5C558A

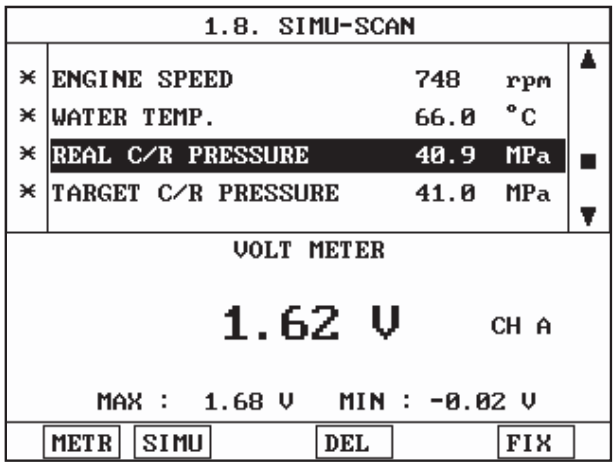
Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Fuel leak in high pressure system • Faulty fuel rail pressure sensor
Enable Conditions	• Running			
Threshold Value	• When there is faulty fuel rail pressure sensor and fuel of high pressure system leaks			
Diagnosis Time	• 180.0CA (Crank angle) or more			
Fail Safe	Fuel Cut	No	• The engine stops.	
	Fuel Limit	Yes		
	MIL	ON		

SPECIFICATION ED3176ED

Rail pressure sensor	Specification
Output voltage	Below 1.7V (At idle after engine warming-up)
Rail pressure	350~500 bar(Engine idling)



Sensor connector

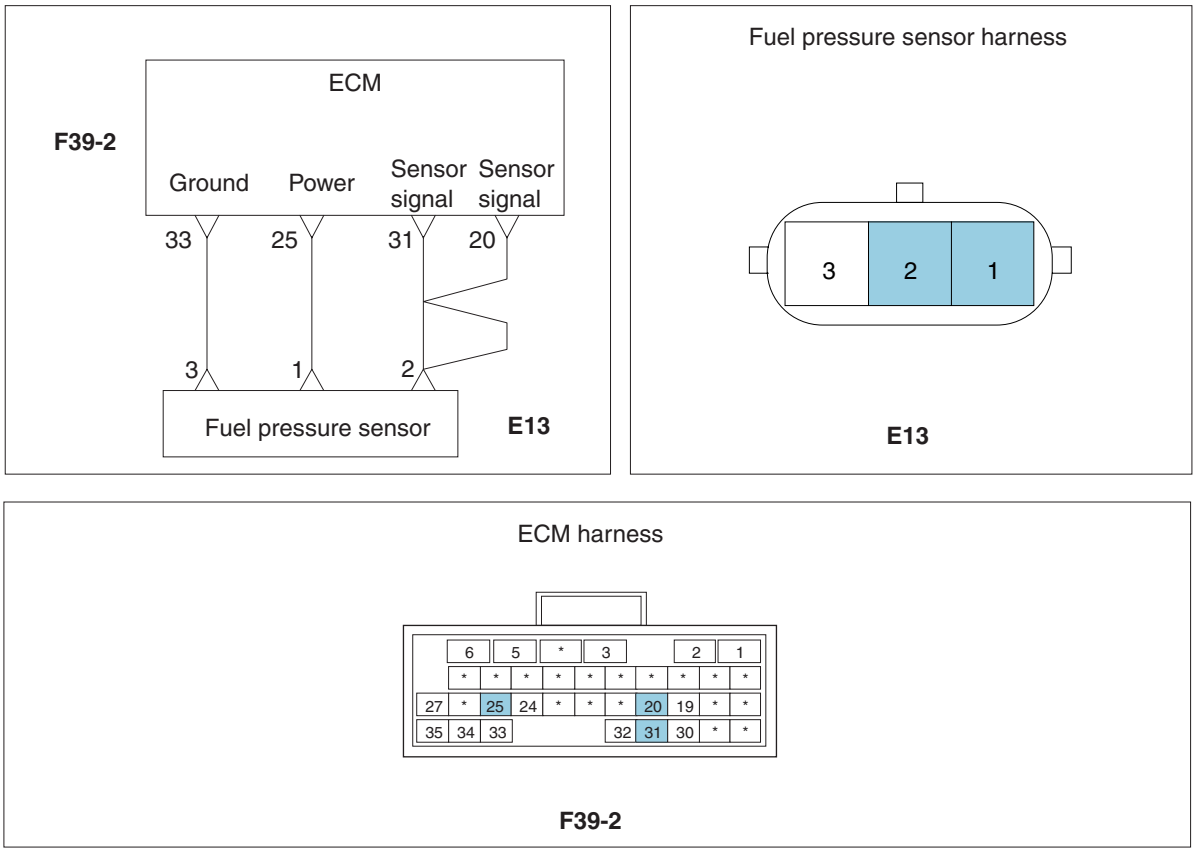


Terminal 1: Power
Terminal 2: Sensor signal
Terminal 3: Ground

Resistance	Specification
1, 2번	3 KΩ
1, 3번	13 KΩ
2, 3번	16.4 KΩ

SNBFL8001L

SCHEMATIC DIAGRAM EDD86BCA



SNBFL8002L

WAVEFORM E4FA2D7B

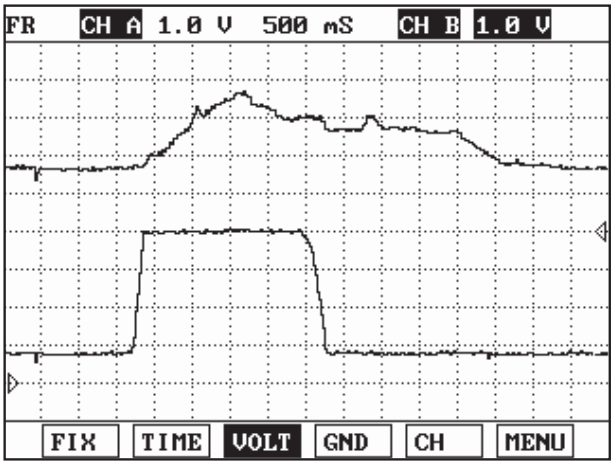
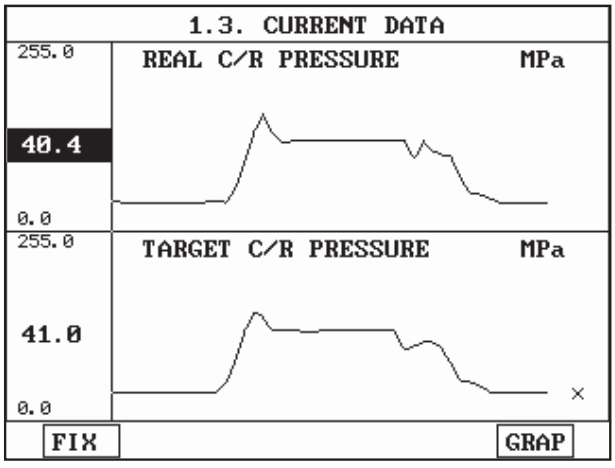


Fig. 1 Check with oscilloscope waveform



Reference Check with control information

Fig1) This is waveform checked together with accelerator pedal position sensor 1 and rail pressure sensor and it is confirmable that rail pressure sensor output is increased at sudden acceleration.

SUDFL8003L

MONITOR SCAN TOOL DATA EE6D76A0

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Rail Pressure" parameter on the scan tool.

NOTE

The rail pressure changes with driving conditions depending on DTC detecting condition. In case of fail safe, be sure to check that fuel pressure is fixed to 450 bar and fuel amount is limited to below 60㎣/st.

■ Specification: 400±20 bar at idle

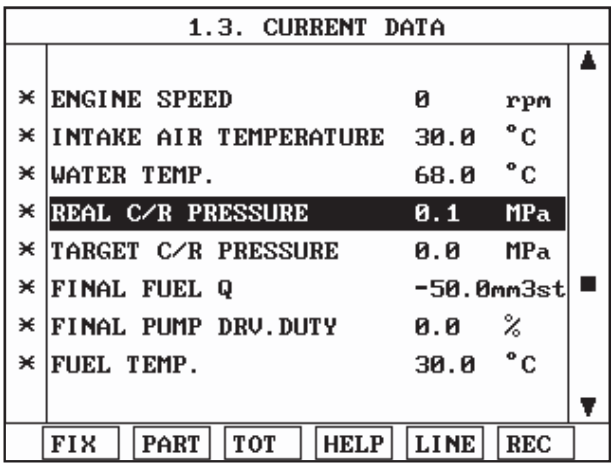


Fig. 1 Fuel pressure sensor data at ignition ON

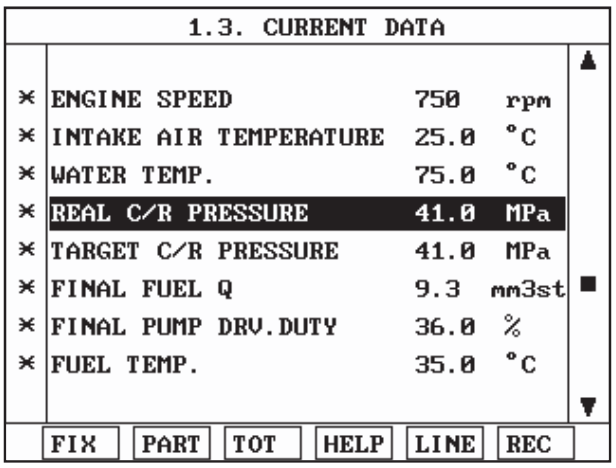


Fig. 2 Fuel pressure sensor data at idle

SUDFL8004L

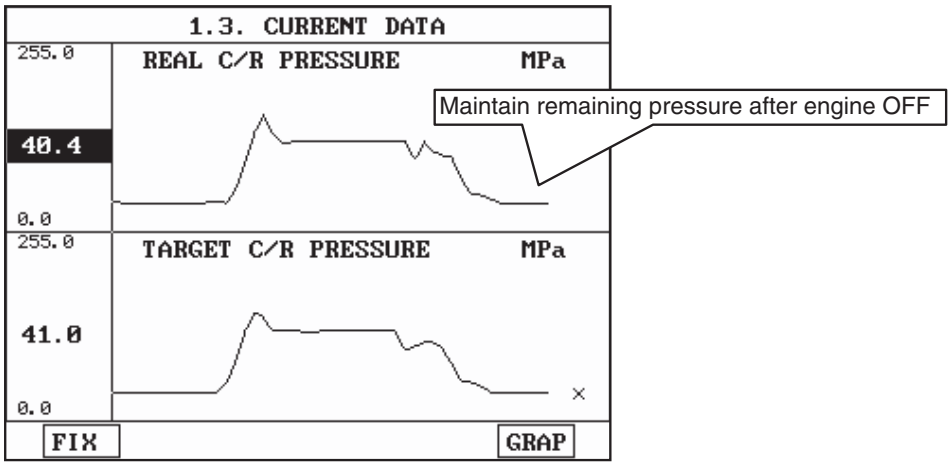
Fig. 1)~2) Check "Rail pressure" item at idle after engine warming-up.
Monitor pressure change of rail pressure sensor after starting the engine. Approx. 400 bar of pressure occurs at hot idle(750rpm) and it is important to check duty of rail pressure regulator. Check that duty ratio of 36.5% shown above service data is displayed. The service data increase depending on acceleration and load condition and rail pressure increases to max. 1,400bar, duty of rail pressure regulator increases up to 95%.

TROUBLESHOOTING AIDS E048C02D

It is necessary for DTC related to rail pressure to diagnose high pressure fuel system(poor formation of high pressure in high pressure fuel pump, bad air tightness or stuck of ball valve in rail pressure regulator, clogging of overflow valve, fuel leak of injector nozzle and return system) high pressure fuel pump and low pressure fuel system(poor fuel supply of low pressure fuel pump, clogging of fuel filter) comprehensively.

NOTE

Overflow valve plays a role to return fuel to fuel tank by opening valve to protect fuel system when common rail fuel pressure is generated excessively more than 2,210 bar.



SUDFL8005L

Above waveform indicates pressure change of rail pressure at starting and engine OFF. It is possible to diagnose fuel system by checking that internal pressure of common rail maintains at engine OFF and how long pressure of approx. 400 bar in common rail will take at starting.

1. It is important for rail pressure to rise rapidly at starting.
   ▶ It is easy to diagnose what condition supply of low pressure fuel pump is, how high pressure of high pressure fuel pump is made, that air tightness of rail pressure regulator remains, and that air tightness of injector nozzle and return side remains.

2. It is important to maintain air tightness at below 101 bar of common rail pressure regulator and decrease fuel pressure little by little at engine OFF.
   ▶ It is easy to diagnose that air tightness of rail pressure regulator remains, and that air tightness of injector nozzle and return side remains.

   NOTE

   Check after the ignition is in ON again not to lose data due to communication cut-off between scan tool and ECM since main relay turns OFF at engine OFF.

TERMINAL & CONNECTOR INSPECTION E4C53ED1

Refer to DTC P0112.

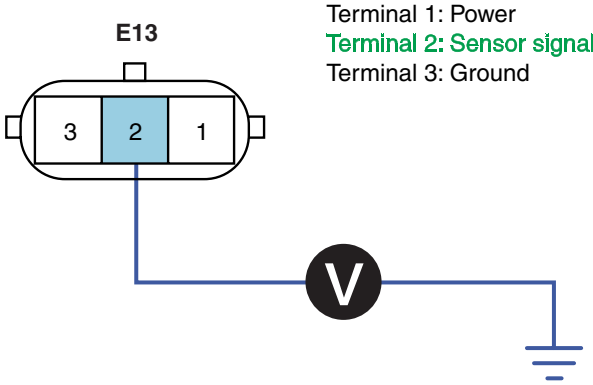
SIGNAL CIRCUIT INSPECTION EF8525FD

1. Signal Voltage Inspection

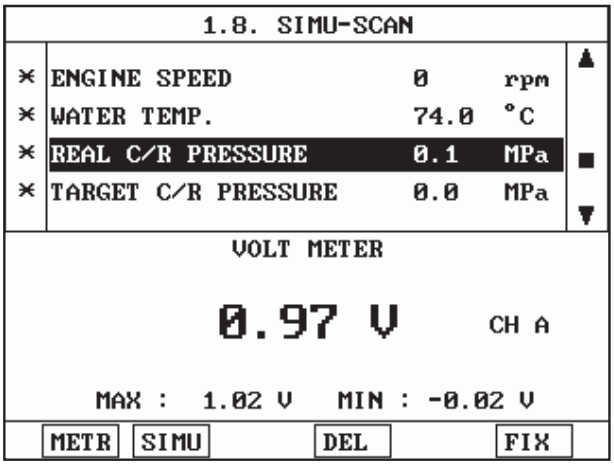
   1) Leave fuel pressure sensor connector(E13) connected.

   2) Turn ignition ON. The engine stops.

   3) Measure voltage between terminal 2 of fuel pressure sensor harness connector and chassis ground.



Terminal 1: Power
Terminal 2: Sensor signal
Terminal 3: Ground



▶ With fuel pressure connector connected at ignition ON

SNBFL8003L

■ Specification: Fuel pressure sensor signal power approx. 1.0V
Note : Signal power can be measured differently depending on rail pressure change.

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Go to "Signal Open Inspection" procedure.

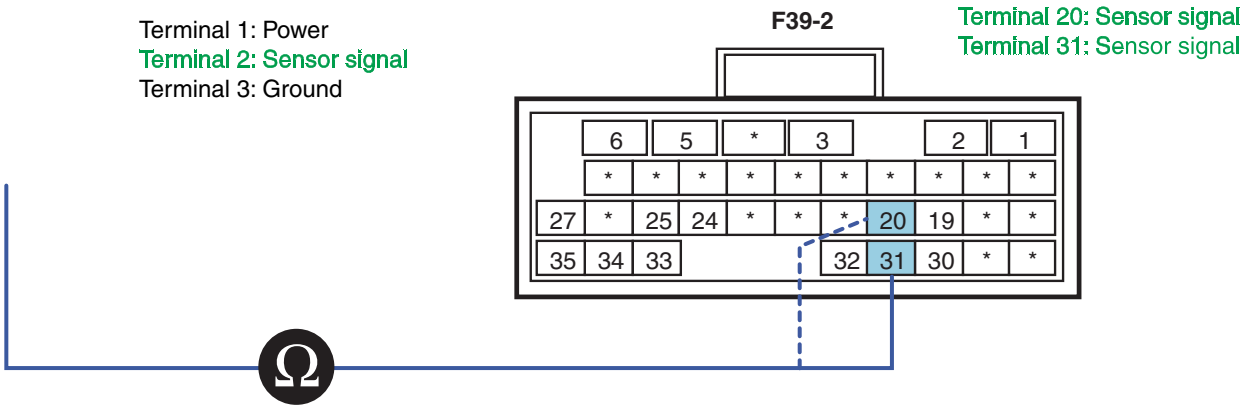
2. Signal Open Inspection

1) Turn the ignition OFF.

2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

3) Measure resistance between terminal 2 of fuel pressure sensor harness connector and terminals 20,31 of ECM connector(F39-2).

Terminal 1: Power
Terminal 2: Sensor signal
Terminal 3: Ground



YES

▶ Go to "Signal Short to Ground Inspection" procedure.

NO

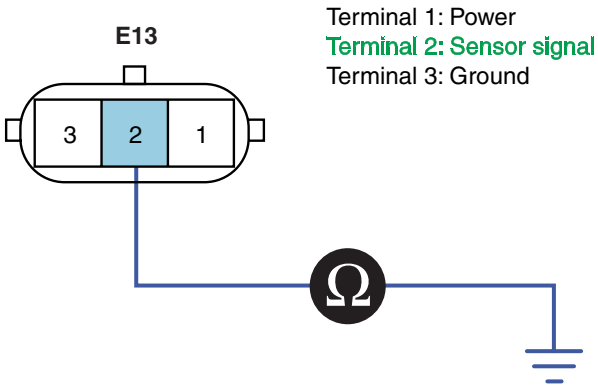
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Signal Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

3) Measure resistance between terminal 2 of fuel pressure sensor harness connector and chassis ground.



SNBFL8005L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Power Inspection" procedure.

NO

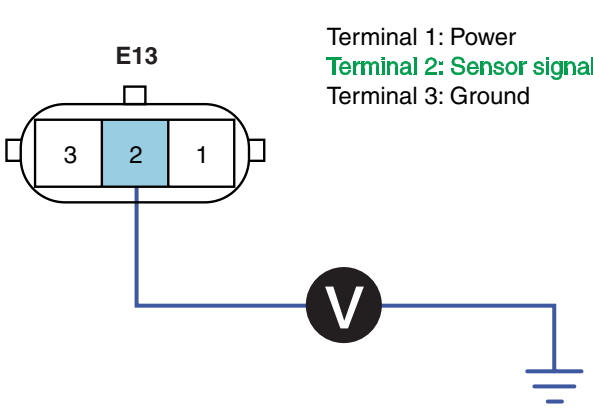
▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

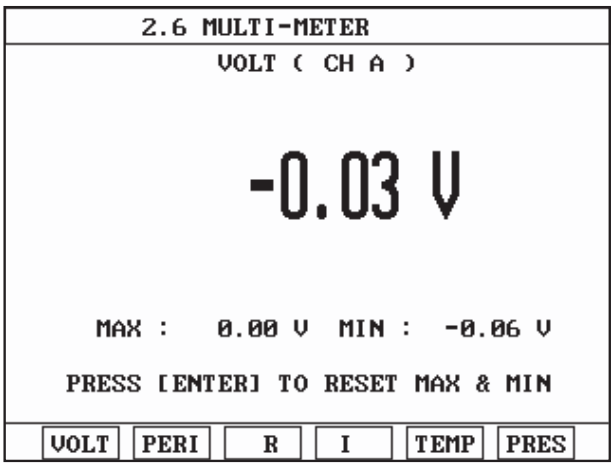
4. Signal Short to Power Inspection

1) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 2 of fuel pressure sensor harness connector and chassis ground.





SNBFL8006L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

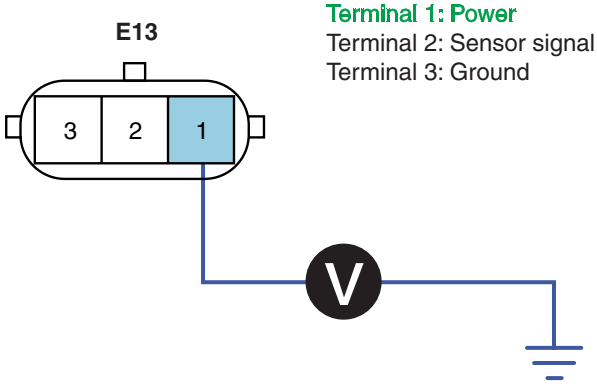
POWER SUPPLY INSPECTION E8A44B46

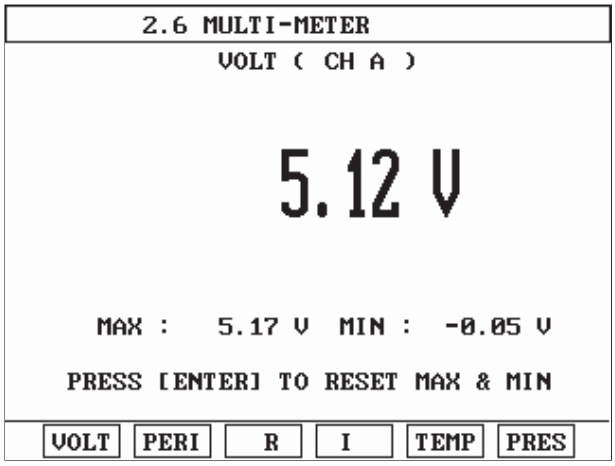
1. Power Supply Voltage Inspection

1) Disconnect fuel pressure sensor connector(E13).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of fuel pressure sensor harness connector and chassis ground.





SNBFL8007L

■ Specification: ECM output approx. 5.27V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

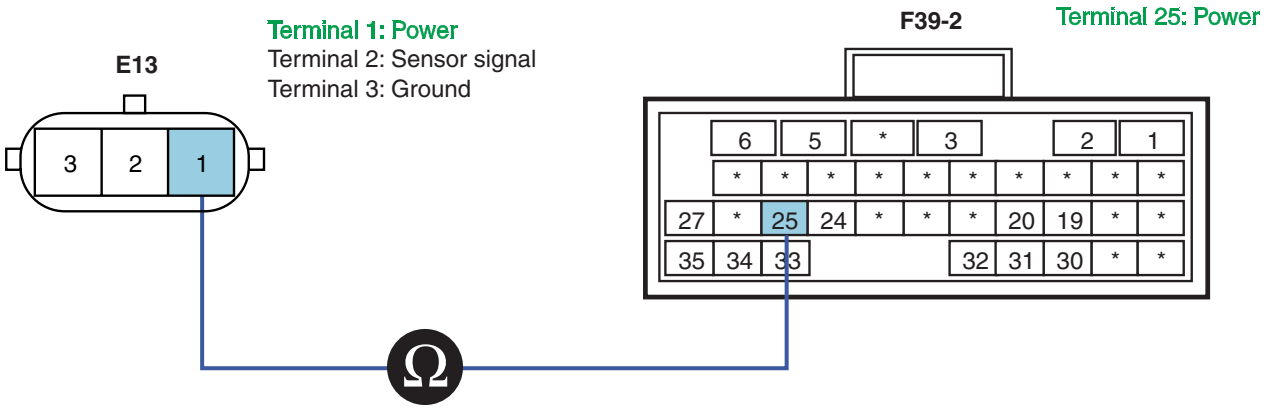
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn the ignition OFF.

2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of fuel pressure sensor harness connector and terminal 25 of ECM connector(F39-2).



SNBFL8008L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

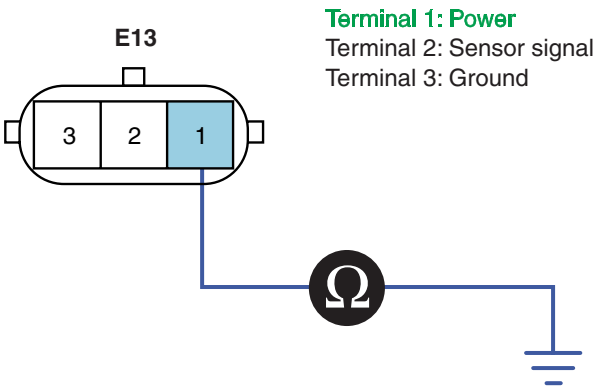
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Power Supply Short to Ground Inspection

1) Turn ignition OFF.

2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of fuel pressure sensor harness connector and chassis ground.



SNBFL8009L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

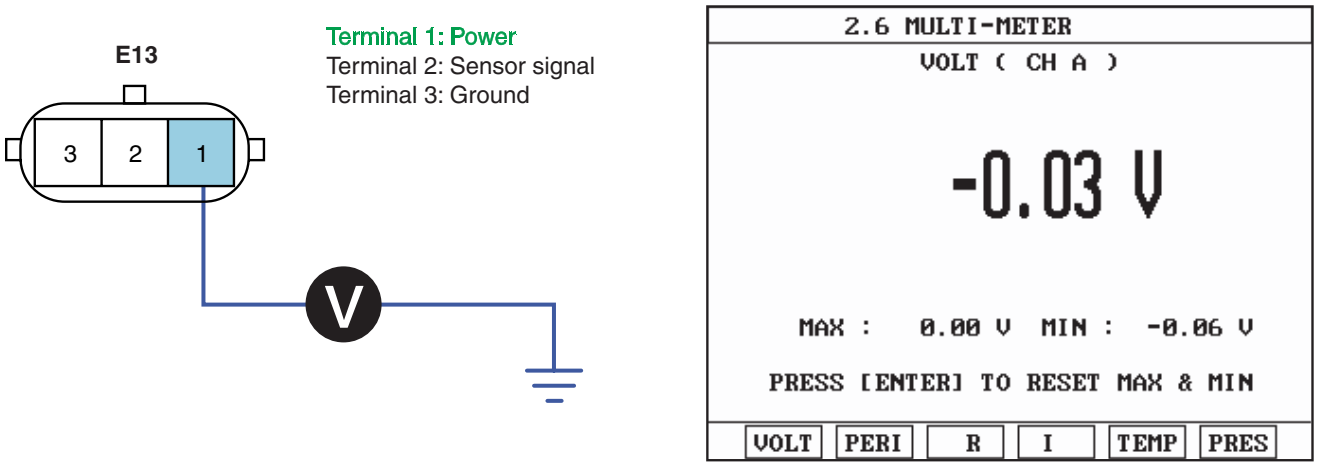
▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

4. Power Supply Short to Power Inspection

1) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of fuel pressure sensor harness connector and chassis ground.



SNBFL8010L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

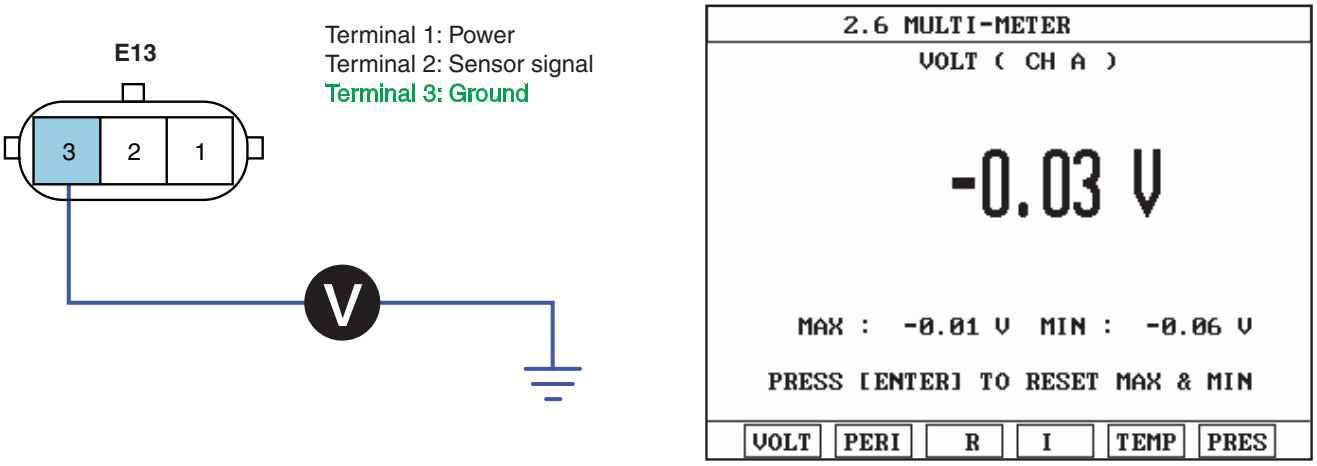
GROUND CIRCUIT INSPECTION E3E9527C

1. Ground Voltage Drop Inspection

   1) Disconnect fuel pressure sensor connector(E13).

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage drop between terminal 3 of fuel pressure sensor harness connector and chassis ground.



SNBFL8011L

■ Specification: Ground voltage drop- Within 200mV

   4) Is the resistance measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

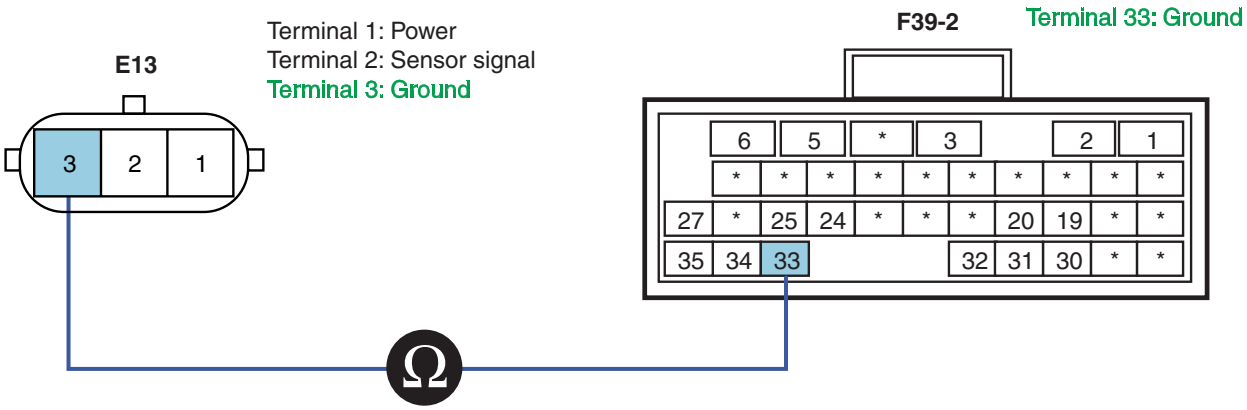
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

   1) Turn the ignition OFF.

   2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

   3) Measure resistance between terminal 3 of fuel pressure sensor harness connector and terminal 33 of ECM connector(F39-2).



SNBFL8012L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION ECE57ABF

1. Fuel Pressure Sensor Inspection

   1) Turn the ignition OFF.

   2) Leave the fuel pressure sensor connector(E13) installed.

   3) Start the engine and compare fuel pressure and fuel pressure signal voltage according to detecting condition.

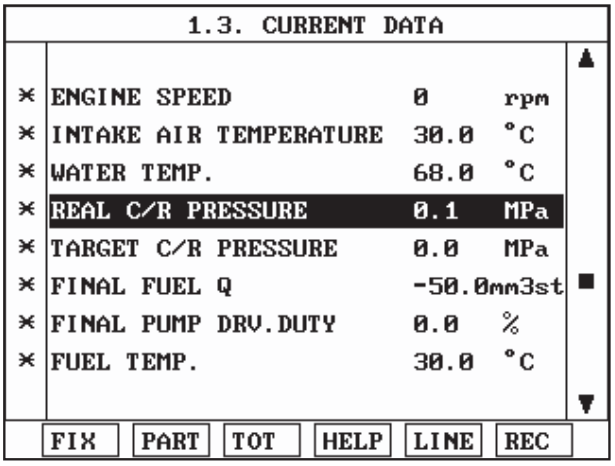


Fig. 1 Fuel pressure sensor data at IG ON

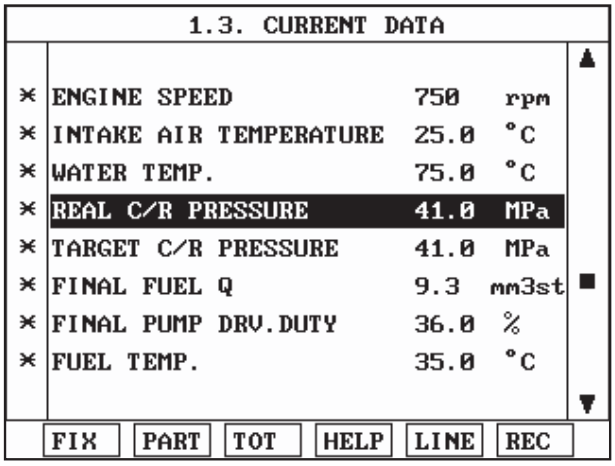


Fig. 2 Fuel pressure sensor data at idle

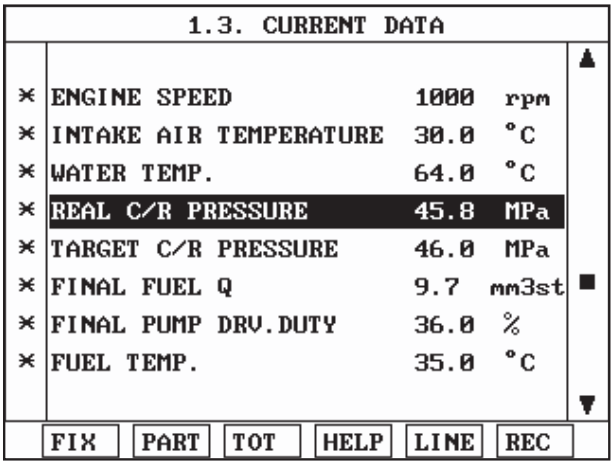


Fig. 3 Fuel pressure sensor data at 1,000rpm

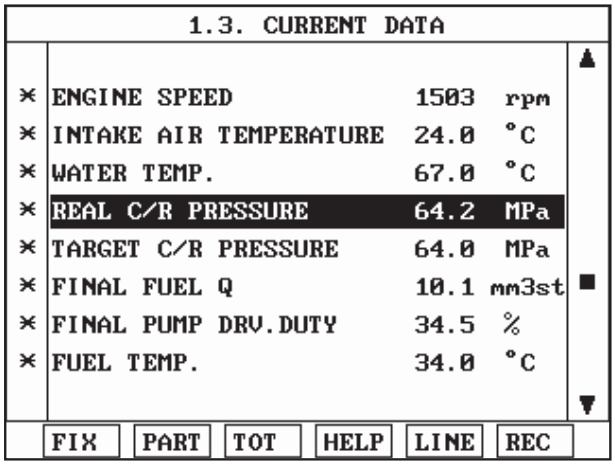


Fig. 4 Fuel pressure sensor data at 1,500rpm

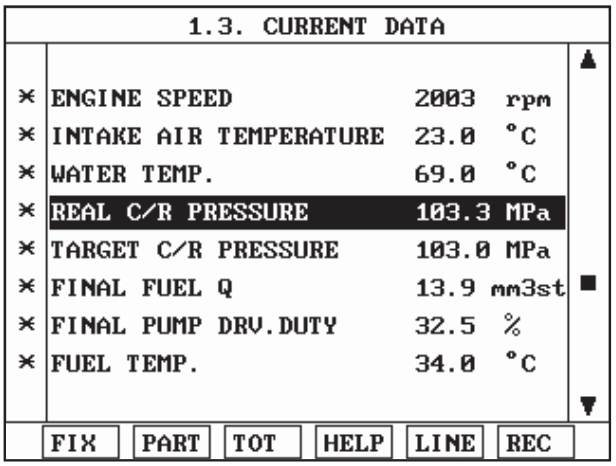


Fig. 5 Fuel pressure sensor data at 2,000rpm

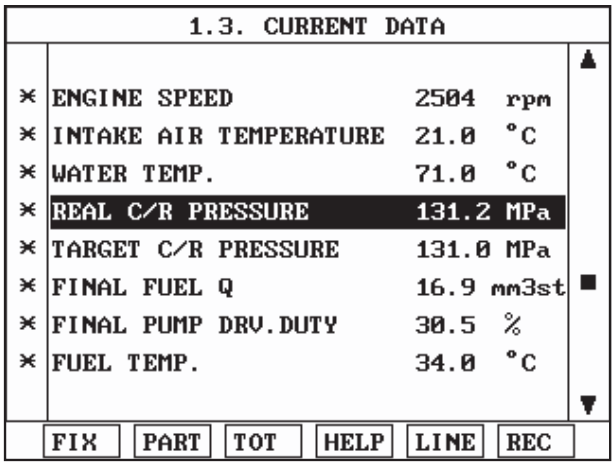


Fig. 6 Fuel pressure sensor data at 2,500rpm

■ **SPECIFICATION:**

Pressure(Mpa)	Output voltage(V)
40	1.64
60	1.96
100	2.60
160	3.56
200	4.20

4) Is the output value measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the fuel pressure sensor and then go to "Verification of Vehicle Repair" procedure.

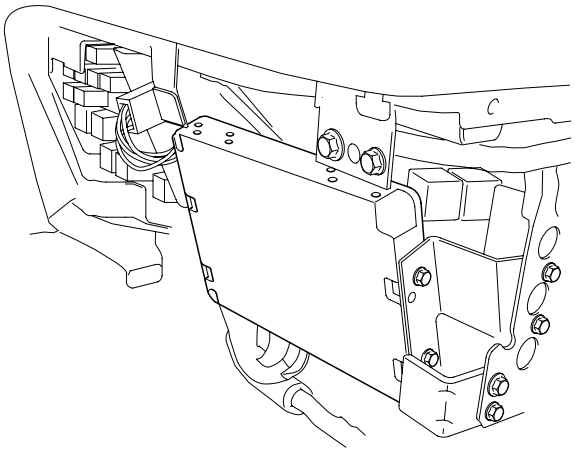
VERIFICATION OF VEHICLE REPAIR EF9B78F4

Refer to DTC P0112.

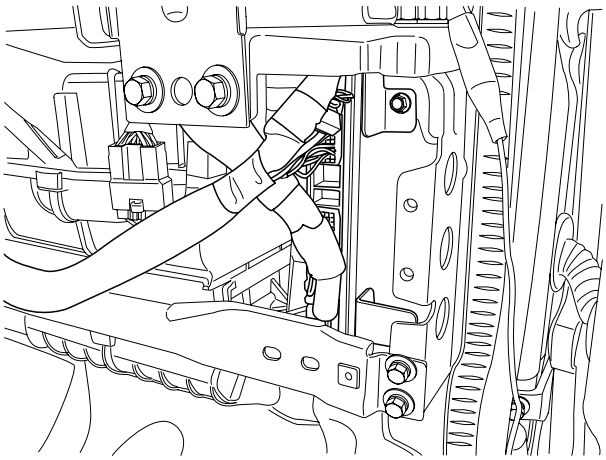
DTC P0107 BAROMETRIC PRESSURE SENSOR -LOW VOLTAGE

COMPONENT LOCATION EB0305AA

Barometric pressure sensor(In the ECM) - Under glove box



[Narrow cab]



[Wide cab]

SUDFL8018L

DESCRIPTION E9622769

1. GENERAL DESCRIPTION
   Barometric pressure sensor which is absolute pressure sensor is located in the ECM and is used to detect changes in barometric pressure. The barometric pressure sensor measures air pressure and converts into voltage and sends signal to ECM. It is used to compensate for the amount of fuel injected. Specially it is used to compensate for proper fuel injection amount while the vehicle is driving under high altitude area and improves drivability by controlling the vehicle condition and the timing to make diesel ignite well.

2. DTC DESCRIPTION
   If the output voltage of the sensor is detected below 1.9V for 1,000.1ms or more with IG ON, at running, the ECM judges this as a fault and DTC is set. The possible cause is the defective barometric pressure sensor built-in ECM. The ECM sets barometric pressure to 101.3Kpa as setting value if the barometric pressure sensor is defective.
   If the vehicle is being driven under high altitude area, black smoke may occur since fuel correction is stopped according to the atmospheric pressure and the mixture of air/fuel is rich. And the engine power is restricted.

DTC DETECTING CONDITION E5C3FA03

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="5">• Defective sensor output value
• Defective barometric pressure sensor(Built-in ECM)</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Ignition ON , at running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• Below 1.9V</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 1,000.1ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• Barometric pressure is fixed at 101.3Kpa.
• Fuel correction stops according to atmospheric pressure.</td></tr>
<tr><td>Fuel Limit</td><td>Yes</td></tr>
<tr><td>MIL</td><td>No</td></tr>
</table>

MONITOR SCAN TOOL DATA EBACC584

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Barometric Pressure Sensor" parameter on the scan tool.

NOTE

Be sure to check that the value of barometric pressure and signal voltage changes depending on altitude by DTC detecting condition and that barometric pressure is fixed at 101.3Kpa if the barometric pressure sensor is defective.

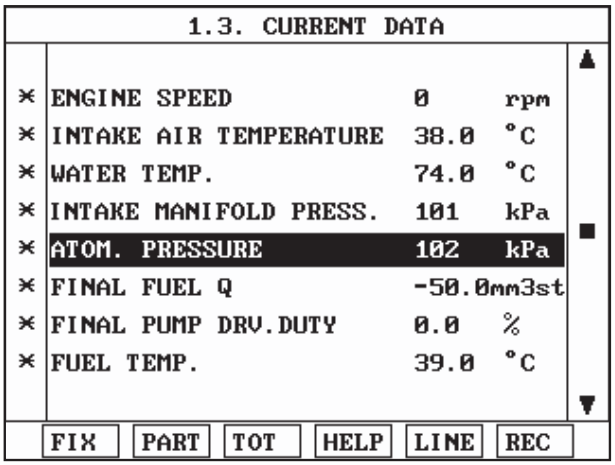


Fig. 1 Barometric pressure sensor data at ignition on
(The value of barometric pressure is the same as that of same area at ignition ON, at starting and at idle)

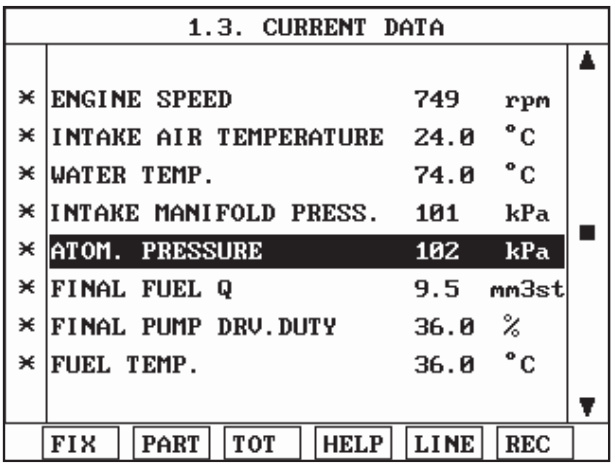


Fig. 2 Barometric pressure sensor data at idle

SUDFL8019L

Troubleshooting Aids
When DTC related to barometric pressure sensor built-in ETC MODULE occurs, sensor data displayed on the scan tool should be utilized as it is impossible to check the component and circuit of barometric pressure sensor. Check that barometric pressure is 101.3Kpa(760mmHg). The higher the vehicle moves to high altitude area, the lower the pressure drops. In case low altitude area, barometric pressure will be displayed approx.101.3Kpa on the scan tool.

NOTE

One barometric pressure is 101.3Kpa(780mmHg) in sea level.

TERMINAL & CONNECTOR INSPECTION ED87383E

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

YES

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

NO

▶ Go to "Component Inspection" procedure.

COMPONENT INSPECTION E657A67D

1. ECM Component Inspection
   1) Turn the ignition OFF.
   2) Disconnect ECM connector(F39-1, F39-2, F39-4, F39-3, F39-5).
   3) Connect ECM connector(F39-1, F39-2, F39-4, F39-3, F39-5) after 5~10 minutes.
   4) Clear DTC using scan tool.
   5) Drive the vehicle under conditions noted in failure records.
   6) Check that DTC was displayed on the scan tool.
   7) Was the system Okay?

      YES

      ▶ Go to "Verification of Vehicle Repair" procedure.

      NO

      ▶ Replace ECM and then go to "Verification of Vehicle Repair" procedure.

Repeat above component inspection 2~3 times.

VERIFICATION OF VEHICLE REPAIR E668BDAC

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Drive the vehicle under conditions noted in failure records.
3. Check that the DTC returns by performing self-diagnosis with a scan tool.
4. Did the DTC return?

   YES

   ▶ Begin the diagnosis again. If same DTC is displayed on the scan tool after repeating inspection 2~3 times, replace ECM. In most cases, the ECM is not at fault. Investigate thoroughly before replacing the ECM. Refer to ECM diagnostic procedure.

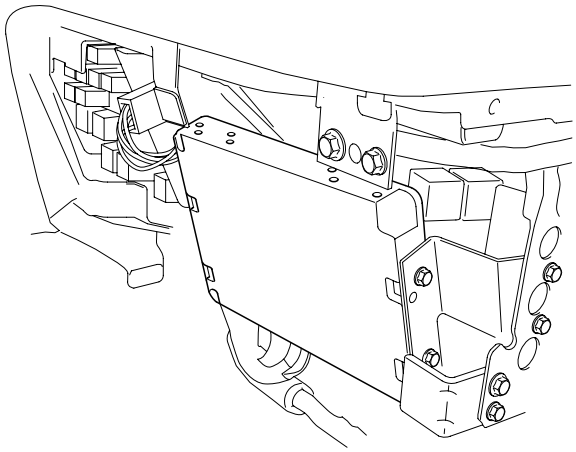
   NO

   ▶ System OK

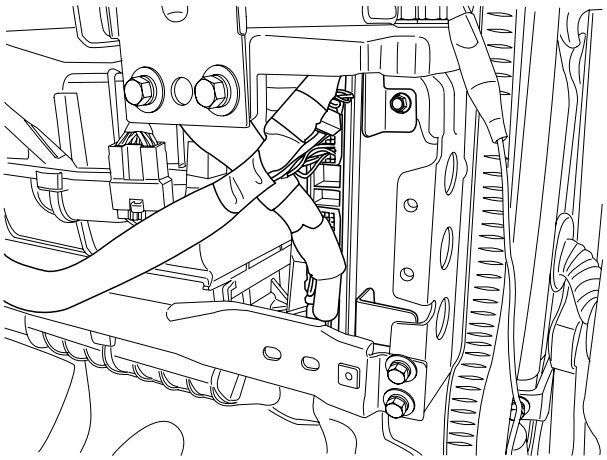
DTC P0108 BAROMETRIC PRESSURE SENSOR -HIGH VOLTAGE

COMPONENT LOCATION EF26F391

Barometric pressure sensor(In the ECM) - Under glove box



[Narrow cab]



[Wide cab]

SUDFL8018L

DESCRIPTION ED7A3843

1. GENERAL DESCRIPTION
   Barometric pressure sensor which is absolute pressure sensor is located in the ECM and is used to detect changes in barometric pressure. The barometric pressure sensor measures air pressure and converts into voltage and sends signal to ECM. It is used to compensate for the amount of fuel injected. Specially it is used to compensate for proper fuel injection amount while the vehicle is driving under high altitude area and improves drive ability by controlling the vehicle condition and the timing to make diesel ignite well.

2. DTC DESCRIPTION
   If the output voltage of the sensor is detected above 4.3V for 1,000.1ms or more with IG ON, at running, the ECM judges this as a fault and DTC is set. The possible cause is the defective barometric pressure sensor built-in ECM. The ECM sets barometric pressure to 101.3Kpa as setting value if the barometric pressure sensor is defective.
   If the vehicle is being driven under high altitude area, black smoke occurs and engine power decreases since the mixture of air/fuel is rich.

DTC DETECTING CONDITION EC477124

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Defective sensor output value • Defective barometric pressure sensor(Built-in ECM)
Enable Conditions	• Ignition ON , at running			
Threshold Value	• Above 4.3V			
Diagnosis Time	• 1,000.1ms or more			
Fail Safe	Fuel Cut	No	• Barometric pressure is fixed at 101.3Kpa. • Fuel correction stops according to atmospheric pressure. • Engine power is restricted.	
	Fuel Limit	Yes		
	MIL	No		

MONITOR SCAN TOOL DATA E48083F5

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Barometric Pressure Sensor" parameter on the scan tool.

NOTE

Be sure to check that the value of barometric pressure and signal voltage changes depending on altitude by DTC detecting condition and that barometric pressure is fixed at 101.3Kpa if the barometric pressure sensor is defective.

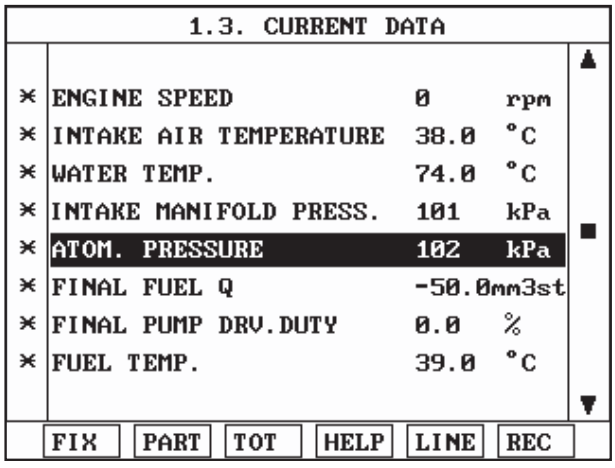


Fig. 1 Barometric pressure sensor data at ignition on

(The value of barometric pressure is the same as that of same area at ignition ON, at starting and at idle)

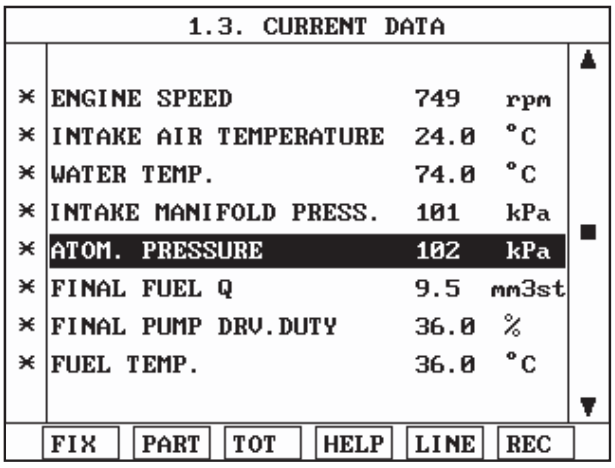


Fig. 2 Barometric pressure sensor data at idle

SUDFL8019L

Troubleshooting Aids

When DTC related to barometric pressure sensor built-in ETC MODULE occurs, sensor data displayed on the scan tool should be utilized as it is impossible to check the component and circuit of barometric pressure sensor. Check that barometric pressure is 101.3Kpa(760mmHg). The higher the vehicle moves to high altitude area, the lower the pressure drops. In case low altitude area, barometric pressure will be displayed approx.101.3Kpa on the scan tool.

NOTE

One barometric pressure is 101.3Kpa(780mmHg) in sea level.

TERMINAL & CONNECTOR INSPECTION E17EBD09

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

YES

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

NO

▶ Go to "Component Inspection" procedure.

COMPONENT INSPECTION EE1FDBE8

1. ECM Component Inspection
   1) Turn the ignition OFF.
   2) Disconnect ECM connector(F39-1, F39-2, F39-4, F39-3, F39-5).
   3) Connect ECM connector(F39-1, F39-2, F39-4, F39-3, F39-5) after 5~10 minutes.
   4) Clear DTC using scan tool.
   5) Drive the vehicle under conditions noted in failure records.
   6) Check that DTC was displayed on the scan tool.
   7) Was the system Okay?

      YES

      ▶ Go to "Verification of Vehicle Repair" procedure.

      NO

      ▶ Replace ECM and then go to "Verification of Vehicle Repair" procedure.

Repeat above component inspection 2~3 times.

VERIFICATION OF VEHICLE REPAIR E9E644EF

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Drive the vehicle under conditions noted in failure records.
3. Check that the DTC returns by performing self-diagnosis with a scan tool.
4. Did the DTC return?

YES

▶ Begin the diagnosis again. If same DTC is displayed on the scan tool after repeating inspection 2~3 times, replace ECM. In most cases, the ECM is not at fault. Investigate thoroughly before replacing the ECM. Refer to ECM diagnostic procedure.

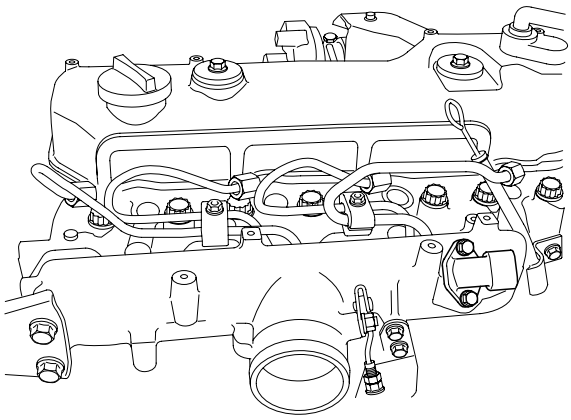
NO

▶ System OK

DTC P0112 INTAKE AIR TEMPERATURE SENSOR - LOW VOLTAGE

COMPONENT LOCATION E750547C

Booster pressure & intake air temperature sensor



SUDFL8020L

DESCRIPTION E6D0E79D

1. GENERAL DESCRIPTION
   IATS(Intake air temperature sensor) is installed on the intake manifold and is built-in together with booster pressure sensor.
   This part employs a thermistor(NTC) which is sensitive to changes in temperature.
   The electric resistance of a thermistor decreases as the temperature increases, and increases as the temperature decreases.
   5 V power from ECM is supplied to the intake air temperature sensor via a resistor and the resistor and electric resistance of thermistor are changed and are converted into output signal according to air temperature entered through cylinder.
   Based on the signal, the ECM corrects fuel injection amount and injection timing.

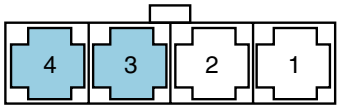
2. DTC DESCRIPTION
   If the output voltage of the intake air temperature sensor is detected below 0.1V for more than 2,995.9 ms, the ECM judges this as a fault and DTC is set. The possible causes may be a defective intake air temperature sensor, faulty wiring and resistance, short to terminal 32 of ECM connector(F39-3).
   The vehicle is being driven, but black smoke and a lack of engine power may occur since fuel correction and injection timing can not be controlled according to the intake air temperature.

DTC DETECTING CONDITION E2BA0AC3

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Poor connection of connector • Ground Short to terminal 32 of ECM connector(F39-3)
Enable Conditions	• Ignition ON/ at running			
Threshold Value	• Below 0.1V			
Diagnosis Time	• 2,995.9ms or more			
Fail Safe	Fuel Cut	No	• At starting: -20°C • At idle or at driving: 25°C	
	Fuel Limit	Yes		
	MIL	OFF		

SPECIFICATION ED42215F

Temp.(℃)	Resistance between terminals 3 and 4(Ω)
0	5,384~6,085
10	3,483~3,900
20	2,311~2,565
30	1,564~1,736
40	1,077~1,205
50	758~854
60	543~616

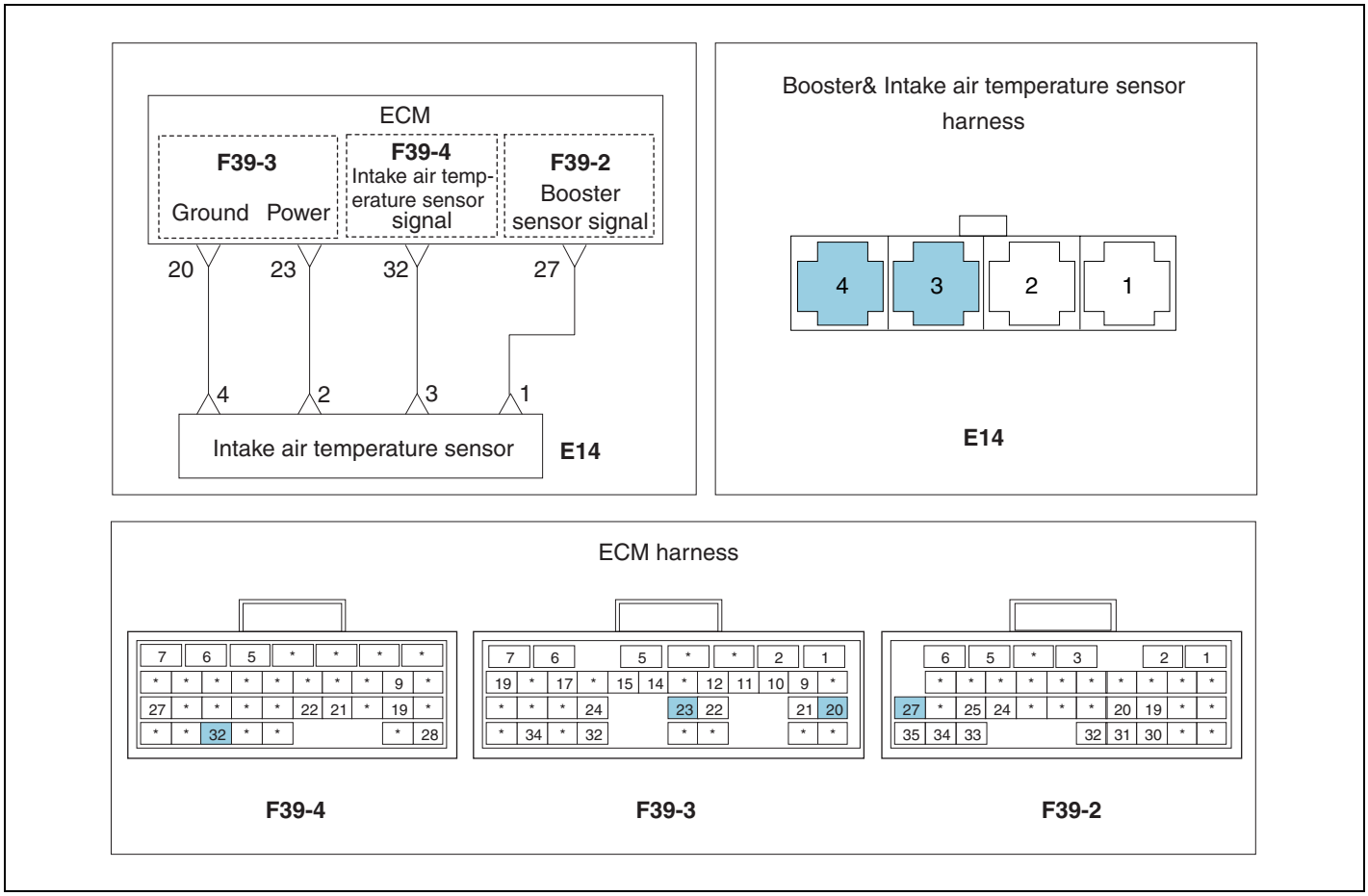


Sensor connector

Terminal 1: Booster sensor signal
Terminal 2: Booster pressure sensor power
Terminal 3: Intake air temperature sensor signal
Terminal 4: Sensor ground

SUDFL8021L

SCHEMATIC DIAGRAM EE45A54A



SNBFL8013L

MONITOR SCAN TOOL DATA EB22B7B0

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Intake Air Temperature Sensor" parameter on the scan tool.

NOTE

Intake air temperature sensor data is displayed on the scan tool depending on DTC detecting condition. (Refer to voltage variation according to temperature.)
In case of fail safe, be sure to check that intake air temperature at starting is fixed at -20°C and the intake air temperature at idle and driving is fixed at 25°C.

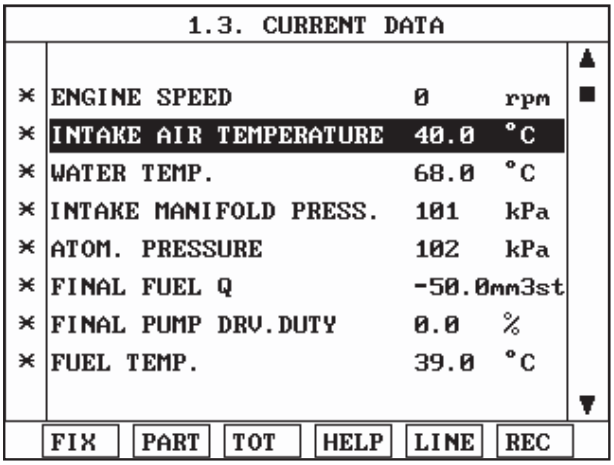


Fig. 1 Intake air temperature sensor data at ignition ON

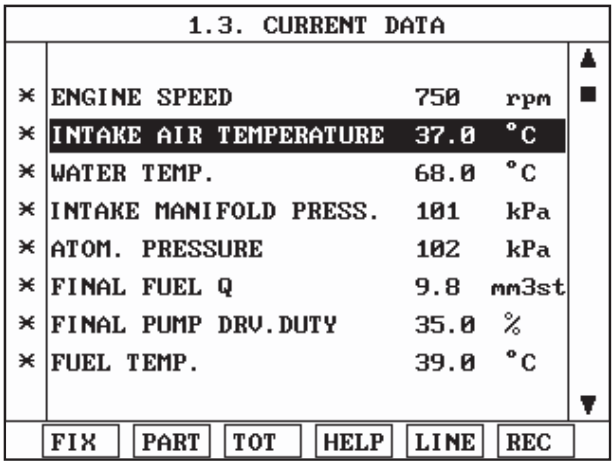


Fig. 2 Intake air temperature sensor data at idle

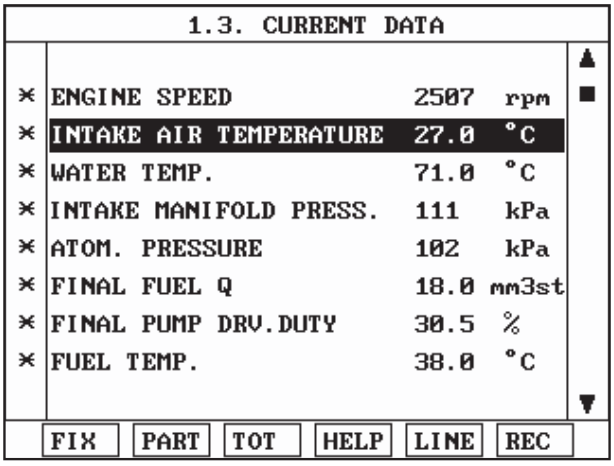


Fig. 3 Intake air temperature sensor data at 2,500 rpm

SUDFL8023L

TERMINAL & CONNECTOR INSPECTION E5B39ABF

Many malfunctions in the electric system are caused by poor harness, and terminals.
Faults can also be caused by interference from other electric 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 then go to "Verification of Vehicle Repair" procedure.

NO

▶ Go to "Signal Circuit Inspection" procedure.

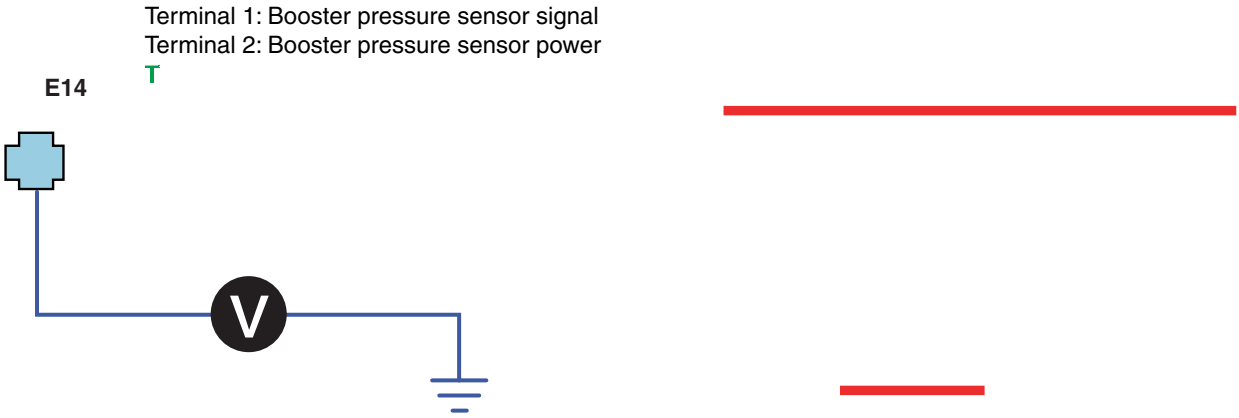
SIGNAL CIRCUIT INSPECTION ED664D4D

1. Signal Voltage Inspection

   1) Leave the intake air temperature sensor connector(E14) installed.

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 3 of the intake air temperature harness connector and chassis ground.



■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Ground Inspection" procedure.

NO

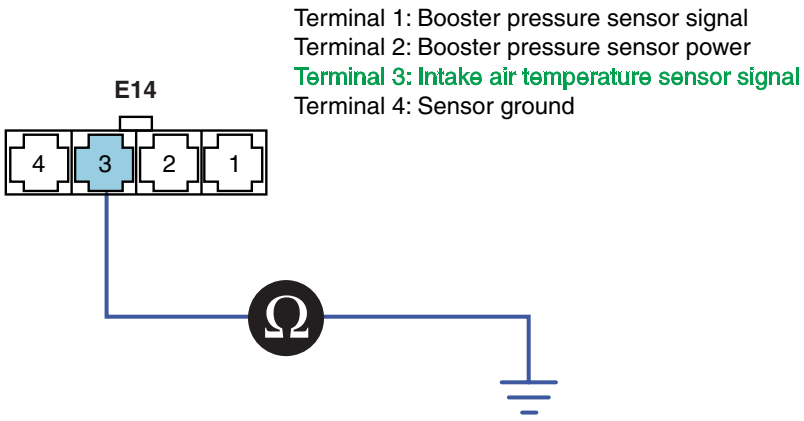
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Signal Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect intake air temperature connector(E14) and ECM connector(F39-4).

3) Measure resistance between terminal 3 of the intake air temperature sensor harness connector and chassis ground.



SUDFL8026L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

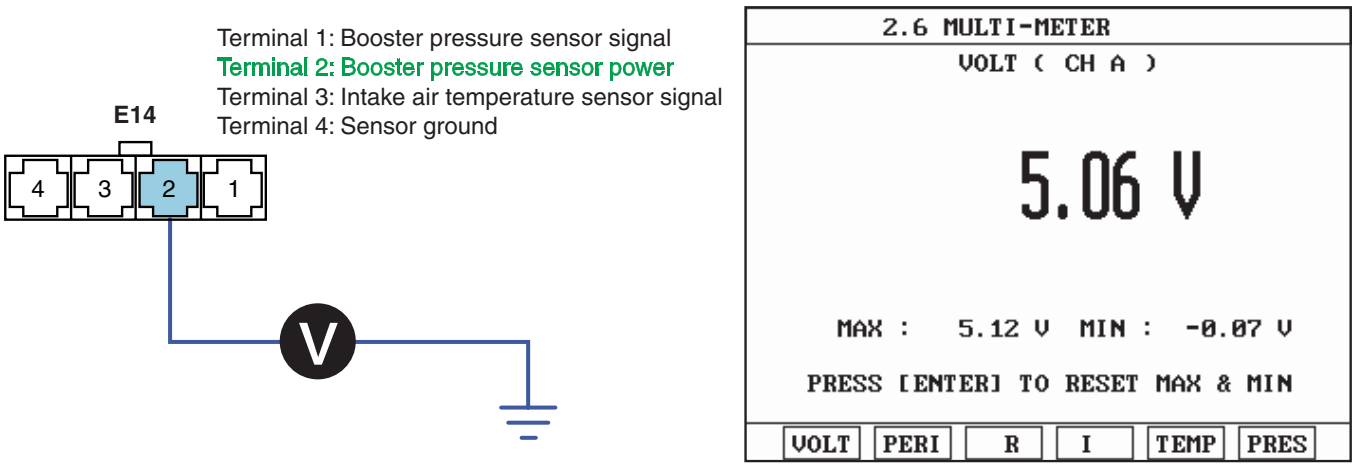
POWER SUPPLY INSPECTION E1C8EF88

1. Power Supply Voltage Inspection

1) Disconnect the intake air temperature sensor connector(E14).

2) Turn ignition ON. The engine stops.

3) Measure voltage between terminal 2 of the intake air temperature sensor harness connector and chassis ground.



SUDFL8027L

■ Specification: ECM output power approx. 5.16V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

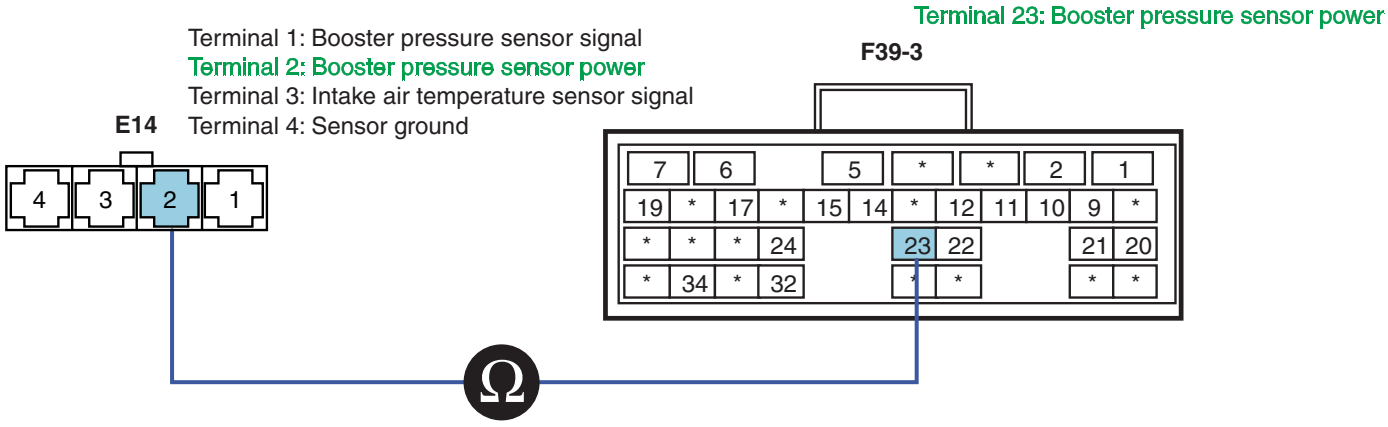
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn ignition OFF.

2) Disconnect intake air temperature sensor connector(E14) and ECM connector(F39-3).

3) Measure resistance between terminal 2 of intake air temperature sensor harness connector and terminal 23 of ECM connector(F39-3).



SNBFL8015L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

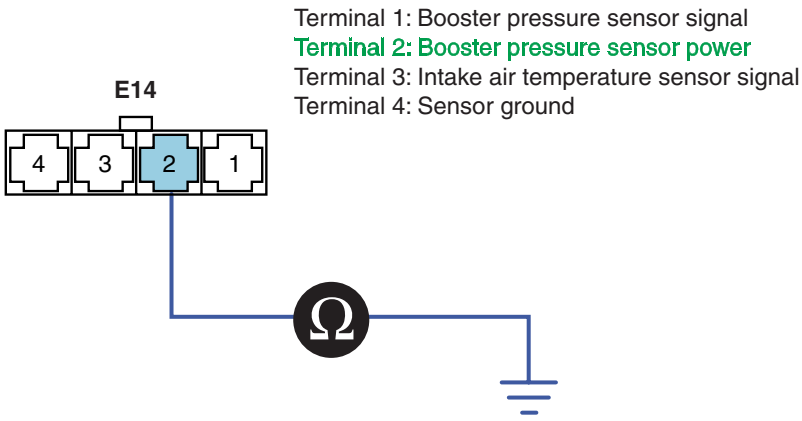
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect the intake air temperature sensor connector(E14) and ECM connector(F39-3).

3) Measure resistance between terminal 2 of intake air temperature sensor and chassis ground.



SUDFL8029L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

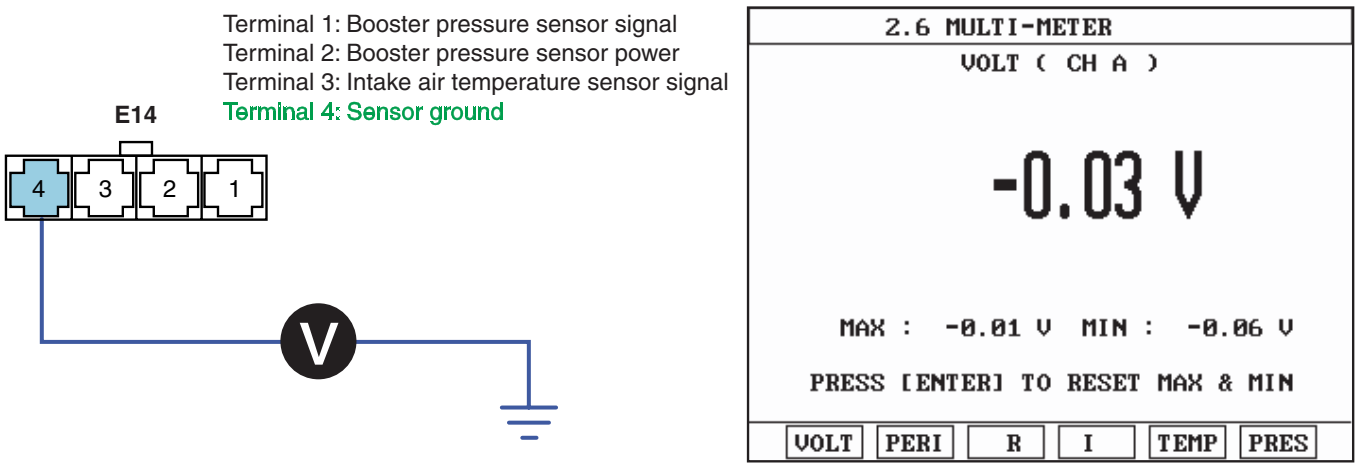
GROUND CIRCUIT INSPECTION E4A9B3C2

1. Ground Voltage Drop Inspection

1) Disconnect intake air temperature sensor(E14).

2) Turn the ignition ON and stop the engine.

3) Measure voltage drop between terminal 4 of intake air temperature sensor harness connector and chassis ground.



SUDFL8030L

■ Specification: Ground voltage drop - within 200mV

4) Is voltage measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

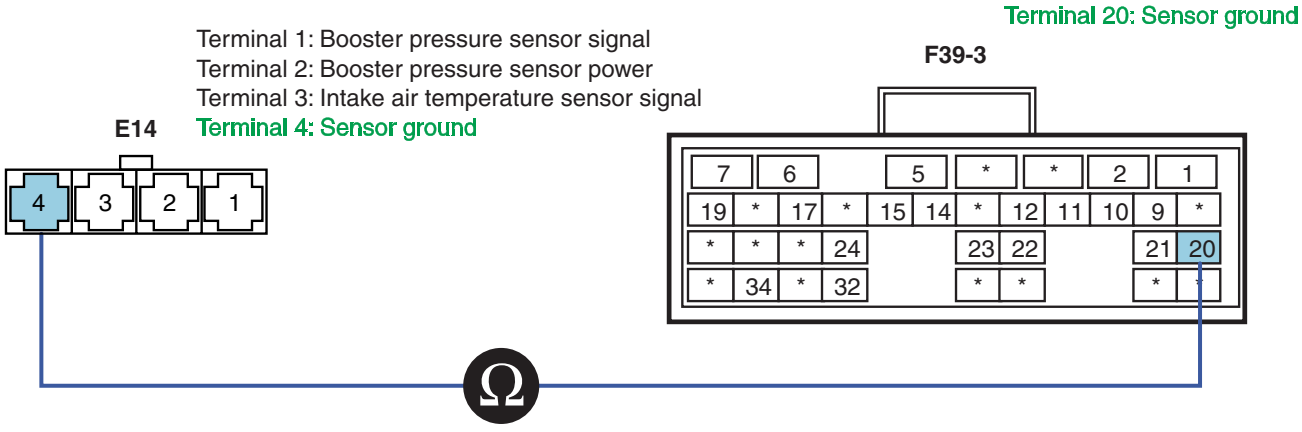
▶ Repair poor connection or the cause of voltage drop and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect intake air temperature sensor connector(E14) and ECM connector(F39-3).

3) Measure resistance between terminal 4 of intake air temperature sensor harness connector and terminal 20 of ECM connector(F39-3).



SNBFL8016L

■ Specification: Continuity(Below 1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E550CF7B

1. Intake Air Temperature Sensor Resistance Inspection

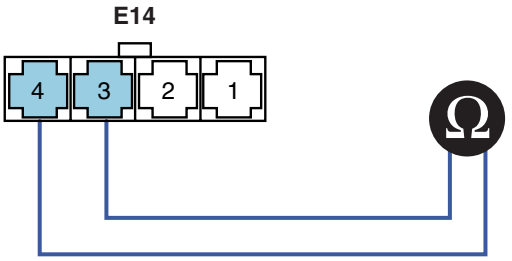
   1) Turn the ignition OFF.

   2) Disconnect intake air temperature sensor connector(E14).

   3) Measure resistance between terminals 3 and 4 of intake air temperature sensor connector.

Specification

Temp.(℃)	Resistance between terminals 3 and 4(Ω)
0	5,384~6,085
10	3,483~3,900
20	2,311~2,565
30	1,564~1,736
40	1,077~1,205
50	758~854
60	543~616



Terminal 1: Booster pressure sensor signal
Terminal 2: Booster pressure sensor power
Terminal 3: Intake air temperature sensor signal
Terminal 4: Sensor ground

SUDFL8032L

   4) Is the resistance measured within the specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the intake air temperature sensor and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EBDC48E2

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

1. Connect scan tool and select " Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.

2. Drive the vehicle under conditions noted in failure records.

3. Check that the DTC returns by performing self-diagnosis with a scan tool.
4. Did the DTC return?

YES

▶ Go to the applicable DTC procedure.

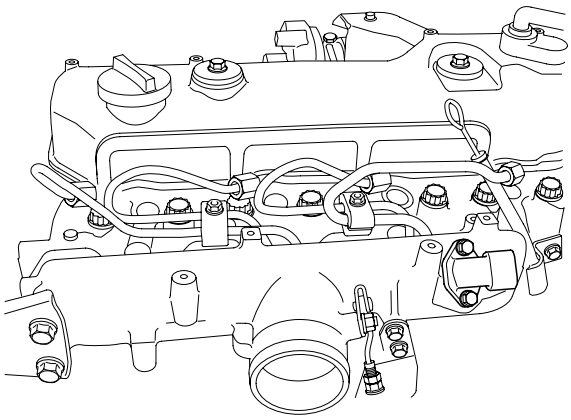
NO

▶ System OK

DTC P0113 INTAKE AIR TEMPERATURE SENSOR - HIGH VOLTAGE

COMPONENT LOCATION E91FA810

Booster pressure & intake air temperature sensor



SUDFL8020L

DESCRIPTION E4825322

1. GENERAL DESCRIPTION
   IATS(Intake air temperature sensor) is installed on the intake manifold and is built-in together with booster pressure sensor.
   This part employs a thermistor(NTC) which is sensitive to changes in temperature.
   The electric resistance of a thermistor decreases as the temperature increases, and increases as the temperature decreases.
   5 V power from ECM is supplied to the intake air temperature sensor via a resistor and the resistor and electric resistance of thermistor are changed and are converted into output signal according to air temperature entered through cylinder.
   Based on the signal, the ECM corrects fuel injection amount and injection timing.

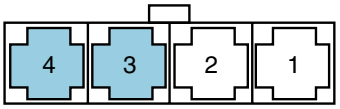
2. DTC DESCRIPTION
   If the output voltage of the intake air temperature sensor is detected above 4.5V for more than 2,995.9 ms, the ECM judges this as a fault and DTC is set. The possible causes may be a defective intake air temperature sensor, faulty wiring and resistance, short to terminal 32 of ECM connector(F39-3).
   The vehicle is being driven, but black smoke and a lack of engine power may occur since fuel correction and injection timing can not be controlled according to the intake air temperature.

DTC DETECTING CONDITION E54AB24E

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Poor connection of connector • Open circuit in terminal 32 of ECM connector(F39-3)
Enable Conditions	• Ignition ON/ at running			
Threshold Value	• Above 4.5V			
Diagnosis Time	• 2,995.9ms or more			
Fail Safe	Fuel Cut	No	• At starting: -20°C • At idle or at driving: 25°C	
	Fuel Limit	Yes		
	MIL	OFF		

SPECIFICATION E02C3DEE

Temp.(℃)	Resistance between terminals 3 and 4(Ω)
0	5,384~6,085
10	3,483~3,900
20	2,311~2,565
30	1,564~1,736
40	1,077~1,205
50	758~854
60	543~616

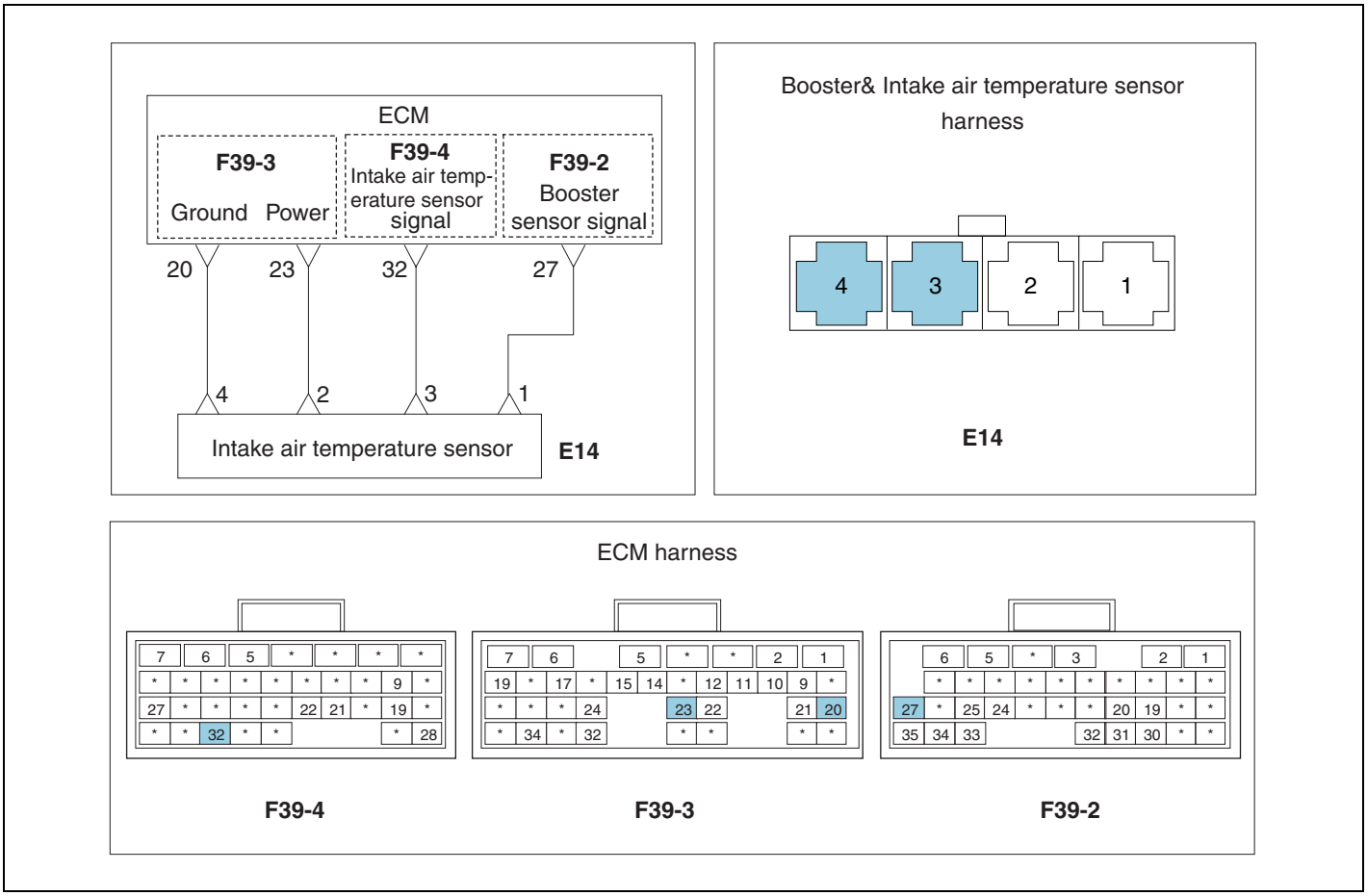


Sensor connector

Terminal 1: Booster sensor signal
Terminal 2: Booster pressure sensor power
Terminal 3: Intake air temperature sensor signal
Terminal 4: Sensor ground

SUDFL8021L

SCHEMATIC DIAGRAM EC4354C4



SNBFL8013L

MONITOR SCAN TOOL DATA E6F2B517

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Intake Air Temperature Sensor" parameter on the scan tool.

NOTE

Intake air temperature sensor data is displayed on the scan tool depending on DTC detecting condition. (Refer to voltage variation according to temperature.)
In case of fail safe, be sure to check that intake air temperature at starting is fixed at -20°C and the intake air temperature at idle and driving is fixed at 25°C.

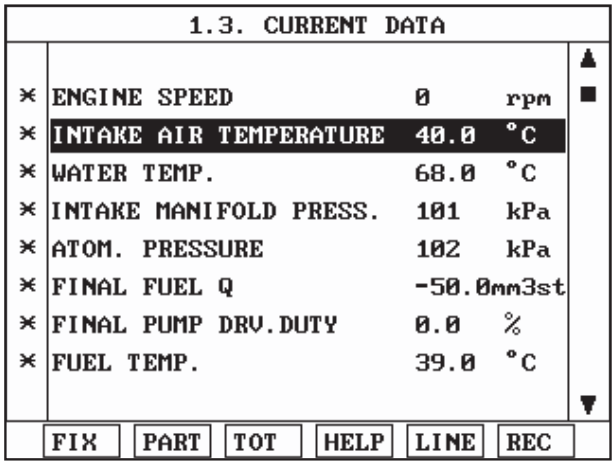


Fig. 1 Intake air temperature sensor data at ignition ON

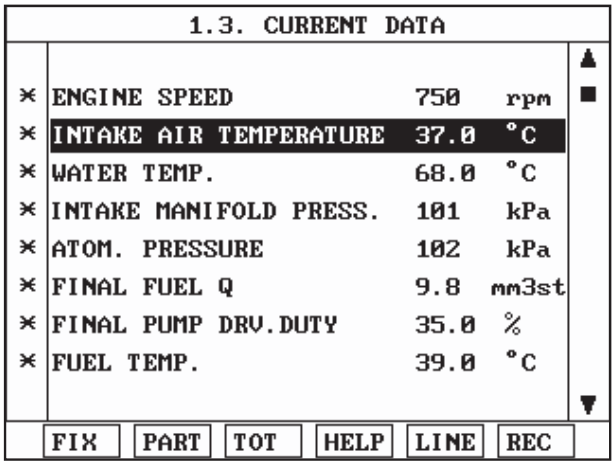


Fig. 2 Intake air temperature sensor data at idle

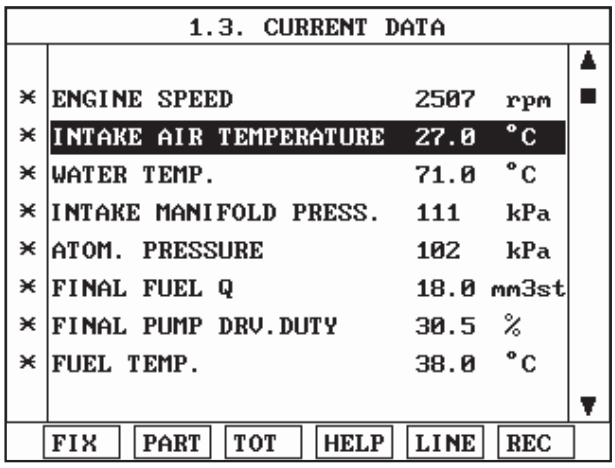


Fig. 3 Intake air temperature sensor data at 2,500 rpm

SUDFL8023L

TERMINAL & CONNECTOR INSPECTION E578F8C4

Many malfunctions in the electric system are caused by poor harness, and terminals.
Faults can also be caused by interference from other electric 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 then go to "Verification of Vehicle Repair" procedure.

NO

▶ Go to "Signal Circuit Inspection" procedure.

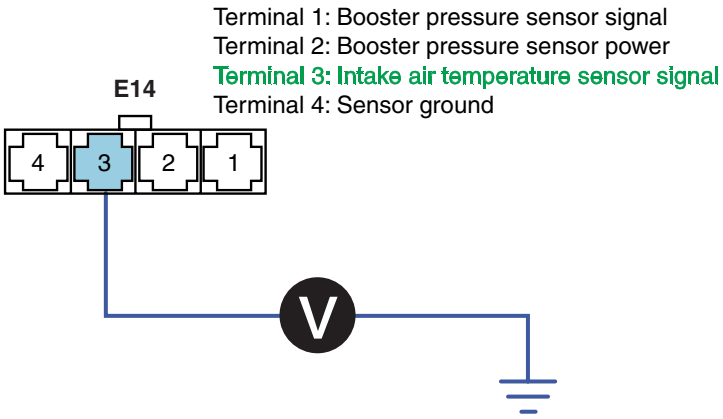
SIGNAL CIRCUIT INSPECTION E8261F1F

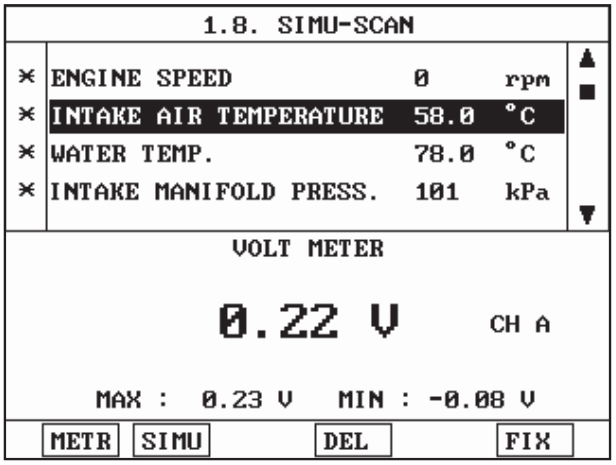
1. Signal Voltage Inspection

   1) Leave the intake air temperature sensor connector(E14) installed.

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 3 of the intake air temperature harness connector and chassis ground.





▶ With intake air temperature sensor connector connected at IG ON

SUDFL8024L

■ Specification: ECM output power Approx. 0.31 V
Note: Voltage value is different depending on intake air temperature.

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

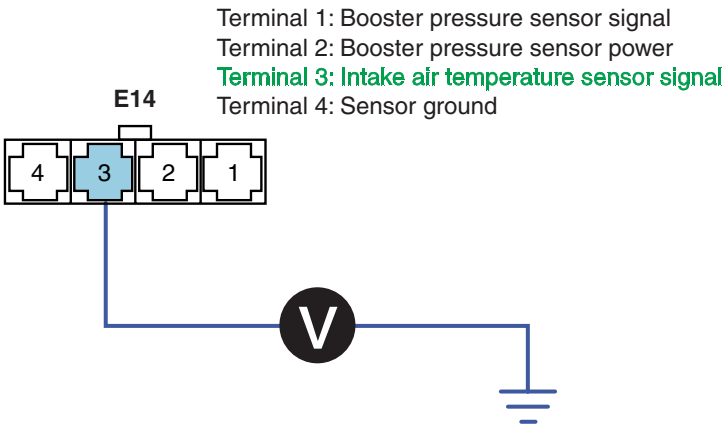
▶ Go to "Signal Short to Power Inspection" procedure.

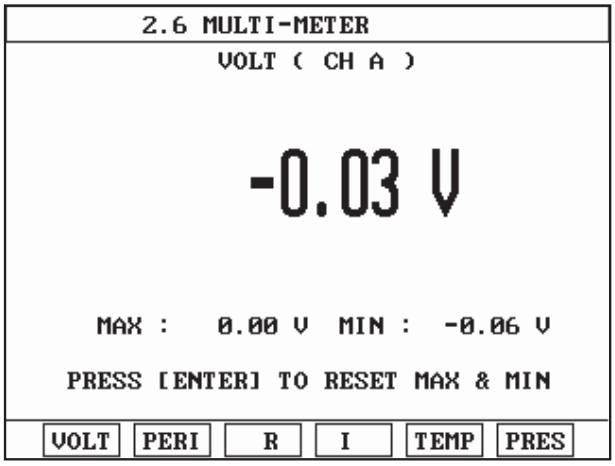
2. Signal Short to Power Inspection

1) Disconnect the intake air temperature sensor connector(E14) and the ECM connector(F39-4).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 3 of the intake air temperature sensor harness connector and chassis ground.





SUDFL8033L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

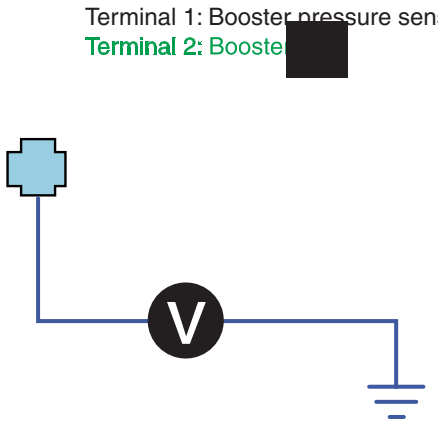
POWER SUPPLY INSPECTION E240D0C9

1. Power Supply Voltage Inspection

1) Disconnect intake air temperature connector(E14).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 2 of the intake air temperature sensor harness connector and chassis ground.



■ Specification: ECM output power approx. 5.16V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

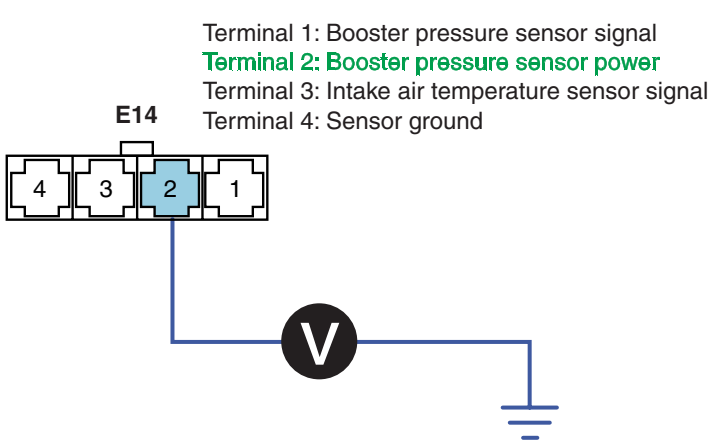
▶ Go to "Power Supply Short to Power Inspection" procedure.

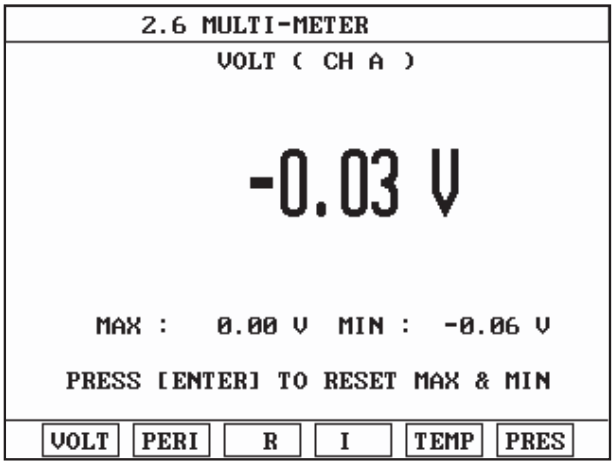
2. Power Supply Short to Power Inspection

1) Disconnect intake air temperature sensor connector(E14) and ECM connector(F39-3).

2) Turn ignition ON. The engine stops.

3) Measure voltage between terminal 2 of the intake air temperature sensor harness connector and chassis ground.





SUDFL8034L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

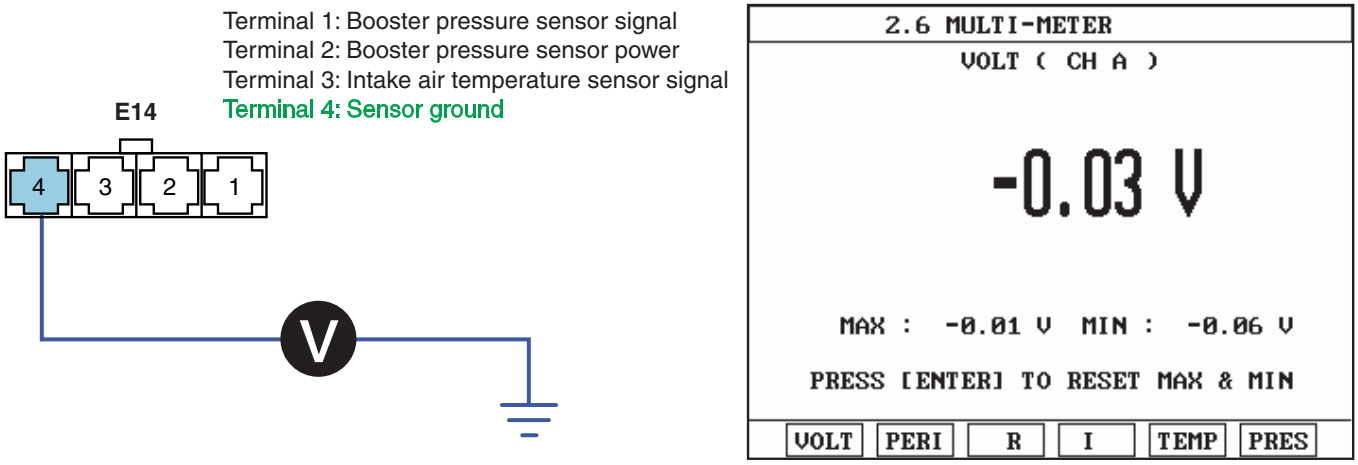
GROUND CIRCUIT INSPECTION E5041A2E

1. Ground Voltage Drop Inspection

1) Disconnect intake air temperature sensor connector(E14).

2) Turn ignition ON. The engine stops.

3) Measure voltage drop between terminal 4 of intake air temperature sensor harness connector and chassis ground.



SUDFL8030L

■ Specification: Ground voltage drop- within 200mV

4) Is the voltage drop measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

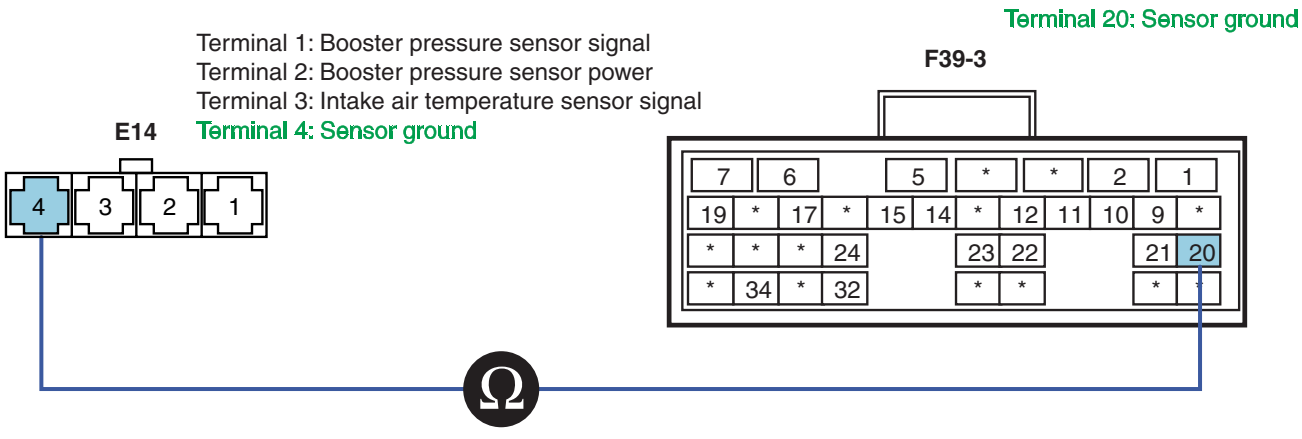
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect the intake air temperature sensor connector(E14) and ECM connector(F39-3).

3) Measure resistance between terminal 4 of intake air temperature sensor and terminal 20 of ECM connector(F39-3).



SNBFL8016L

■ Specification: Continuity(Below 1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E84DB03C

1. Intake Air Temperature Sensor Resistance Inspection

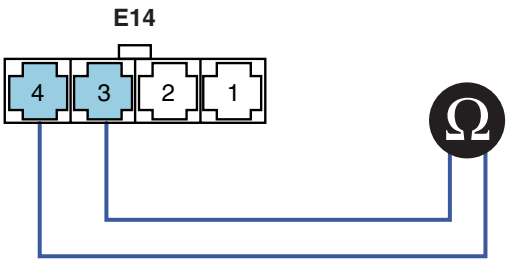
1) Turn the ignition OFF.

2) Disconnect intake air temperature sensor connector(E14).

3) Measure resistance between terminals 3 and 4 of intake air temperature sensor connector.

Specification

Temp.(℃)	Resistance between terminals 3 and 4(Ω)
0	5,384~6,085
10	3,483~3,900
20	2,311~2,565
30	1,564~1,736
40	1,077~1,205
50	758~854
60	543~616



Terminal 1: Booster pressure sensor signal
Terminal 2: Booster pressure sensor power
Terminal 3: Intake air temperature sensor signal
Terminal 4: Sensor ground

SUDFL8032L

4) Is the resistance measured within the specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the intake air temperature sensor and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E20C1E38

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

1. Connect scan tool and select "Diagnostic Trouble Codes(DTCs)" mode and then clear DTC.
2. Drive the vehicle under conditions noted in failure records.
3. Check that the DTC returns by performing self-diagnosis with a scan tool.
4. Did the DTC return?

YES

▶ Go to the applicable DTC procedure.

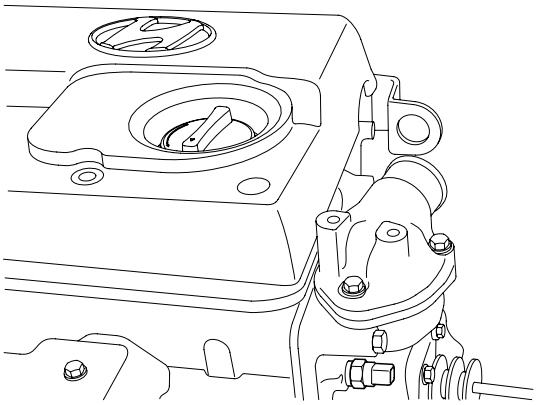
NO

▶ System OK

DTC P0117 ENGINE COOLANT TEMPERATURE SENSOR-LOW VOLTAGE

COMPONENT LOCATION ED9B8AA9

Coolant temperature sensor



SUDFL8035L

DESCRIPTION ECA24930

1. GENERAL DESCRIPTION
   ECTS(Engine Coolant Temperature Sensor) is located on coolant passage of cylinder head. The ECTS uses a thermistor whose resistance changes with the temperature. The electric resistance of the ECTS decreases as the temperature increases, and increases as the temperature decreases.
   The ECTS receives 5 voltage via resistor from ECM and resistor and thermistor are linked in series. ECM received signal from ECTS is used to control injection timing, fuel amount correction and automatic cooling fan.
   Specially the defective engine coolant temperature sensor has a great influence on the cold starting and is one of the factors to cause white smoke at starting.

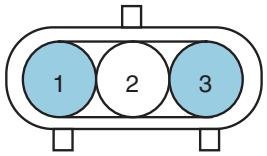
2. DTC DESCRIPTION
   If the output voltage of the engine coolant temperature sensor is detected below 0.1V for 2,995.9ms or more, the ECM judges this as a fault and DTC is set. The possible causes are defective ECTS, faulty wiring & resistance or short to terminal 19 of ECM connector(F39-1) etc.
   The vehicle is being driven, but black smoke and a lack of engine power may occur since fuel correction and injection timing can not be controlled according to the engine coolant temperature.

DTC DETECTING CONDITION E5486C54

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="5">• Defective wiring and sensor
• Ground Short to terminal 19 of ECM connector(F39-1)</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Ignition ON/ At running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• Below 0.1V</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 2,995.9ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• At starting: -20°C
• At idle or at driving: 80°C</td></tr>
<tr><td>Fuel Limit</td><td>Yes</td></tr>
<tr><td>MIL</td><td>ON</td></tr>
</table>

SPECIFICATION E7572845

Temperature		Resistance between terminals 1 and 3(kΩ)
℃	°F	
-20	-4	15.48
0	32	5.79
20	68	2.45
40	104	1.148
80	176	0.322

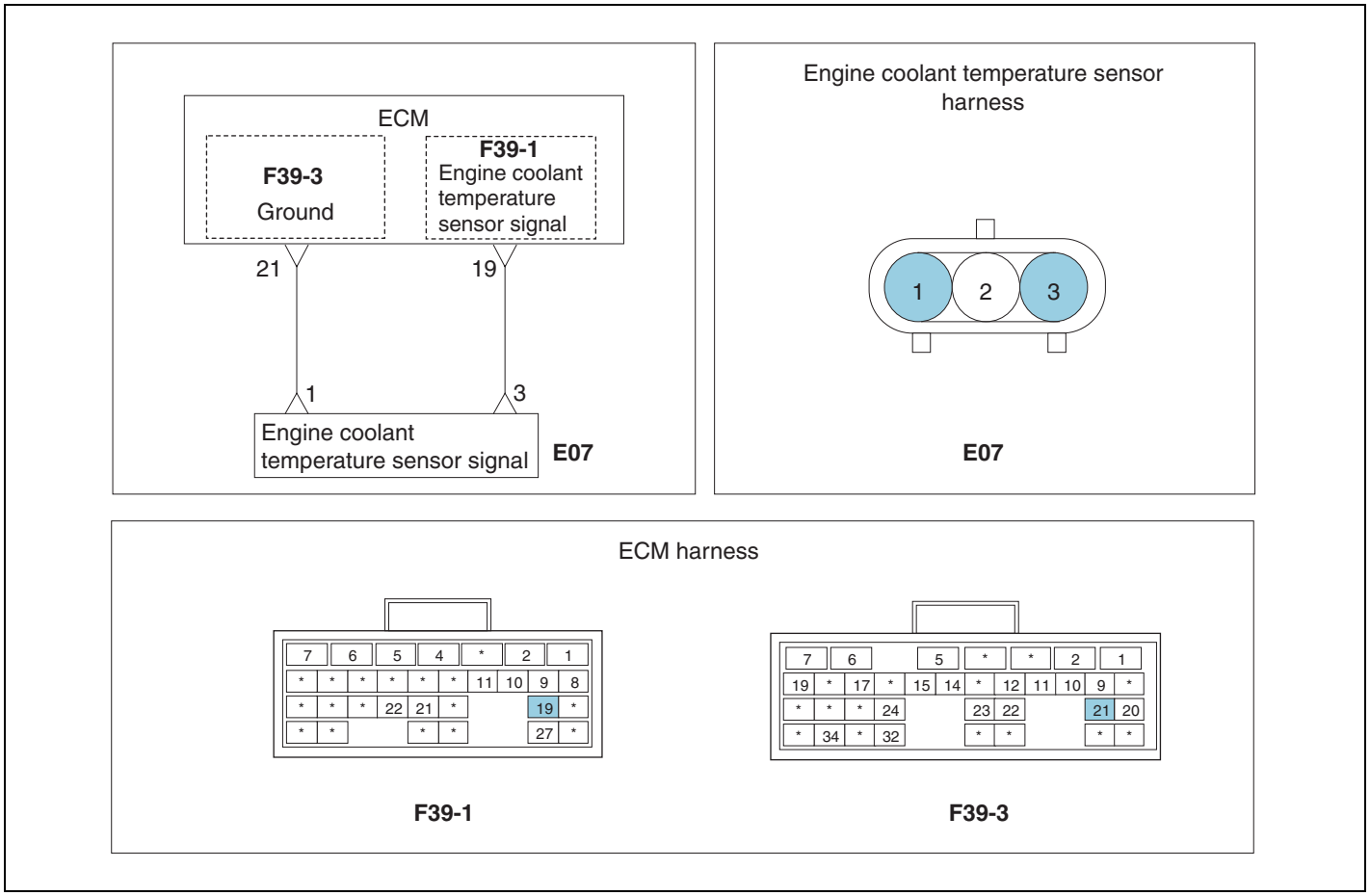


Sensor connector

Terminal 1: Ground
Terminal 3: Sensor output

SUDFL8036L

SCHEMATIC DIAGRAM E7B6EE18



SNBFL8017L

MONITOR SCAN TOOL DATA EA4D2863

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Engine Coolant Temperature Sensor"parameter on the scan tool.

NOTE

Engine coolant temperature sensor data is displayed on the scan tool depending on DTC detecting condition. In case of fail safe, be sure to check that engine coolant temperature at starting is fixed at -20°C and engine coolant temperature at idle and running is fixed at 80°C.

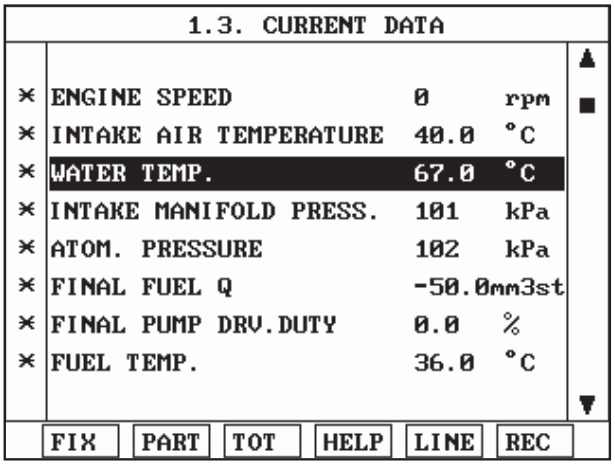


Fig. 1 Engine coolant temperature sensor data at ignition ON

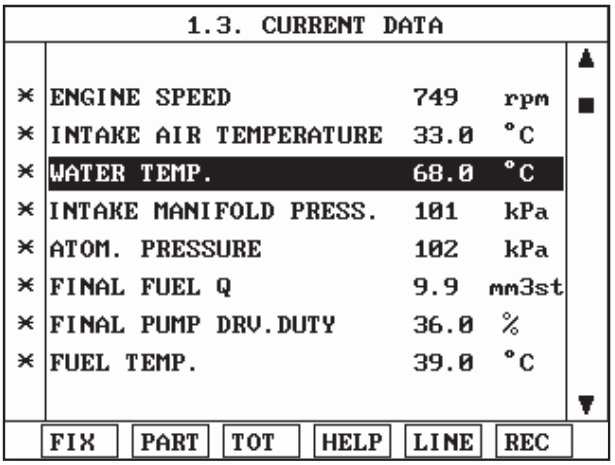


Fig. 2 Engine coolant temperature sensor data at idle

SUDFL8038L

TERMINAL & CONNECTOR INSPECTION EDB2F875

Refer to DTC P0112.

SIGNAL CIRCUIT INSPECTION E2EEBE08

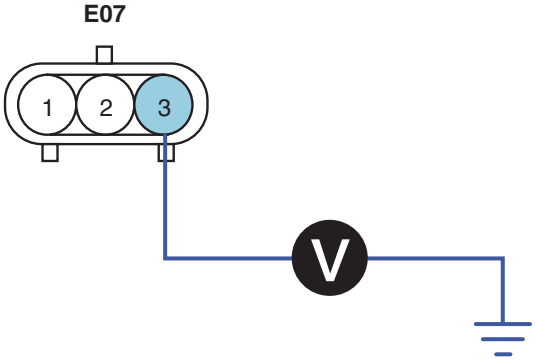
1. Signal Voltage Inspection

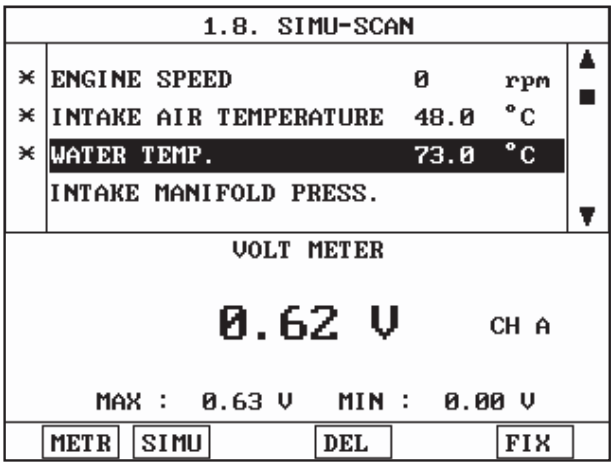
   1) Leave the engine coolant temperature sensor connector(E07) installed.

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 3 of the engine coolant temperature harness connector and chassis ground.

Terminal 1: Sensor ground
Terminal 2: Temperature gauge
Terminal 3: Engine coolant temperature sensor signal





▶ With engine coolant temperature sensor connector installed at IG ON

SUDFL8039L

■ Specification: ECTS signal output approx. 0.68V(With installed)
Note: Output voltage value is different depending on engine coolant temperature.

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

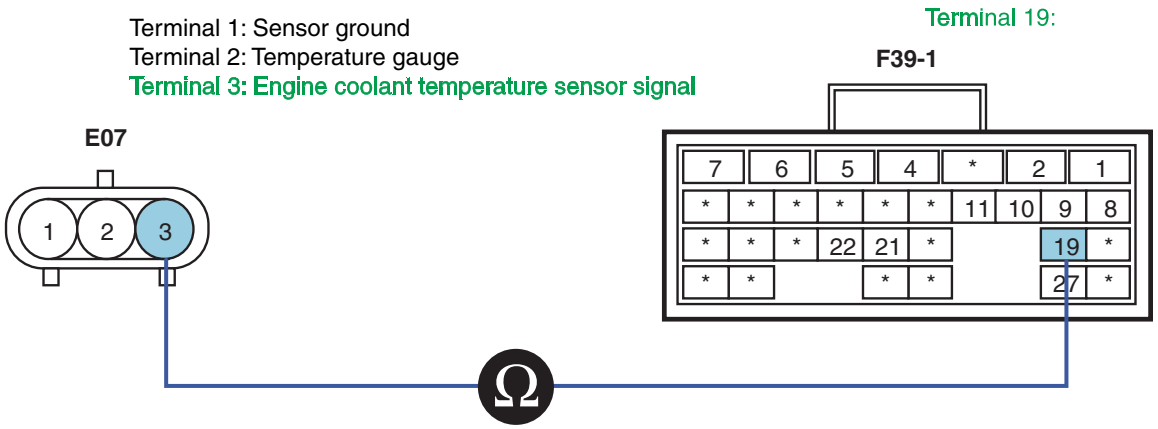
▶ Go to "Signal Open Inspection" procedure.

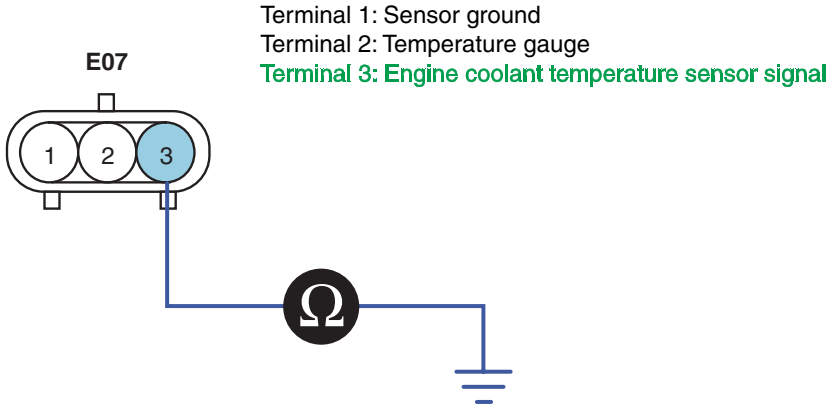
2. Signal Open Inspection

1) Turn the ignition OFF.

2) Disconnect engine coolant temperature sensor connector(E07) and ECM connector(F39-1).

3) Measure resistance between terminal 3 of engine coolant temperature sensor harness connector and terminal 19 of ECM connector(F39-1).





SUDFL8041L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

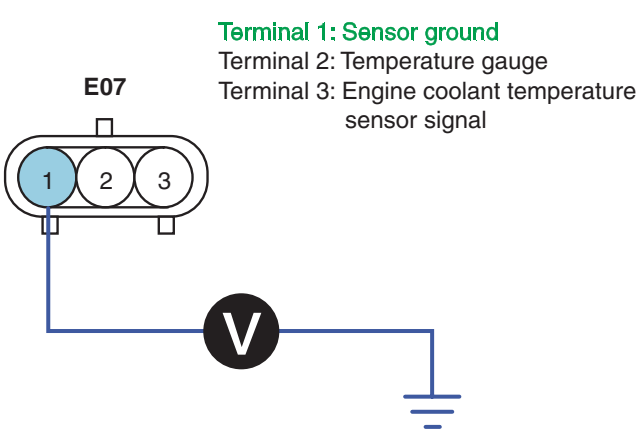
GROUND CIRCUIT INSPECTION E7A8D5C5

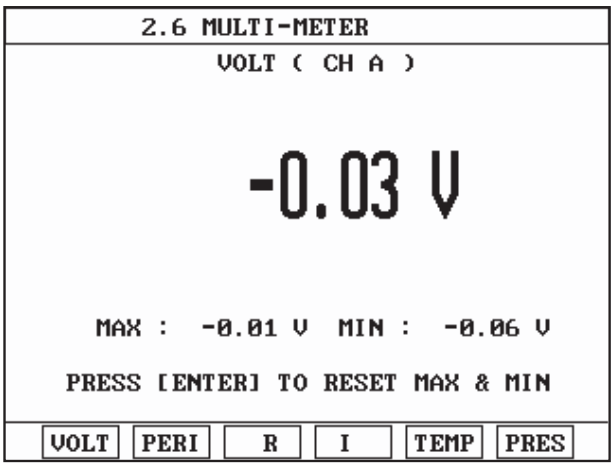
1. Ground Voltage Drop Inspection

1) Disconnect engine coolant temperature sensor connector(E07).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 1 of engine coolant temperature sensor harness connector and chassis ground.





SUDFL8042L

■ Specification: Ground voltage drop- Within 200mV

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

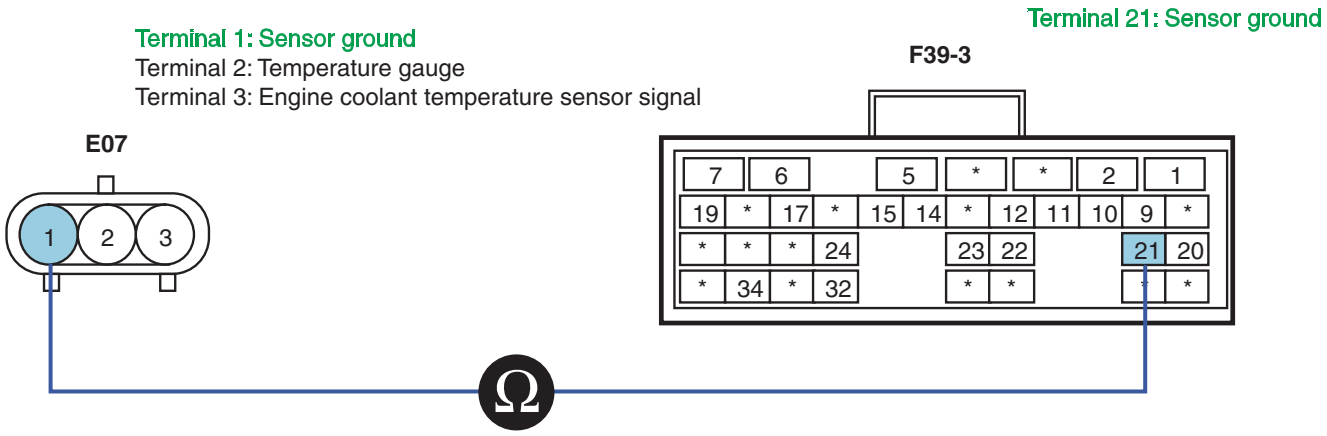
▶ Repair poor connection or excessive resistance of ground circuit and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect engine coolant temperature sensor connector(E07) and ECM connector(F39-3).

3) Measure resistance between terminal 1 of engine coolant temperature sensor harness connector and terminal 21 of ECM connector(F39-3).



SNBFL8019L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E2272386

1. Engine Coolant Temperature Sensor Resistance Inspection

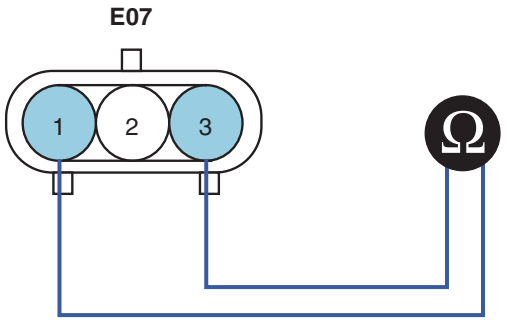
1) Turn the ignition OFF.

2) Disconnect the engine coolant temperature sensor connector(E07).

3) Measure resistance between terminals 1 and 3 of engine coolant temperature sensor.

SPECIFICATION

Temp.(℃)	Resistance between terminals 1 and 3(kΩ)
-20	15.48
0	5.79
20	2.45
40	1.148
80	0.322



Terminal 1: Sensor ground
Terminal 2: Temperature gauge
Terminal 3: Engine coolant temperature sensor signal

SUDFL8044L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the engine coolant temperature sensor and then go to "Verification of Vehicle Repair" procedure.

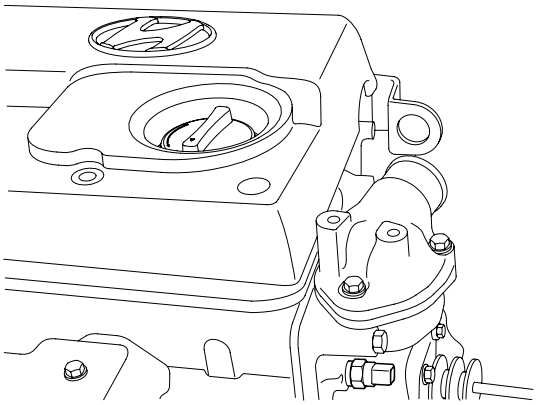
VERIFICATION OF VEHICLE REPAIR E7D672D0

Refer to DTC P0112.

DTC P0118 ENGINE COOLANT TEMPERATURE SENSOR-HIGH VOLTAGE

COMPONENT LOCATION E0A34CEA

Coolant temperature sensor



SUDFL8035L

DESCRIPTION EBA3BA2F

1. GENERAL DESCRIPTION
   ECTS(Engine Coolant Temperature Sensor) is located on coolant passage of cylinder head. The ECTS uses a thermistor whose resistance changes with the temperature. The electric resistance of the ECTS decreases as the temperature increases, and increases as the temperature decreases.
   The ECTS receives 5 voltage via resistor from ECM and resistor and thermistor are linked in series. ECM received signal from ECTS is used to control injection timing, fuel amount correction and automatic cooling fan.
   Specially the defective engine coolant temperature sensor has a great influence on the cold starting and is one of the factors to cause white smoke at starting.

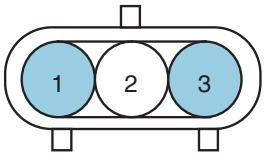
2. DTC DESCRIPTION
   If the output voltage of the engine coolant temperature sensor is detected above 4.92V for 2,995.9ms or more, the ECM judges this as a fault and DTC is set. The possible causes are defective ECTS, faulty wiring & resistance or open in terminal 19 of ECM connector(F39-1) etc.
   The vehicle is being driven, but black smoke and a lack of engine power may occur since fuel correction and injection timing can not be controlled according to the engine coolant temperature.

DTC DETECTING CONDITION EA6DAEEF

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="5">• Defective wiring and sensor
• Open in terminal 19 of ECM connector(F39-1)</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Ignition ON/ At running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• Above 4.92V</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 2,995.9ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• At starting: -20°C
• At idle or at driving: 80°C</td></tr>
<tr><td>Fuel Limit</td><td>Yes</td></tr>
<tr><td>MIL</td><td>ON</td></tr>
</table>

SPECIFICATION EFF71CCA

Temperature		Resistance between terminals 1 and 3(kΩ)
℃	°F	
-20	-4	15.48
0	32	5.79
20	68	2.45
40	104	1.148
80	176	0.322

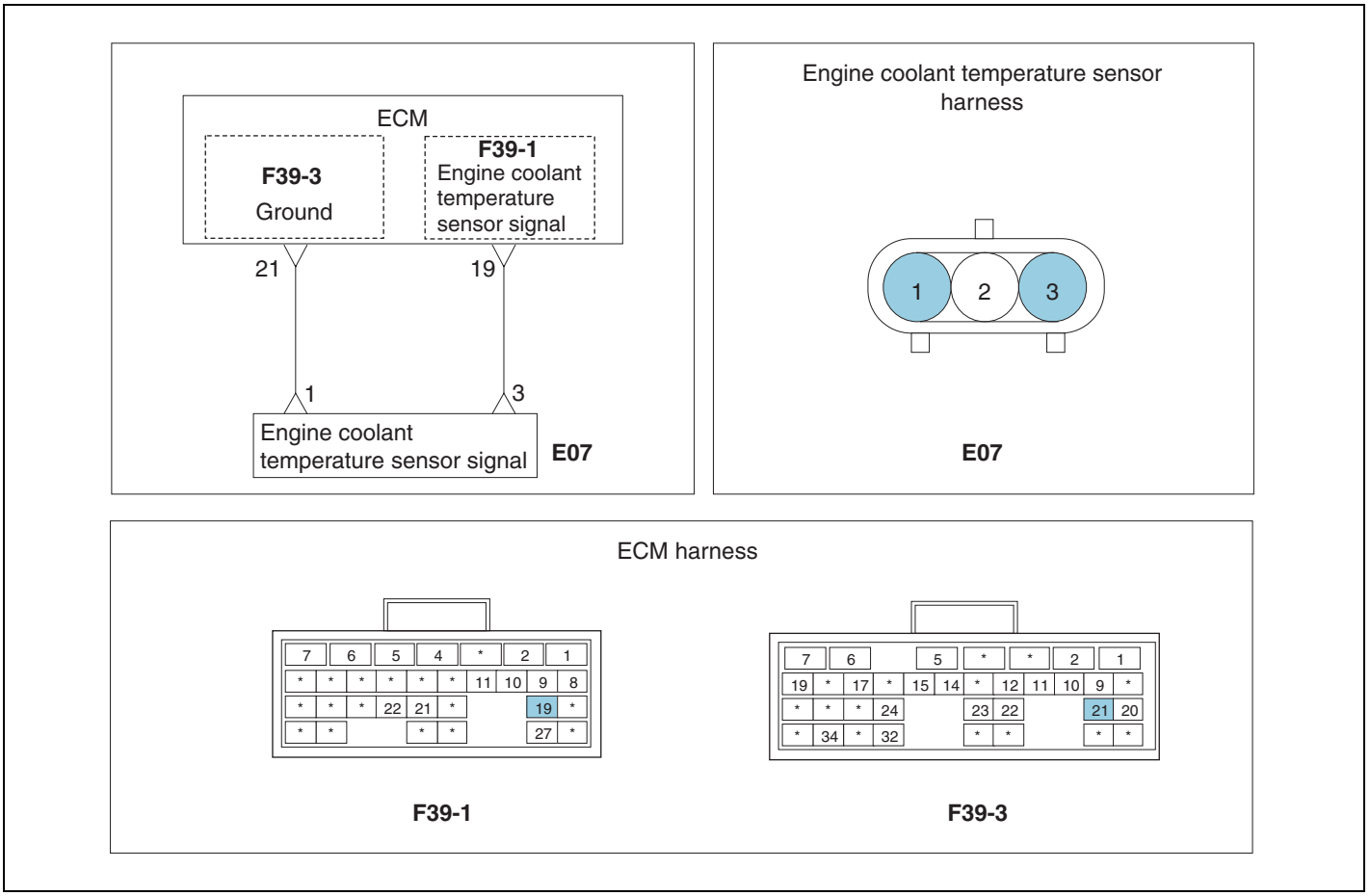


Sensor connector

Terminal 1: Ground
Terminal 3: Sensor output

SUDFL8036L

SCHEMATIC DIAGRAM EDCB557F



SNBFL8017L

MONITOR SCAN TOOL DATA EB4F16BB

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Engine Coolant Temperature Sensor" parameter on the scan tool.

NOTE

Engine coolant temperature sensor data is displayed on the scan tool depending on DTC detecting condition. In case of fail safe, be sure to check that engine coolant temperature at starting is fixed at -20°C and engine coolant temperature at idle and running is fixed at 80°C.

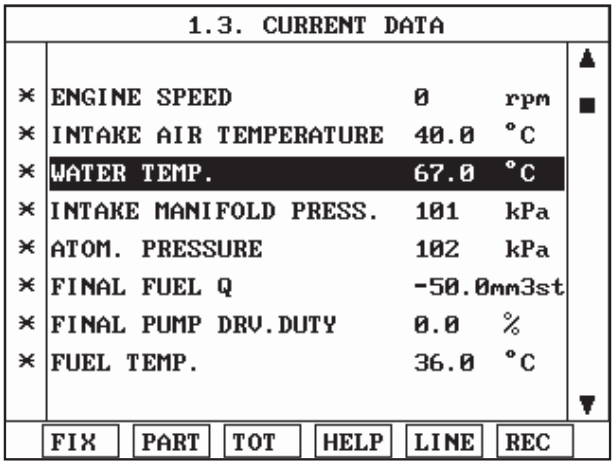


Fig. 1 Engine coolant temperature sensor data at ignition ON

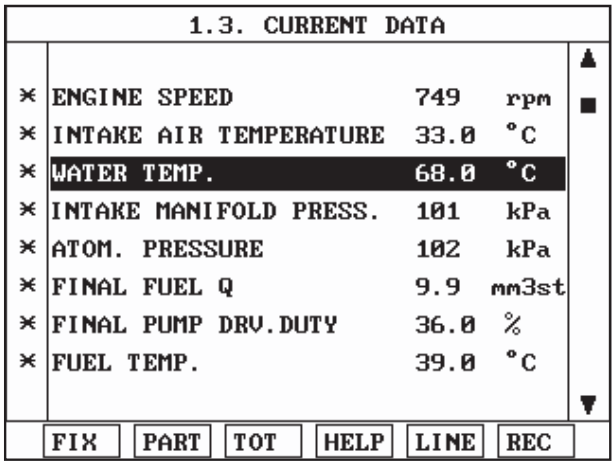


Fig. 2 Engine coolant temperature sensor data at idle

SUDFL8038L

TERMINAL & CONNECTOR INSPECTION E3F5D636

Refer to DTC P0112.

SIGNAL CIRCUIT INSPECTION EF9F421B

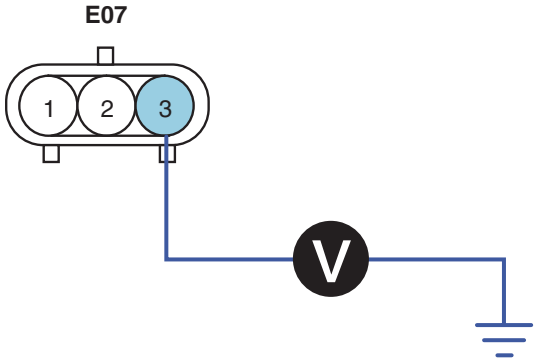
1. Signal Voltage Inspection

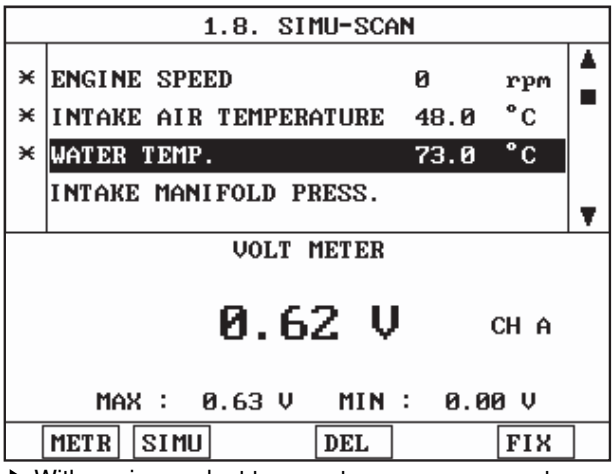
   1) Leave the engine coolant temperature sensor connector(E07) installed.

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 3 of the engine coolant temperature harness connector and chassis ground.

Terminal 1: Sensor ground
Terminal 2: Temperature gauge
Terminal 3: Engine coolant temperature sensor signal





▶ With engine coolant temperature sensor connector installed at IG ON

SUDFL8039L

■ Specification: ECTS signal output approx. 0.68V(With installed)
Note: Output voltage value is different depending on engine coolant temperature.

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

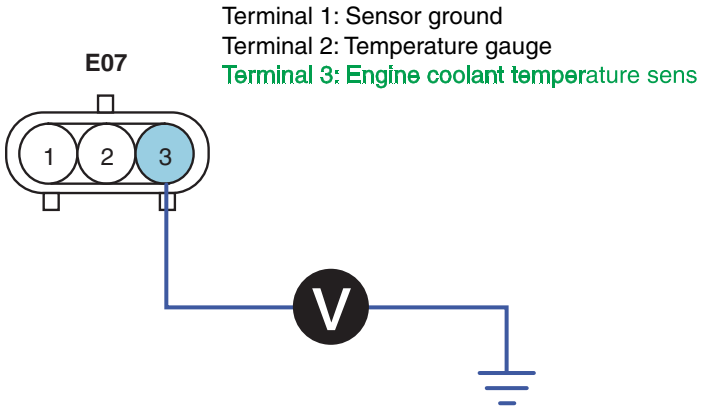
▶ Go to "Signal Short to Power Inspection" procedure.

2. Signal Short to Power Inspection

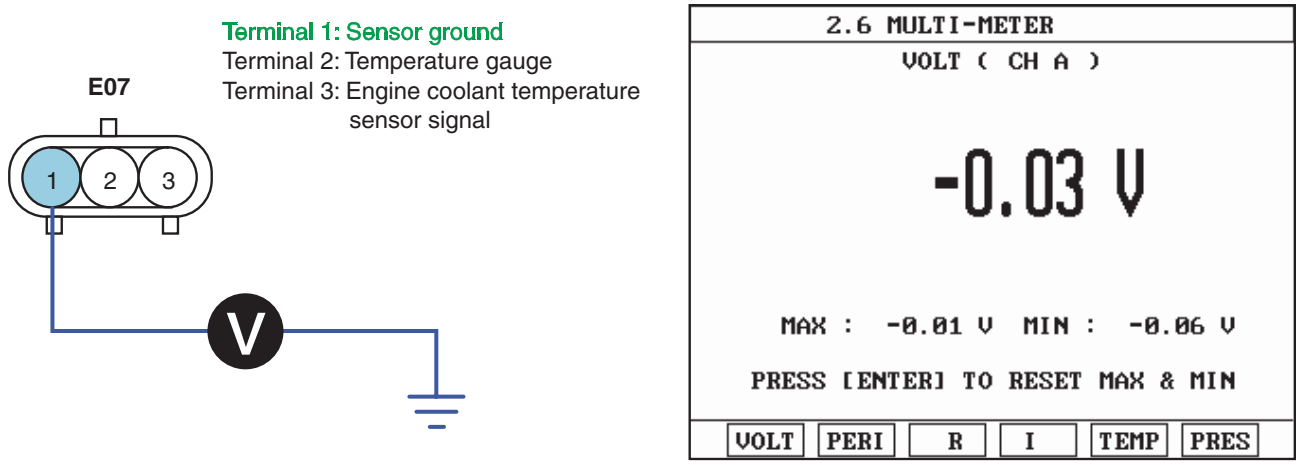
1) Disconnect engine coolant temperature sensor connector(E07) and ECM connector(F39-3, F39-1).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 3 of engine coolant temperature sensor harness connector and chassis ground.



3) Measure voltage drop between terminal 1 of engine coolant temperature sensor harness connector and chassis ground.



SUDFL8042L

■ Specification: Ground Voltage Drop - Within 200mV

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

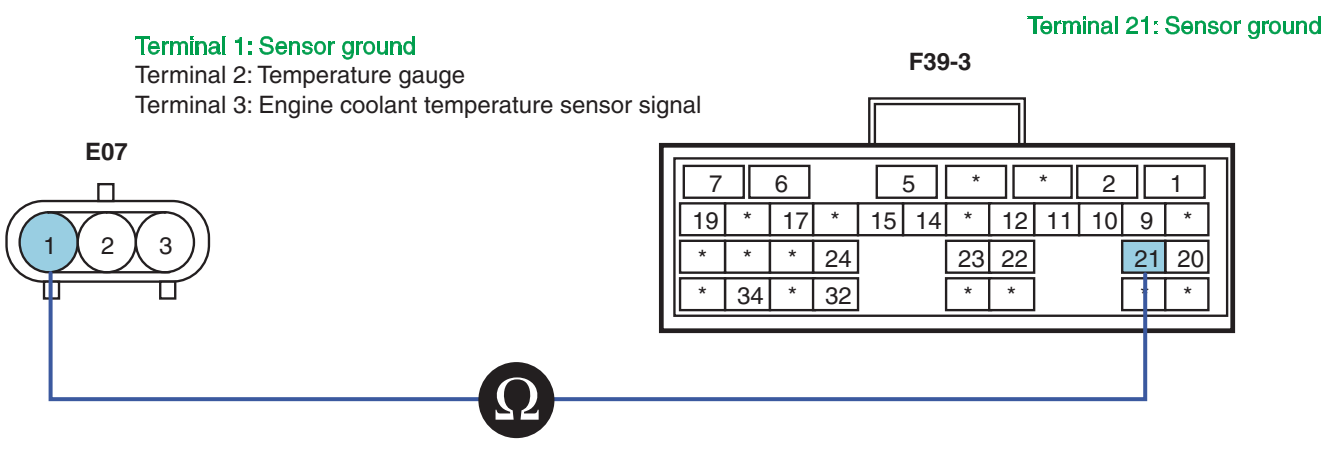
▶ Repair poor connection or excessive resistance of ground circuit and then go to " Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect engine coolant temperature sensor connector(E07) and ECM connector(F39-3).

3) Measure resistance between terminal 1 of engine coolant temperature sensor harness connector and terminal 21 of ECM connector(F39-3).



SNBFL8019L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E315BFB9

1. Engine Coolant Temperature Sensor Resistance Inspection

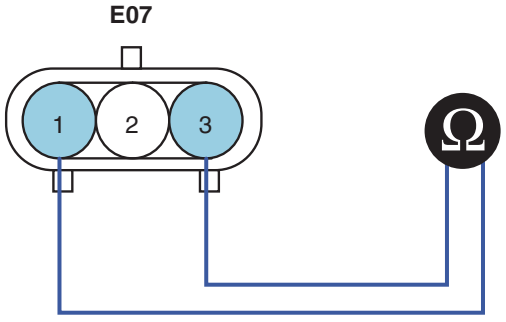
1) Turn the ignition OFF.

2) Disconnect the engine coolant temperature sensor connector(E07).

3) Measure resistance between terminals 1 and 3 of engine coolant temperature sensor.

SPECIFICATION

Temp.(℃)	Resistance between terminals 1 and 3(kΩ)
-20	15.48
0	5.79
20	2.45
40	1.148
80	0.322



Terminal 1: Sensor ground
Terminal 2: Temperature gauge
Terminal 3: Engine coolant temperature sensor signal

SUDFL8044L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the engine coolant temperature sensor and then go to "Verification of Vehicle Repair" procedure.

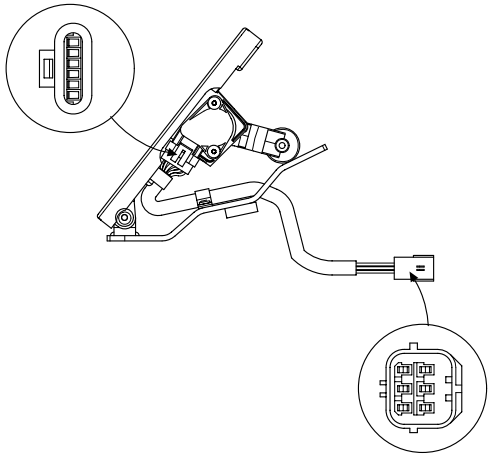
VERIFICATION OF VEHICLE REPAIR EC79D8B3

Refer to DTC P0112.

DTC P0120 PEDAL SENSOR NO.1 NOT OPEN

COMPONENT LOCATION EEBBA6E6

Accelerator pedal position sensor



SUDFL8046L

DESCRIPTION ED72124F

1. GENERAL DESCRIPTION
   Electronic control fuel injection is injected by engine control module(ECM) via factors received from various components.
   The accelerator pedal position sensor detects pedal position and sends signal to ECM. It is composed of two potentiometers(dual variable resistor type). Power supply is provided separately to detect acceleration condition exactly. The voltage of accelerator pedal position sensor is generated by potentiometer and the position of accelerator pedal is calculated by using characteristic curve programmed beforehand.

2. DTC DESCRIPTION
   If the accelerator pedal sensor indicates idle state when the vehicle is being accelerated(idle switch OFF) and the accelerator pedal sensor "1" outputs 0~5V and the accelerator pedal sensor "2" outputs 5.1V or more for more than 1048.6ms, the ECM judges this as a fault and DTC is set. The possible causes are defective sensor, wiring problem etc.

DTC DETECTING CONDITION E69B5F36

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Wiring problem • Defective sensor
Enable Conditions	• IG ON/ Running			
Threshold Value	• Idle switch OFF, 0V≤ accelerator pedal position sensor "1" output voltage≤ 5.0V, Accelerator pedal position sensor "2" output voltage≥ 5.1V			
Diagnosis Time	• 1,048.6ms or more			
Fail Safe	Fuel Cut	No		
	Fuel Limit	No		
	MIL	OFF		

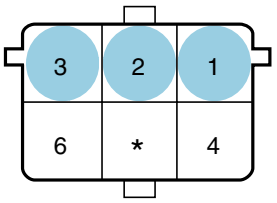
SPECIFICATION E6028A66

Terminals 1-2(Not operating)	Terminals 1-2(Operating)	Terminals 1-3(Not operating)	Terminals 1-3(Operating)
Approx. 2.67kΩ	Approx. 1.06kΩ	Approx. 2.64kΩ	Approx. 2.64kΩ

Terminals 2-3(Not operating)	Terminals 2-3(Operating)
Approx. 0.732kΩ	Approx. 2.59kΩ

Accelerator pedal position sensor track "1", "2"	Specification	
	Idle state((0%)	Wide open(100%)
Output voltage	0.65V	3.85V

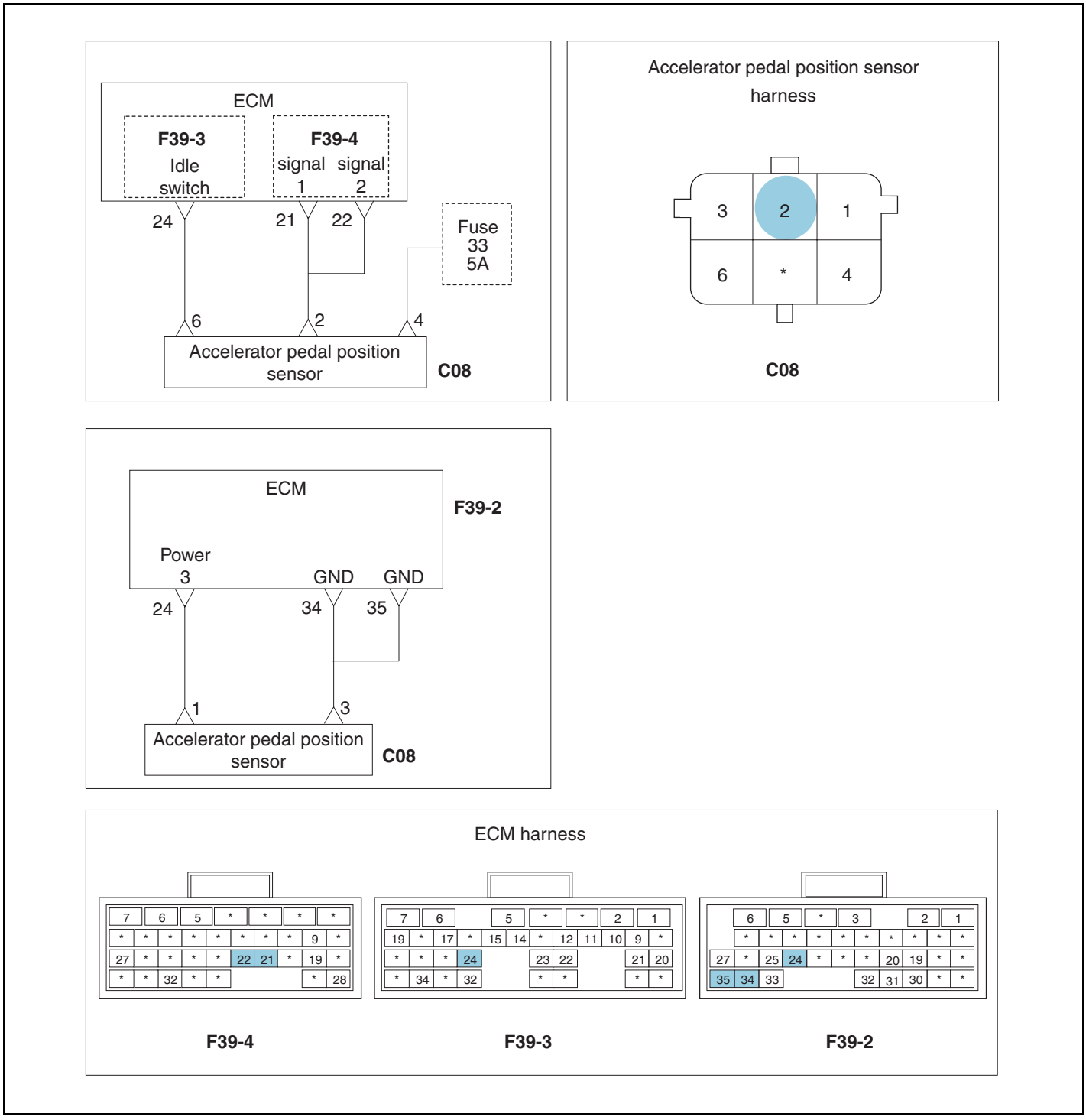
Terminal 2: Sensor "1", "2"



Sensor connector

SUDFL8047L

SCHEMATIC DIAGRAM E6814194



SNBFL8020L

MONITOR SCAN TOOL DATA EB19EAAD

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Accelerator Pedal Position Sensor" parameter on the scan tool.

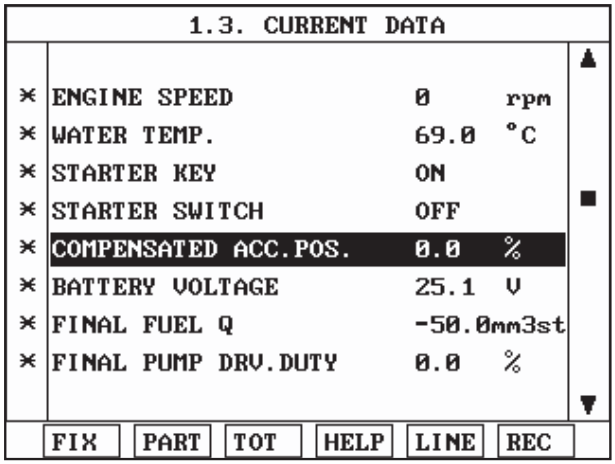


Fig. 1 Accelerator pedal position sensor data at ignition ON

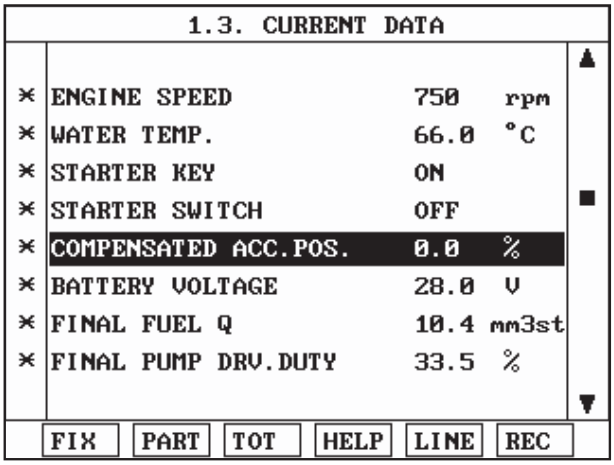


Fig. 2 Accelerator pedal position sensor data at idle

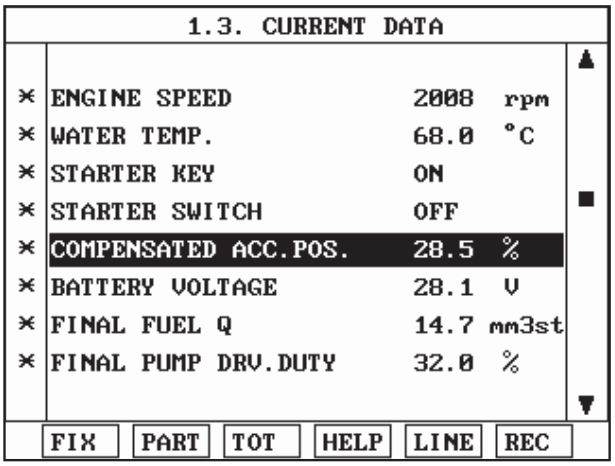


Fig. 3 Accelerator pedal position sensor data at 2,000rpm

SUDFL8049L

TERMINAL & CONNECTOR INSPECTION E0E508AF

Refer to DTC P0112.

SIGNAL INSPECTION E1E6D21C

1. Signal Voltage Inspection

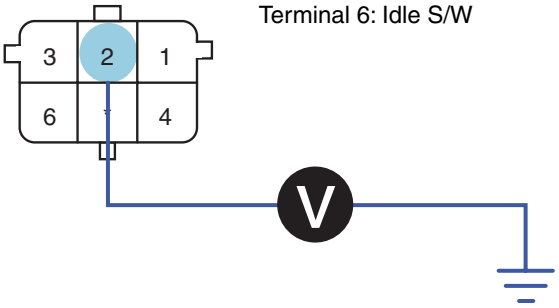
   1) Leave the accelerator pedal sensor connector(C08) and ECM(F39-4) installed.

   2) Turn the ignition ON. The engine stops.

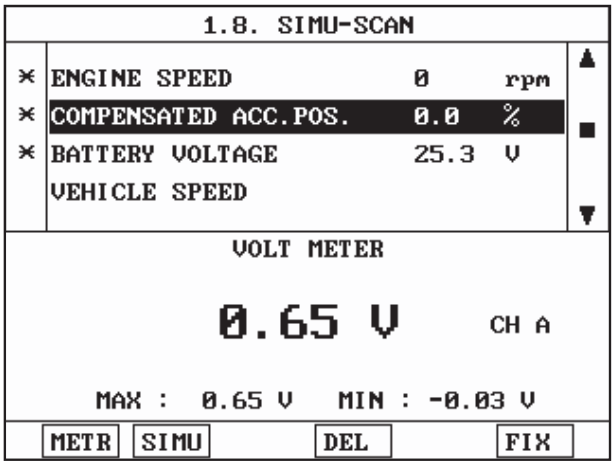
   3) Measure voltage between terminal 2 of accelerator pedal position sensor harness connector and chassis ground.

[Sensor side]

C08



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W



▶ With accelerator pedal position sensor connector installed (At IG ON)

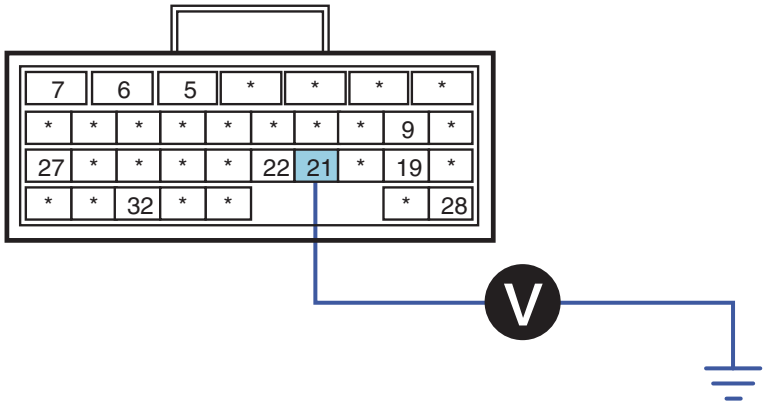
SNBFL8021L

4) Measure voltage between terminal 21 of ECM connector and chassis ground.

[ECM]

F39-4

Terminal 21: SNR1



SNBFL8022L

■ Specification: Accelerator pedal position signal power approx.0.13V(When not operating)

5) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

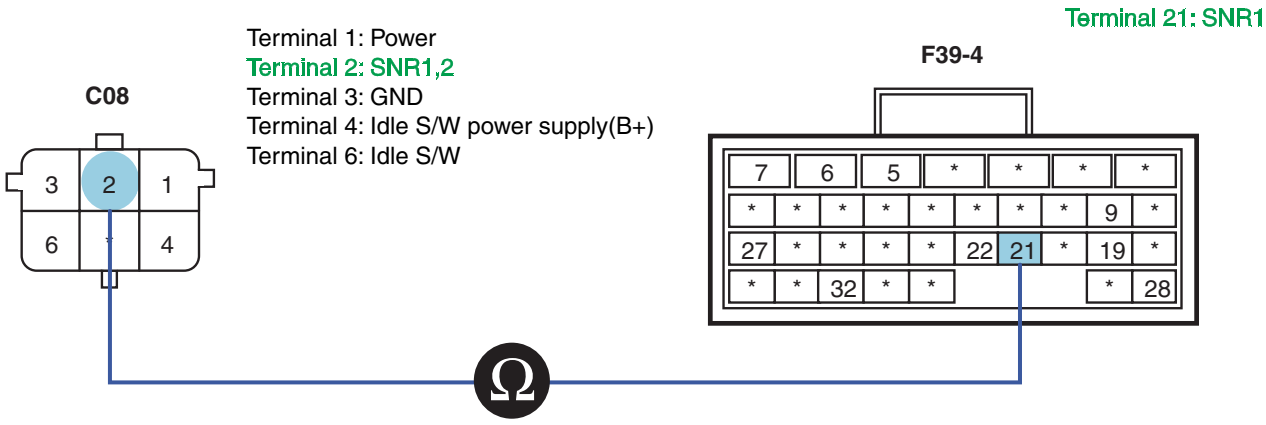
▶ Go to "Signal Open Inspection" procedure.

2. Signal Open Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 2 of accelerator pedal position sensor harness connector(C08) and terminal 21 of ECM connector(F39-4).



SNBFL8023L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Power Inspection" procedure.

NO

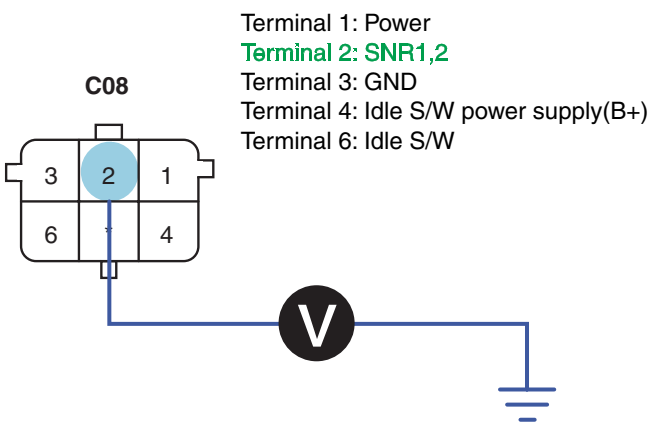
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

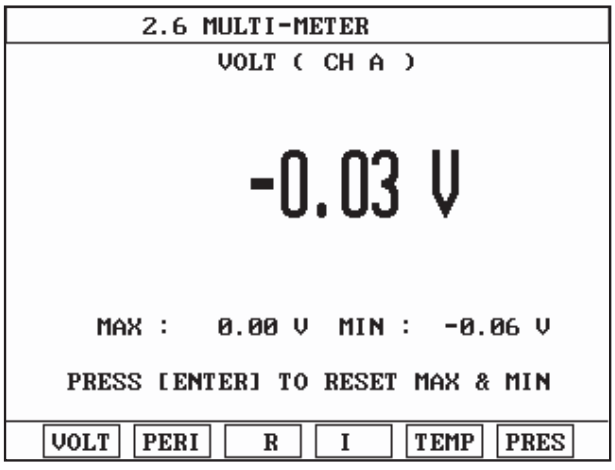
3. Signal Short to Power Inspection

1) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 2 of accelerator pedal position sensor harness connector(C08) and chassis ground.

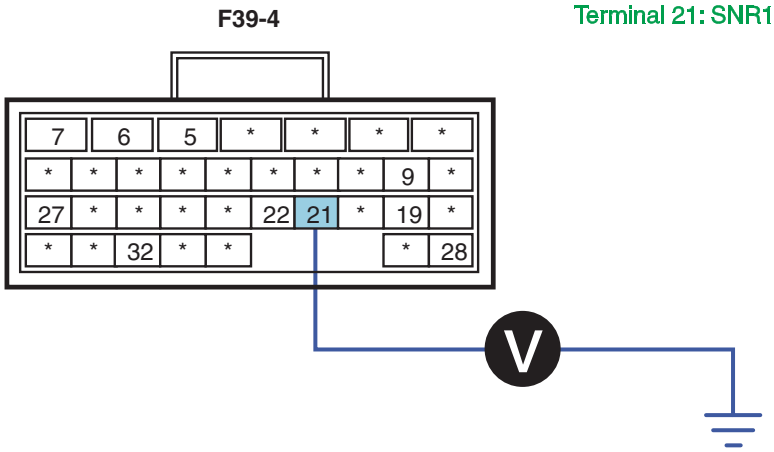




SNBFL8024L

4) Measure voltage between terminal 21 of ECM connector and chassis ground.

[ECM]



SNBFL8022L

■ Specification: Below 0~0.1V

5) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Ground Inspection" procedure.

NO

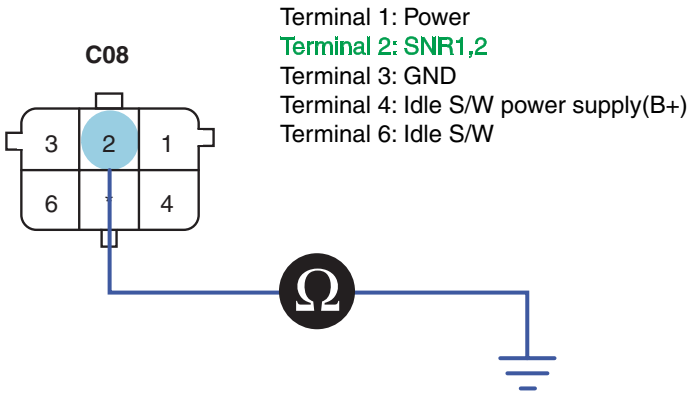
▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

4. Signal Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

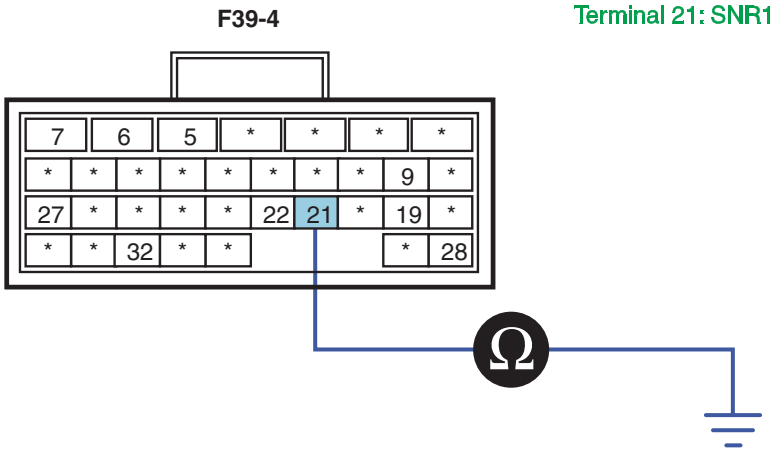
3) Measure resistance between terminal 2 of accelerator pedal position sensor harness connector(C08) and chassis ground.



SNBFL8025L

4) Measure resistance between terminal 21 of ECM connector and chassis ground.

[ECM]



SNBFL8026L

■ Specification: Infinite

5) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

POWER SUPPLY INSPECTION E23D78C5

1. Power Supply Voltage Inspection

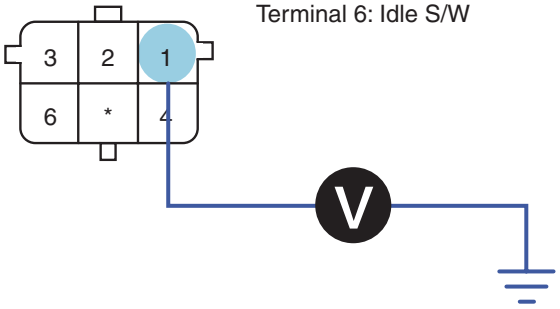
1) Leave accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2) installed.

2) Turn the ignition ON. The engine stops.

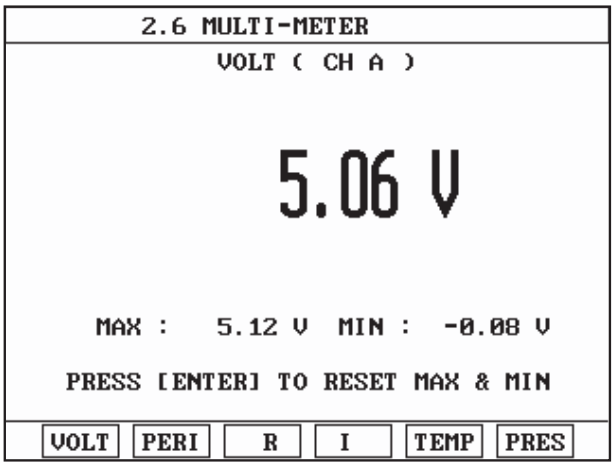
3) Measure voltage between terminal 1 of accelerator pedal position sensor harness connector(C08) and chassis ground.

[Sensor side]

C08



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W



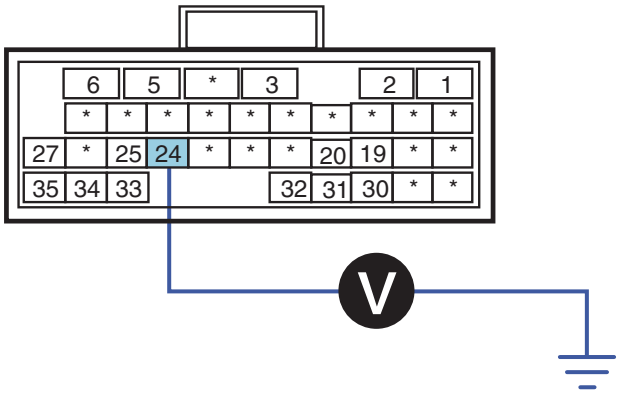
▶ With accelerator pedal position sensor connector disconnected/connected(At IG ON)

SNBFL8027L

4) Measure voltage between terminals 24 of ECM connector and chassis ground.

[ECM]

F39-2



Terminal 24: Power

SNBFL8028L

■ Specification: Accelerator pedal position sensor signal power approx. 5.21V

5) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn the ignition OFF.

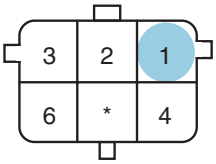
2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 1 of accelerator pedal position sensor harness connector(C08) and terminals 24 of ECM connector(F39-2).

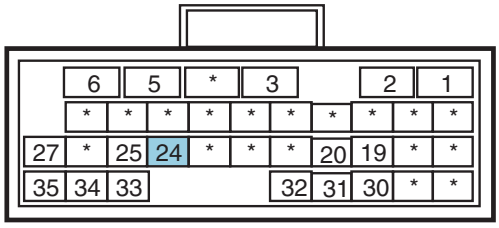
Term

Terminal 24: Power

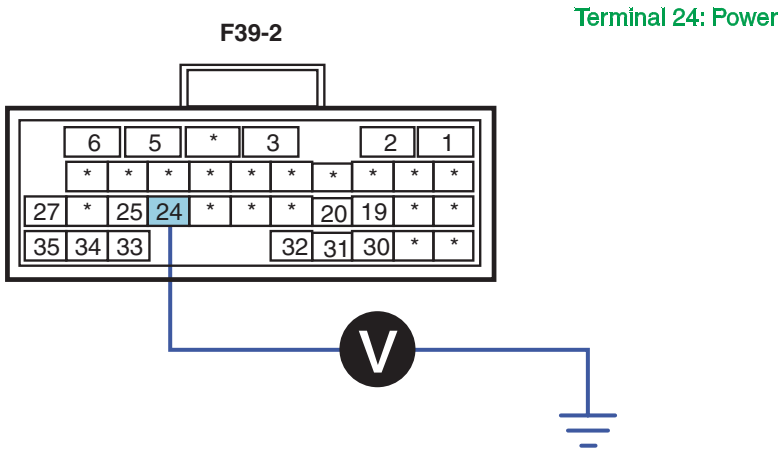
C08



F39-2



[ECM]



SNBFL8028L

■ Specification: Below 0~0.1V

5) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

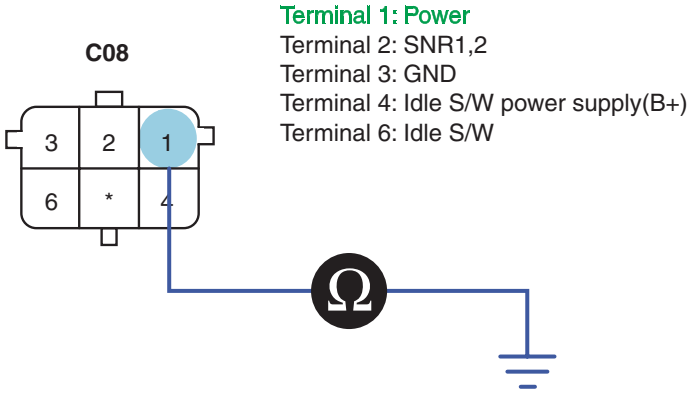
▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

4. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

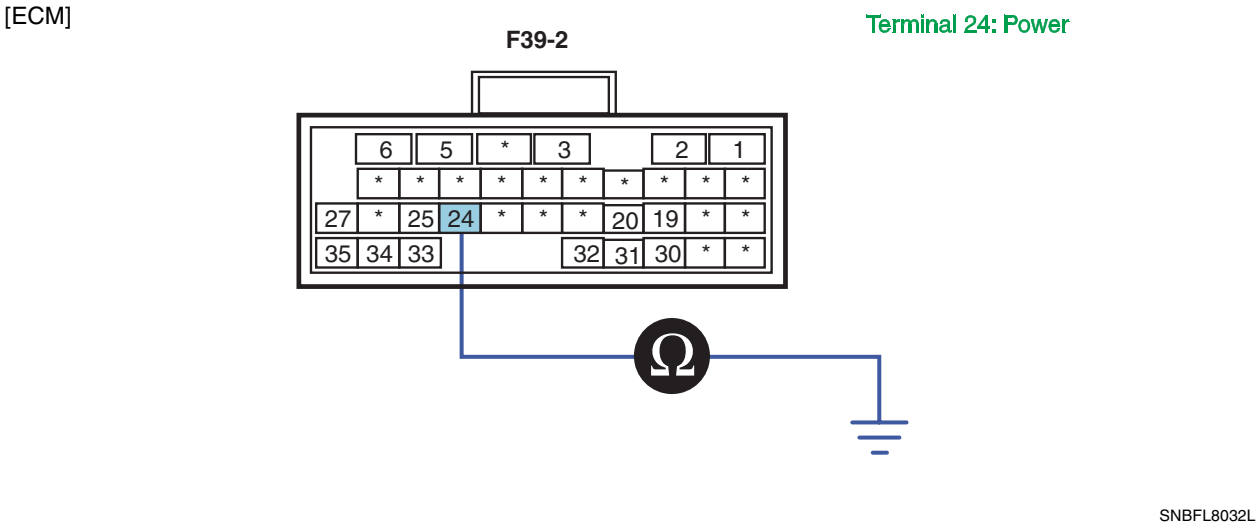
2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure voltage between terminal 1 of accelerator pedal position sensor harness connector and chassis ground.



SNBFL8031L

4) Measure resistance between terminals 24 of ECM connector and chassis ground.



■ Specification: Infinite

5) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

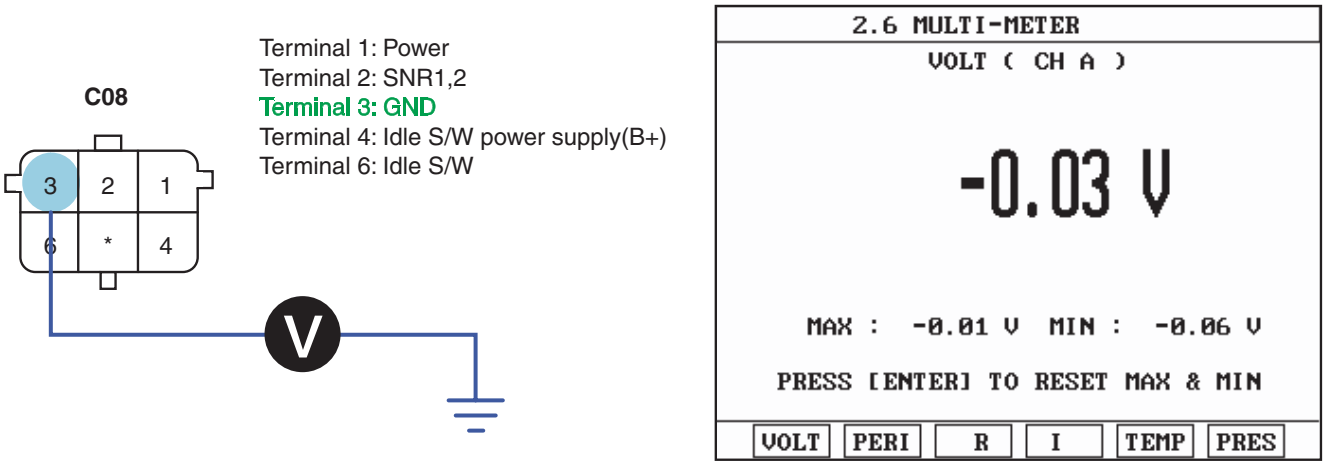
GROUND CIRCUIT INSPECTION E7C9FCC0

1. Ground Voltage Drop Inspection

   1) Disconnect accelerator pedal position sensor connector(C08).

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage drop between terminal 3 of accelerator pedal position sensor harness connector and chassis ground.



SNBFL8033L

■ Specification: Ground Voltage Drop - Within 200mV

4) Is the ground voltage drop measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

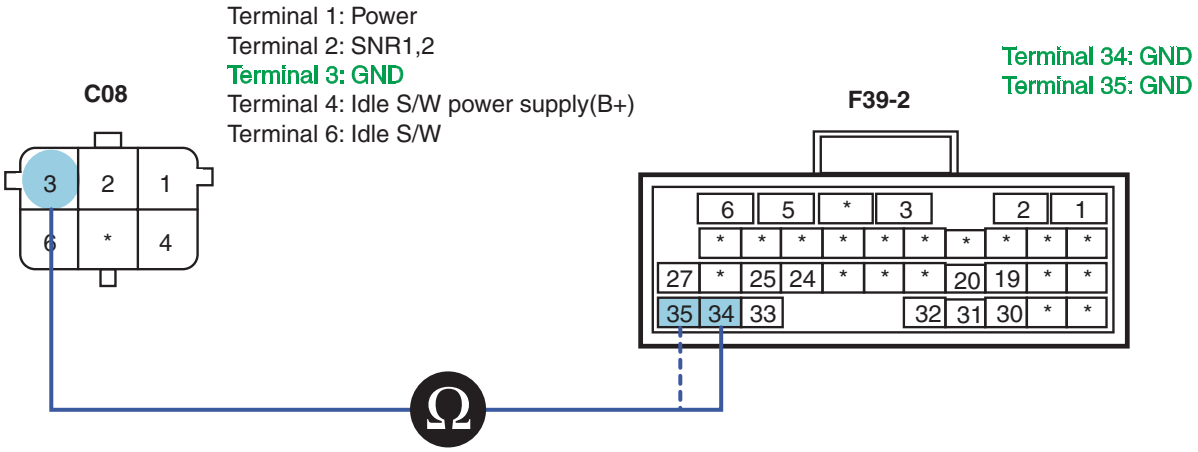
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 3 of accelerator pedal position sensor harness connector and terminals 34,35 of ECM connector(F39-2).



SNBFL8034L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

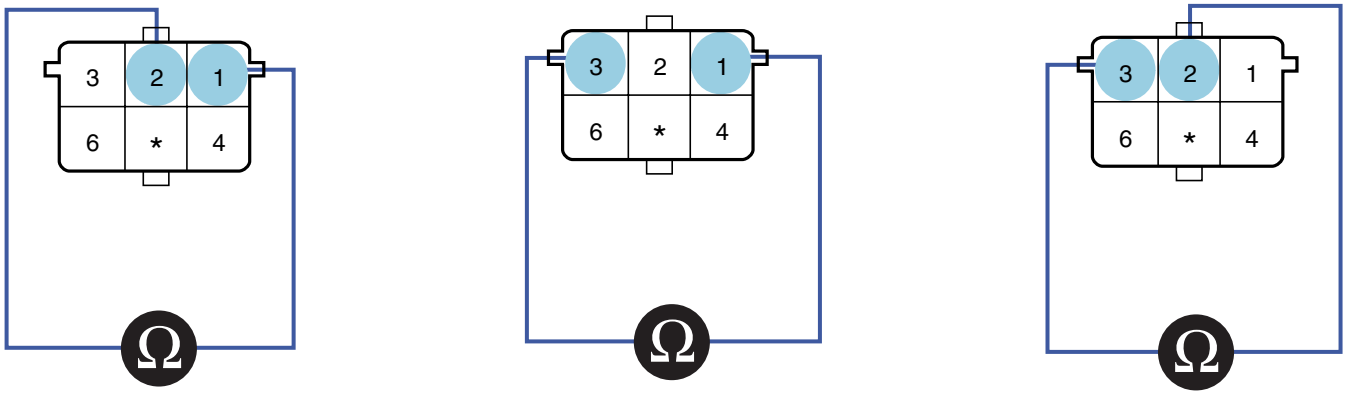
COMPONENT INSPECTION ED360A8F

1. Accelerator Pedal Position Sensor Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08).

3) Measure resistance between terminals 1-2, 2-3, 1-3 of accelerator pedal position sensor connector.



Resistance between terminals of accelerator pedal position sensor

Terminals 1-2(Not operating)	Terminals 1-2(Operating)	Terminals 1-3(Not operating)	Terminals 1-3(Operating)
Approx. 2.67kΩ	Approx. 1.06kΩ	Approx. 2.64kΩ	Approx. 2.64kΩ

Terminals 2-3(Not operating)	Terminals 2-3(Operating)
Approx. 0.732kΩ	Approx. 2.59kΩ

SUDFL8064L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace accelerator pedal position sensor and then go to "Verification of Vehicle Repair" procedure.

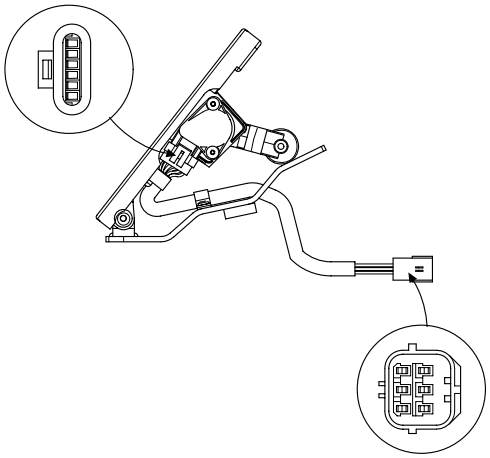
VERIFICATION OF VEHICLE REPAIR E9E855A7

Refer to DTC P0112.

DTC P0121 PEDAL SENSOR NO.1 NOT CLOSE

COMPONENT LOCATION E701A1F6

Accelerator pedal position sensor



SUDFL8046L

DESCRIPTION E1208F2C

1. GENERAL DESCRIPTION
   Electronic control fuel injection is injected by engine control module(ECM) via factors received from various components.
   The accelerator pedal position sensor detects pedal position and sends signal to ECM. It is composed of two potentiometers(dual variable resistor type). Power supply is provided separately to detect acceleration condition exactly. The voltage of accelerator pedal position sensor is generated by potentiometer and the position of accelerator pedal is calculated by using characteristic curve programmed beforehand.

2. DTC DESCRIPTION
   If the accelerator pedal sensor indicates idle state when the vehicle is being accelerated(idle switch OFF) and the accelerator pedal sensor "1" outputs 5.1V or more and the accelerator pedal sensor "2" outputs 0~5.1V for more than 1048.6ms, the ECM judges this as a fault and DTC is set. The possible causes are defective sensor, wiring problem etc.

DTC DETECTING CONDITION E42CDB78

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Wiring problem • Defective sensor
Enable Conditions	• IG ON/ Running			
Threshold Value	• Idle switch ON, Accelerator pedal position sensor "1" output voltage≥ 5.1V, 0V≤ accelerator pedal position sensor "2" output voltage≤ 5.0V,			
Diagnosis Time	• 1,048.6ms or more			
Fail Safe	Fuel Cut	No		
	Fuel Limit	No		
	MIL	OFF		

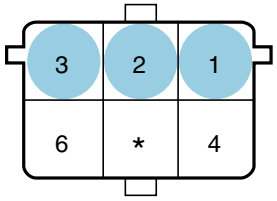
SPECIFICATION EE81F932

Terminals 1-2(Not operating)	Terminals 1-2(Operating)	Terminals 1-3(Not operating)	Terminals 1-3(Operating)
Approx. 2.67kΩ	Approx. 1.06kΩ	Approx. 2.64kΩ	Approx. 2.64kΩ

Terminals 2-3(Not operating)	Terminals 2-3(Operating)
Approx. 0.732kΩ	Approx. 2.59kΩ

Accelerator pedal position sensor track "1", "2"	Specification	
	Idle state((0%)	Wide open(100%)
Output voltage	0.65V	3.85V

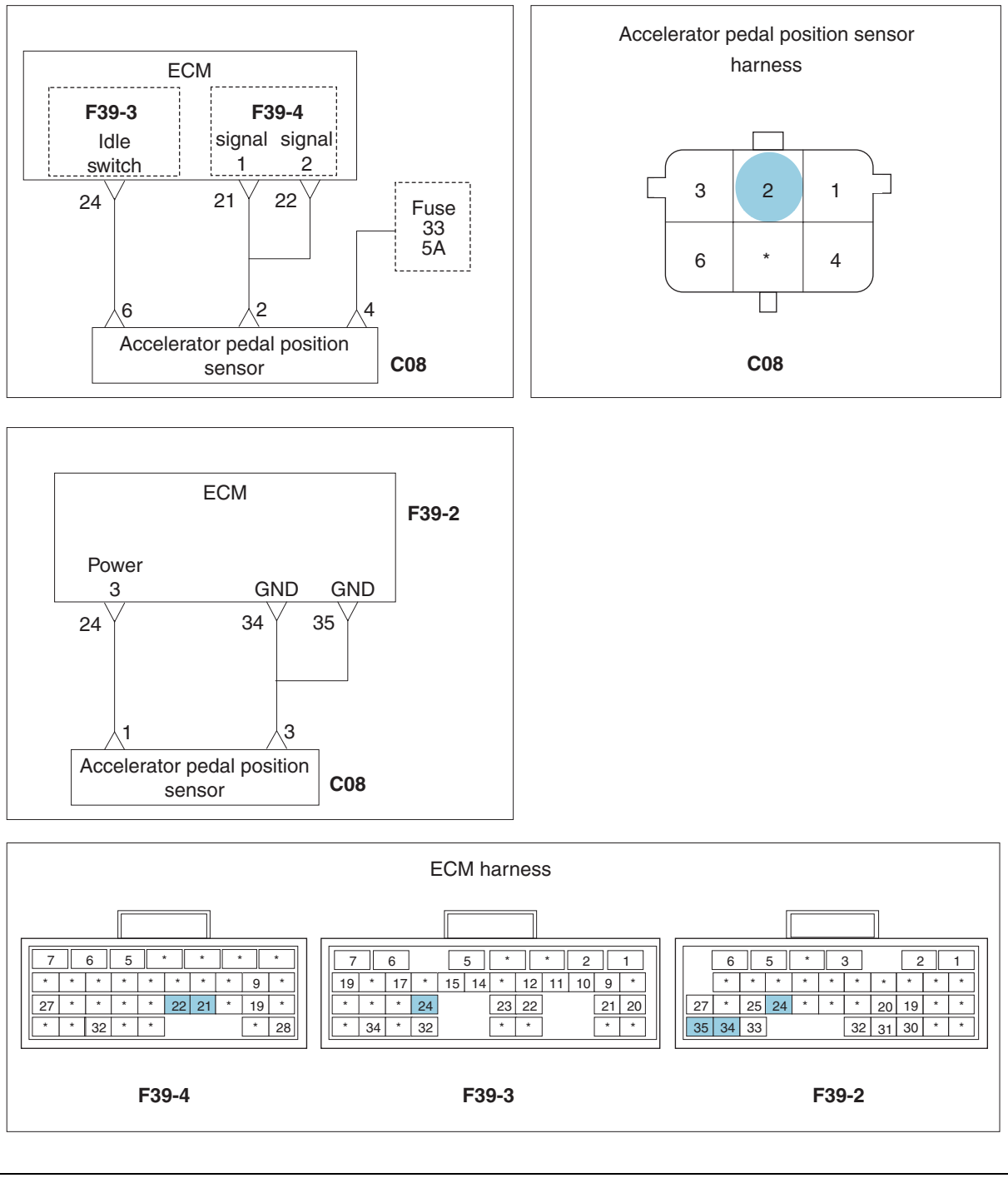
Terminal 2: Sensor "1", "2"



Sensor connector

SUDFL8047L

SCHEMATIC DIAGRAM E073C910



SNBFL8020L

MONITOR SCAN TOOL DATA ECAB0B2C

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Accelerator Pedal Position Sensor" parameter on the scan tool.

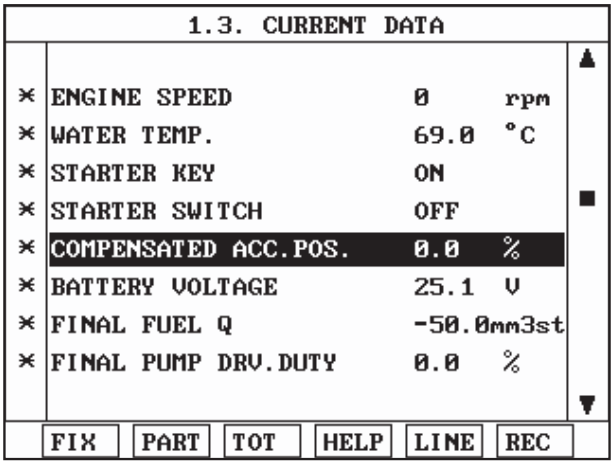


Fig. 1 Accelerator pedal position sensor data at ignition ON

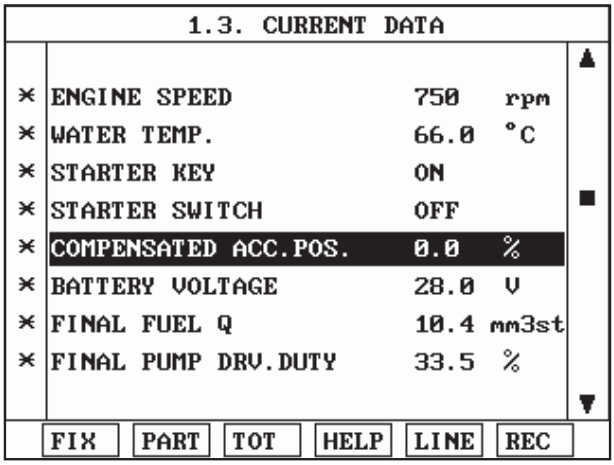


Fig. 2 Accelerator pedal position sensor data at idle

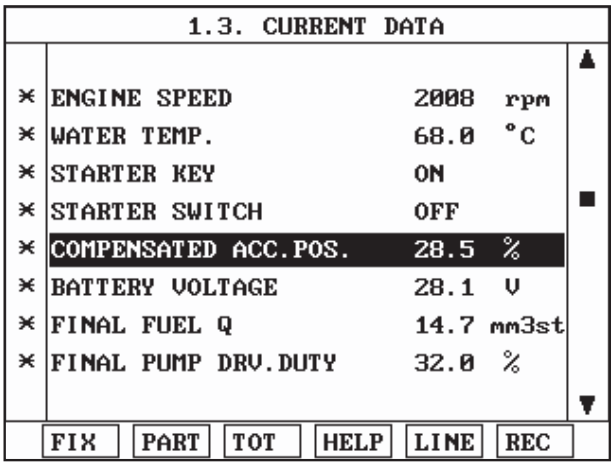


Fig. 3 Accelerator pedal position sensor data at 2,000rpm

SUDFL8049L

TERMINAL & CONNECTOR INSPECTION E27C3FEA

Refer to DTC P0112.

SIGNAL INSPECTION ECFE0AA6

1. Signal Voltage Inspection

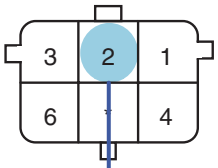
   1) Leave the accelerator pedal sensor connector(C08) and ECM(F39-4) installed.

   2) Turn the ignition ON. The engine stops.

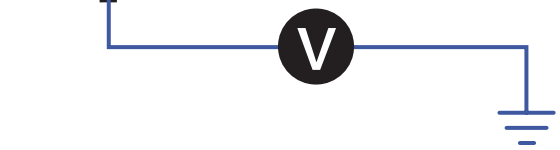
   3) Measure voltage between terminal 2 of accelerator pedal position sensor harness connector and chassis ground.

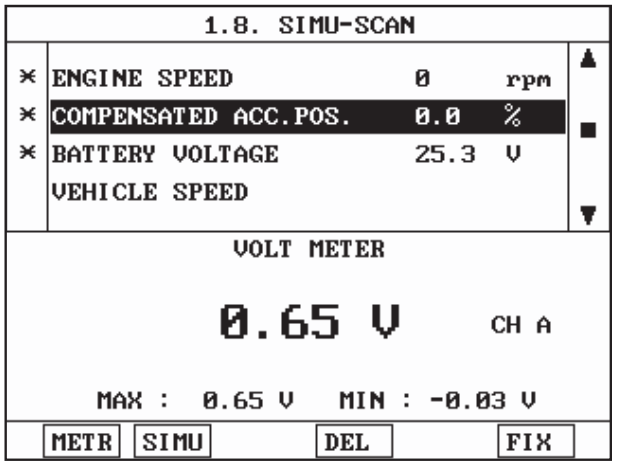
[Sensor side]

C08



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W





▶ With accelerator pedal position sensor connector installed (At IG ON)

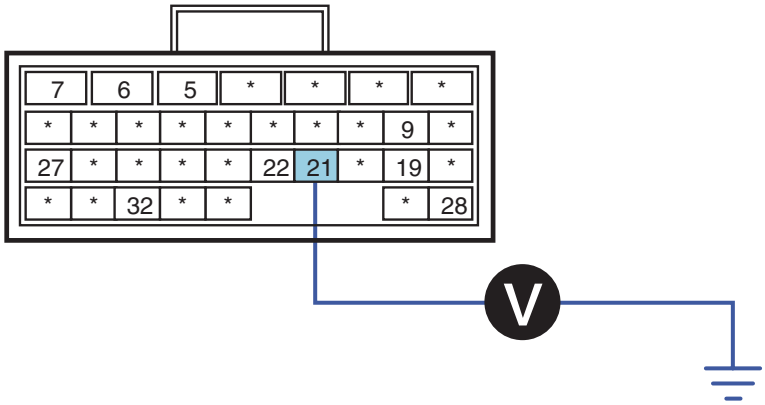
SNBFL8021L

4) Measure voltage between terminal 21 of ECM connector and chassis ground.

[ECM]

F39-4

Terminal 21: SNR1



SNBFL8022L

■ Specification: Accelerator pedal position signal power approx.0.13V(When not operating)

5) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

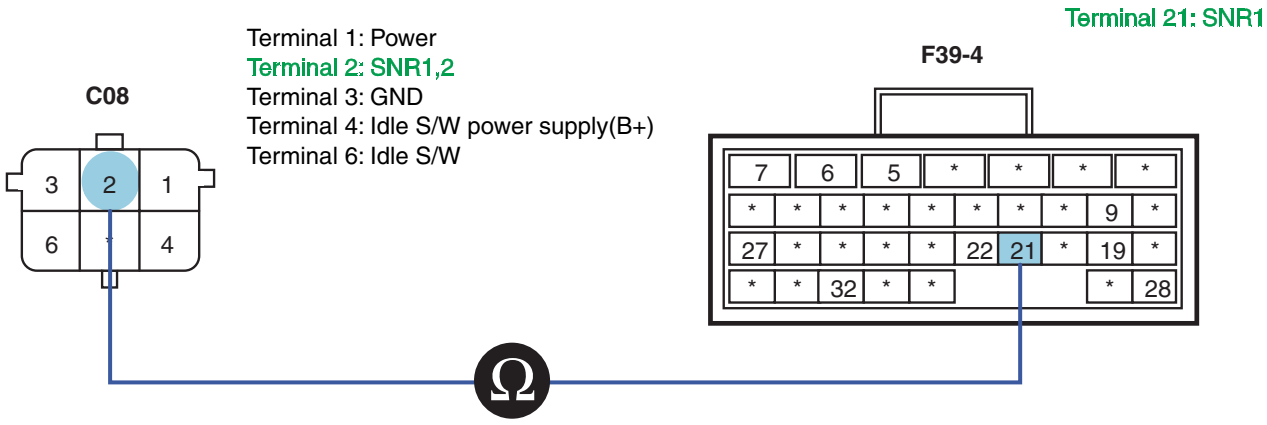
▶ Go to "Signal Open Inspection" procedure.

2. Signal Open Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 2 of accelerator pedal position sensor harness connector(C08) and terminal 21 of ECM connector(F39-4).



SNBFL8023L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Power Inspection" procedure.

NO

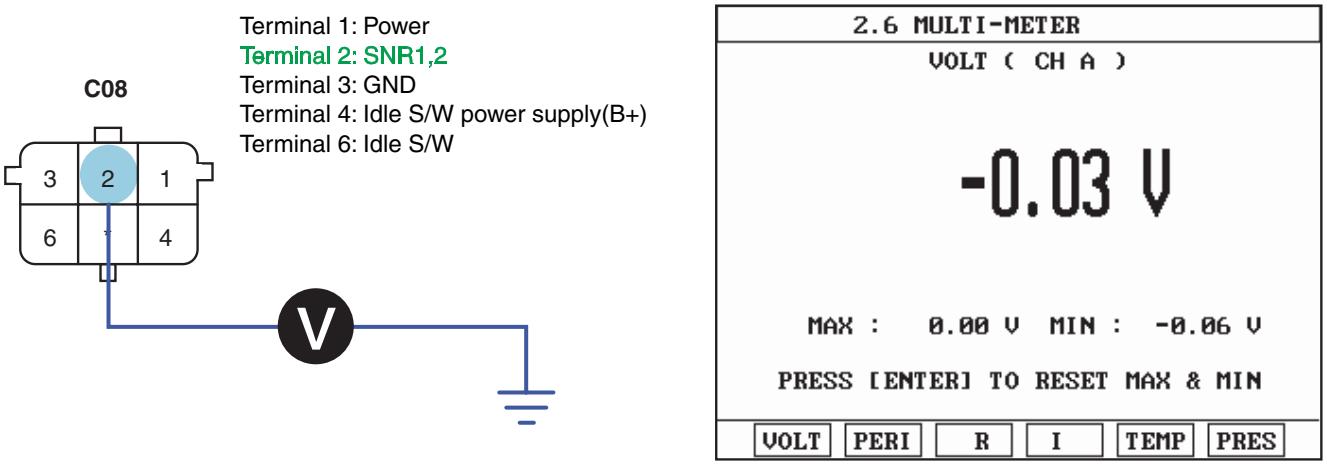
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Signal Short to Power Inspection

1) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

2) Turn the ignition ON. The engine stops.

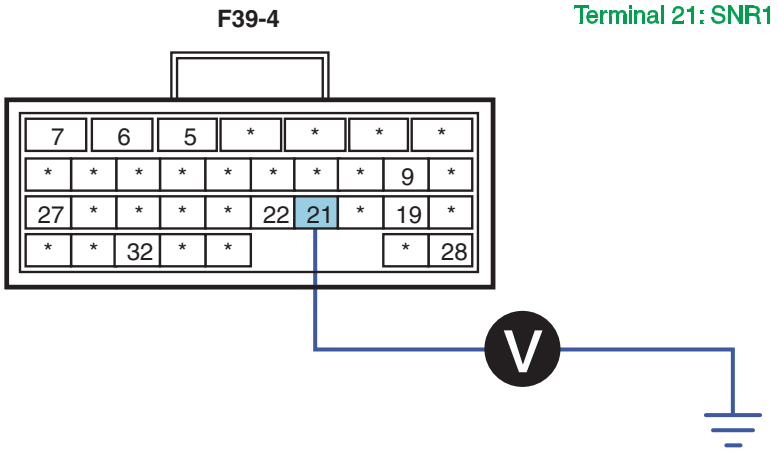
3) Measure voltage between terminal 2 of accelerator pedal position sensor harness connector(C08) and chassis ground.



SNBFL8024L

4) Measure voltage between terminal 21 of ECM connector and chassis ground.

[ECM]



SNBFL8022L

■ Specification: Below 0~0.1V

5) Is the voltage measured within specification?

YES

▶ Go to "Signal Short to Ground Inspection" procedure.

NO

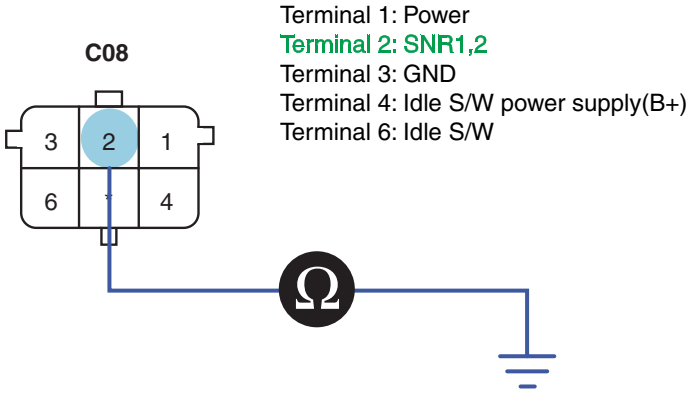
▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

4. Signal Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

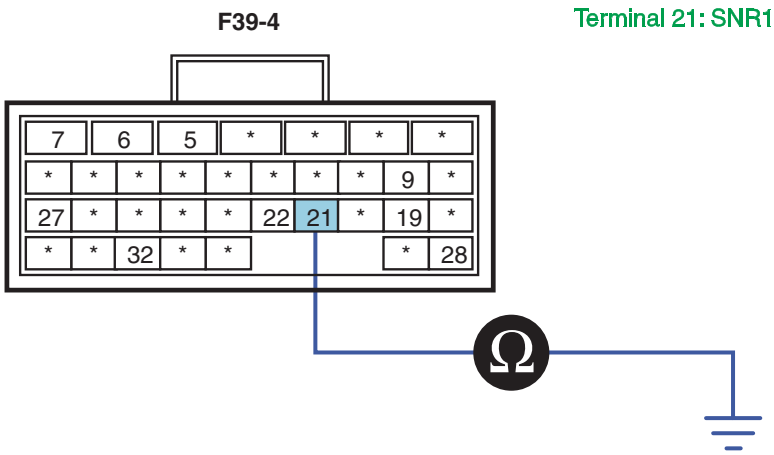
3) Measure resistance between terminal 2 of accelerator pedal position sensor harness connector(C08) and chassis ground.



SNBFL8025L

4) Measure resistance between terminal 21 of ECM connector and chassis ground.

[ECM]



SNBFL8026L

■ Specification: Infinite

5) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

POWER SUPPLY INSPECTION E47A51D3

1. Power Supply Voltage Inspection

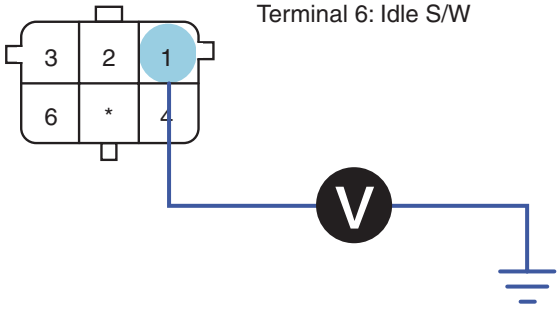
1) Leave accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2) installed.

2) Turn the ignition ON. The engine stops.

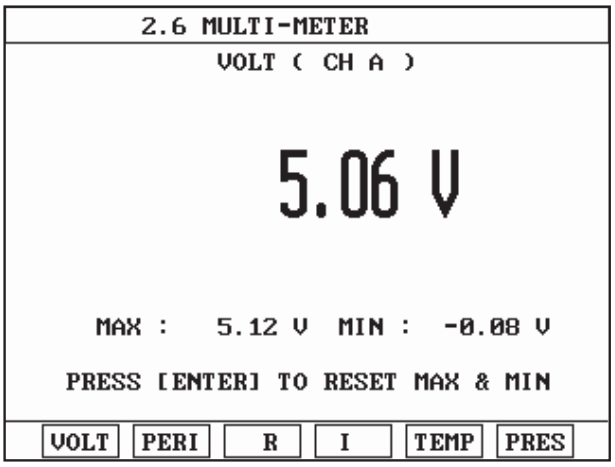
3) Measure voltage between terminal 1 of accelerator pedal position sensor harness connector(C08) and chassis ground.

[Sensor side]

C08



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W



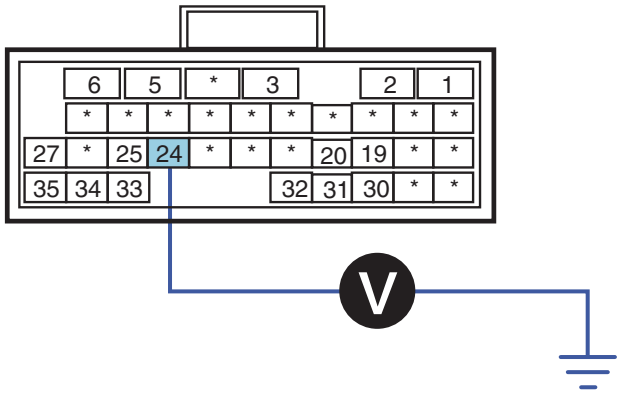
▶ With accelerator pedal position sensor connector disconnected/connected(At IG ON)

SNBFL8027L

4) Measure voltage between terminals 24 of ECM connector and chassis ground.

[ECM]

F39-2



Terminal 24: Power

SNBFL8028L

■ Specification: Accelerator pedal position sensor signal power approx. 5.21V

5) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

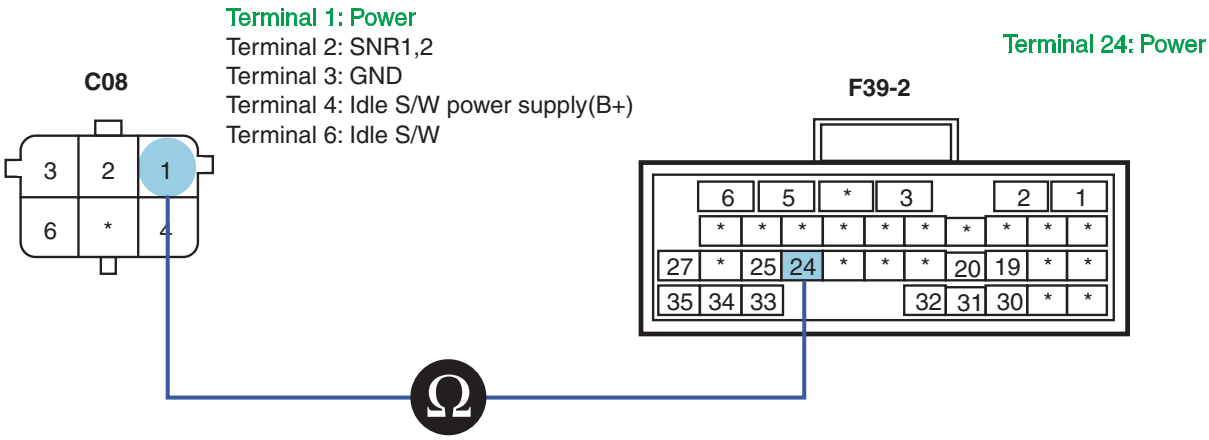
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 1 of accelerator pedal position sensor harness connector(C08) and terminals 24 of ECM connector(F39-2).



SNBFL8029L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

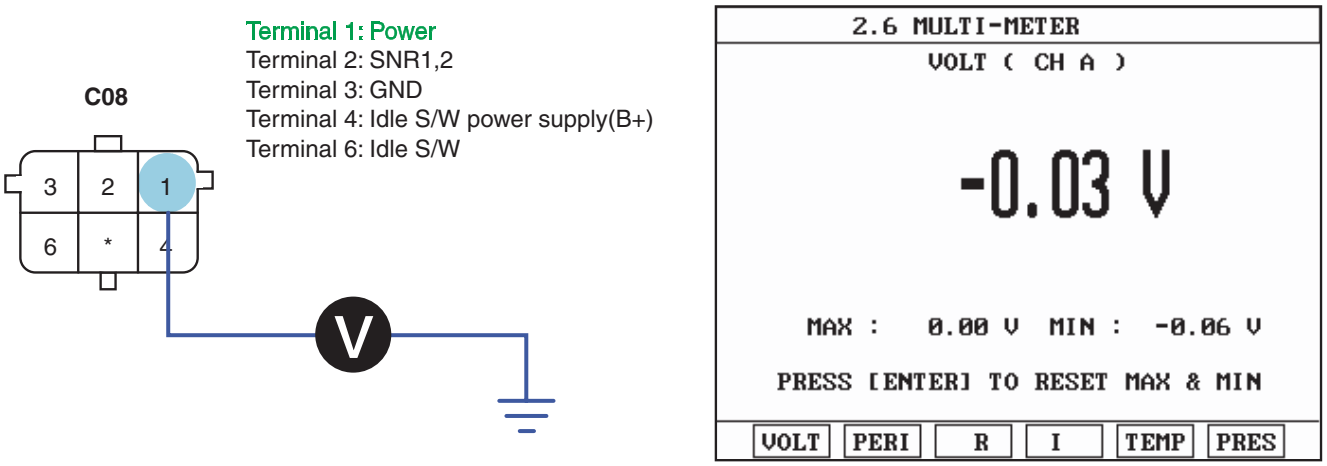
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Power Supply Short to Power Inspection

1) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

2) Turn the ignition ON. The engine stops.

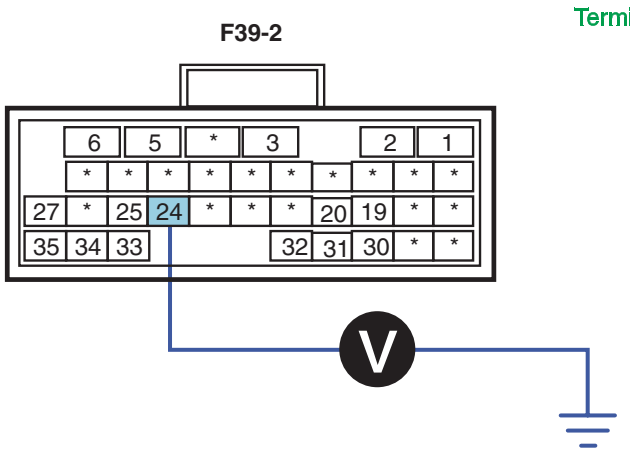
3) Measure voltage between terminal 1 of accelerator pedal position sensor harness connector and chassis ground.



SNBFL8030L

4) Measure voltage between terminals 24 of ECM connector and chassis ground.

[ECM]



SNBFL8028L

■ Specification: Below 0~0.1V

5) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

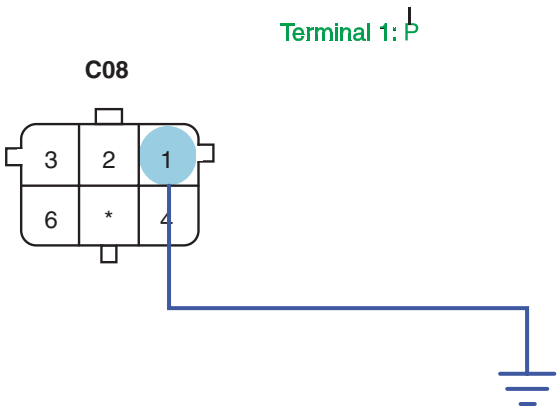
▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

4. Power Supply Short to Ground Inspection

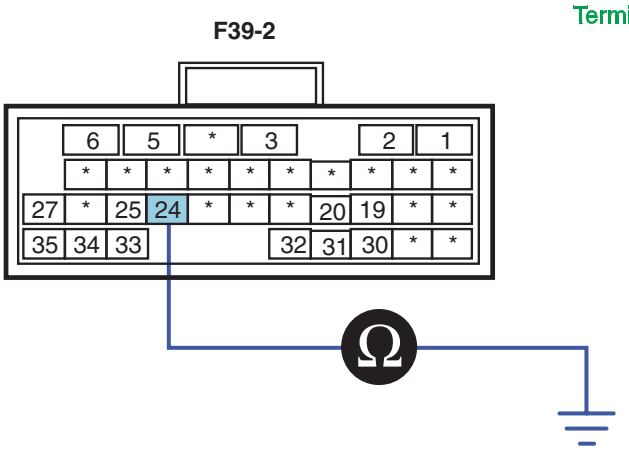
1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 1 of accelerator pedal position sensor harness connector and chassis ground.



[ECM]



SNBFL8032L

■ Specification: Infinite

5) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

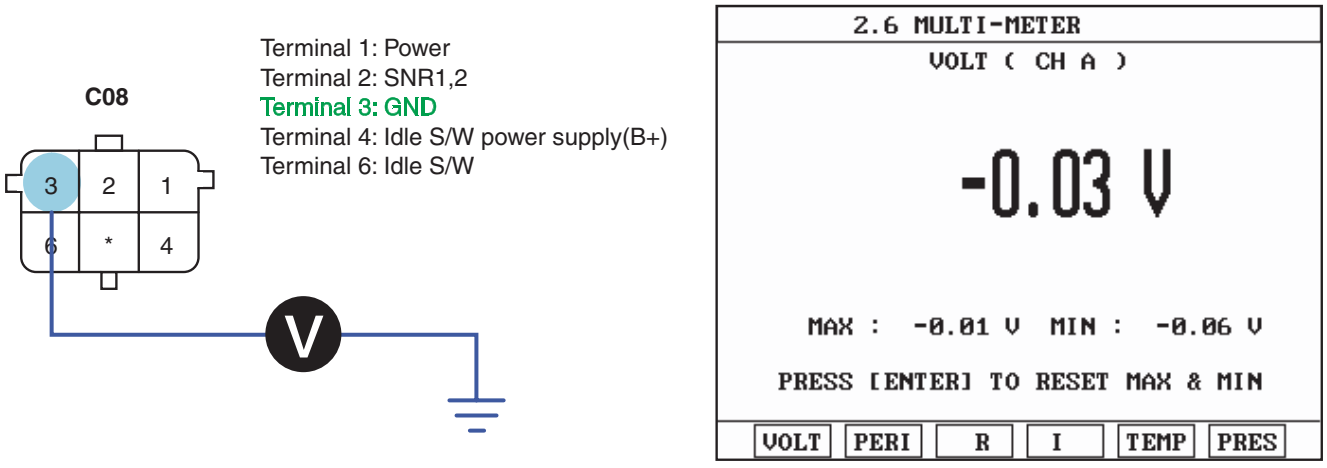
GROUND CIRCUIT INSPECTION E8067EFA

1. Ground Voltage Drop Inspection

   1) Disconnect accelerator pedal position sensor connector(C08).

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage drop between terminal 3 of accelerator pedal position sensor harness connector and chassis ground.



SNBFL8033L

■ Specification: Ground Voltage Drop - Within 200mV

4) Is the ground voltage drop measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

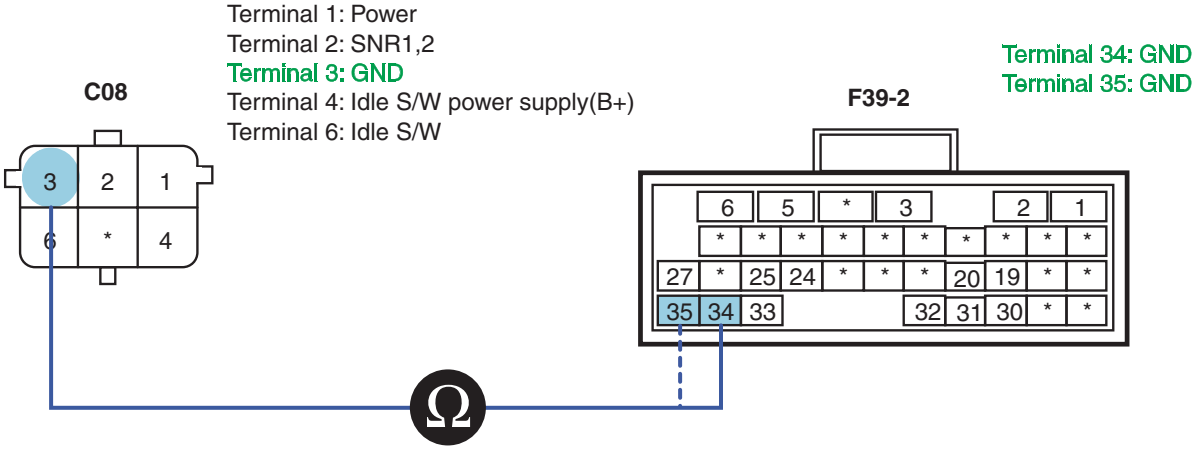
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 3 of accelerator pedal position sensor harness connector and terminals 34,35 of ECM connector(F39-2).



SNBFL8034L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

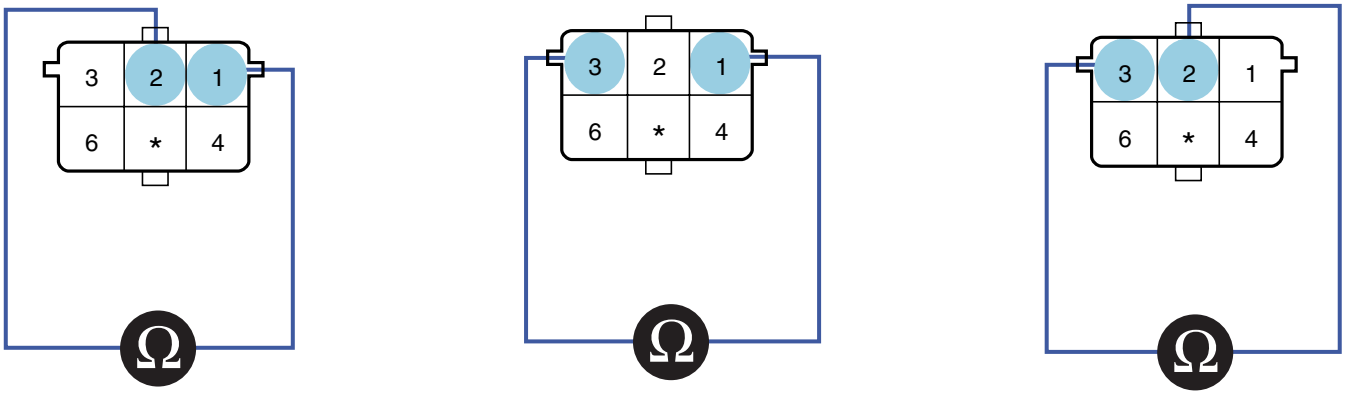
COMPONENT INSPECTION EFD4893A

1. Accelerator Pedal Position Sensor Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08).

3) Measure resistance between terminals 1-2, 2-3, 1-3 of accelerator pedal position sensor connector.



Resistance between terminals of accelerator pedal position sensor

Terminals 1-2(Not operating)	Terminals 1-2(Operating)	Terminals 1-3(Not operating)	Terminals 1-3(Operating)
Approx. 2.67kΩ	Approx. 1.06kΩ	Approx. 2.64kΩ	Approx. 2.64kΩ

Terminals 2-3(Not operating)	Terminals 2-3(Operating)
Approx. 0.732kΩ	Approx. 2.59kΩ

SUDFL8064L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace accelerator pedal position sensor and then go to "Verification of Vehicle Repair" procedure.

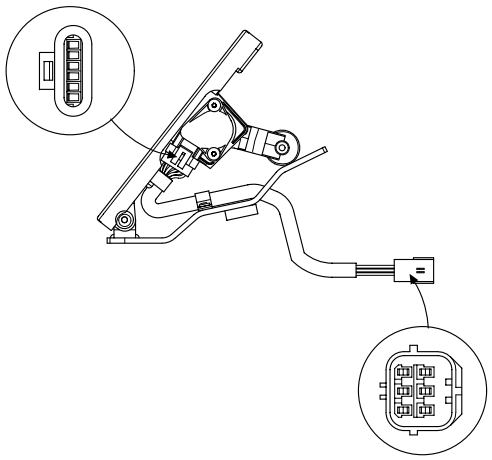
VERIFICATION OF VEHICLE REPAIR E0915DC0

Refer to DTC P0112.

DTC P0122 PEDAL SENSOR NO.1 SIGNAL LOW

COMPONENT LOCATION EBCB0D4B

Accelerator pedal position sensor



SUDFL8046L

DESCRIPTION E5A2FBDF

1. GENERAL DESCRIPTION
   Electronic control fuel injection is injected by engine control module(ECM) via factors received from various components.
   The accelerator pedal position sensor detects pedal position and sends signal to ECM. It is composed of two potentiometers(dual variable resistor type). Power supply is provided separately to detect acceleration condition exactly. The voltage of accelerator pedal position sensor is generated by potentiometer and the position of accelerator pedal is calculated by using characteristic curve programmed beforehand.

2. DTC DESCRIPTION
   When the accelerator pedal sensor "1" outputs below 0.5V for more than 1048.6ms, the ECM judges this as a fault and DTC is set. The possible causes are defective sensor, wiring problem and open in terminal 21 of ECM connector(F39-4) etc. When the accelerator pedal sensor "1" is defective, ECM is controlled by using data of the accelerator pedal sensor "2" and the vehicle is being driven in normal condition.

DTC DETECTING CONDITION EE21427B

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• Wiring problem
• Defective sensor
• Open circuit of terminal 21 of ECM connector(F39-4)</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG ON/ Running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• Below 0.5V</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 1,048.6ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• When sensor "1" is defective, ECM uses data of sensor "2". Normal driving is possible.</td></tr>
<tr><td>Fuel Limit</td><td>No</td></tr>
<tr><td>MIL</td><td>OFF</td></tr>
</table>

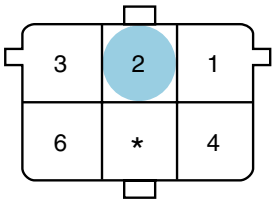
SPECIFICATION EED2581C

Terminals 1-2(Not operating)	Terminals 1-2(Operating)	Terminals 1-3(Not operating)	Terminals 1-3(Operating)
Approx. 2.67kΩ	Approx. 1.06kΩ	Approx. 2.64kΩ	Approx. 2.64kΩ

Terminals 2-3(Not operating)	Terminals 2-3(Operating)
Approx. 0.732kΩ	Approx. 2.59kΩ

Accelerator pedal position sensor track "1", "2"	Specification	
	Idle state((0%)	Wide open(100%)
Output voltage	0.65V	3.85V

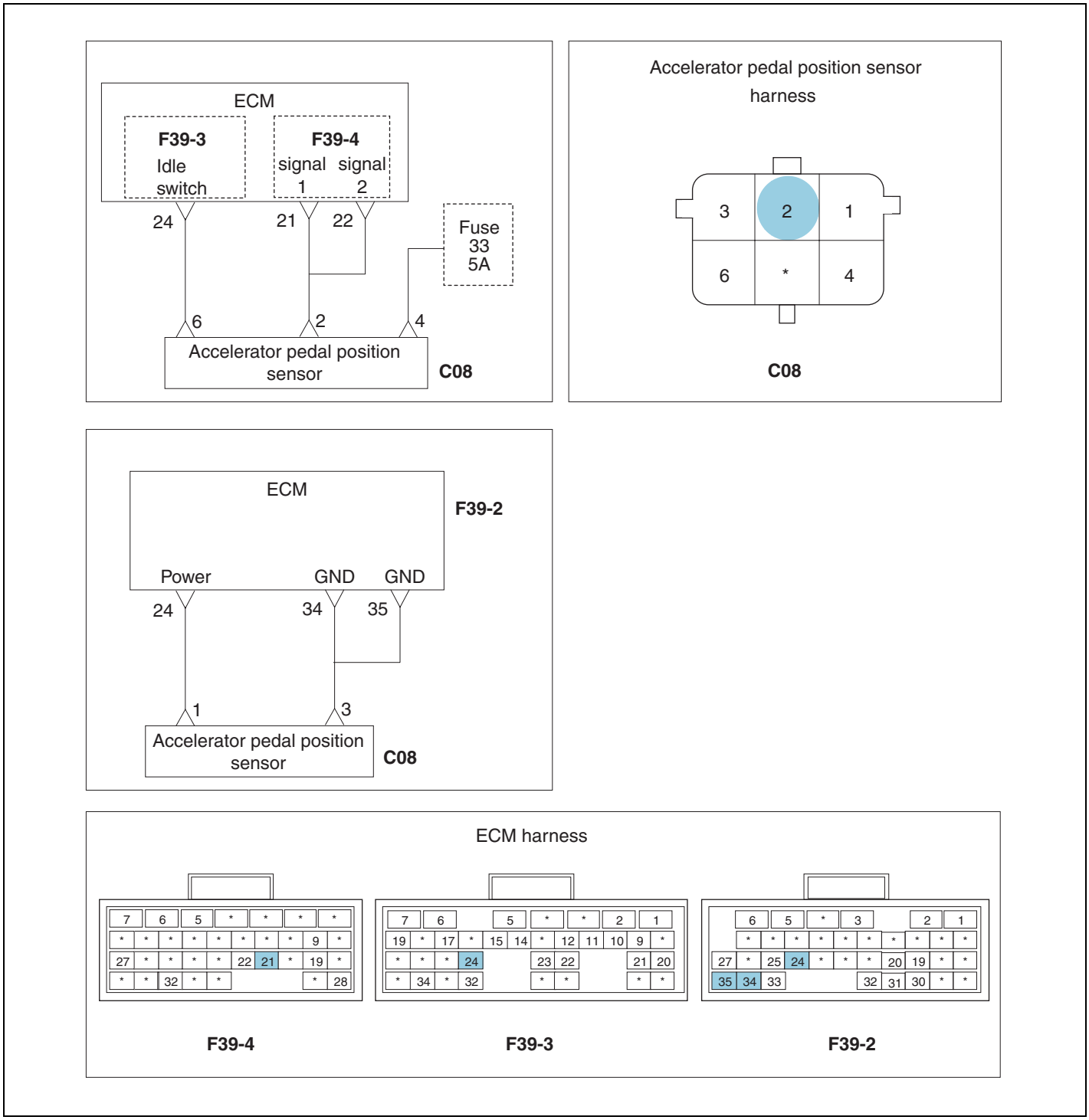
Terminal 2: Sensor "1", "2"



Sensor connector

SUDFL8065L

SCHEMATIC DIAGRAM EEC36F07



SNBFL8035L

MONITOR SCAN TOOL DATA E4872839

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Accelerator Pedal Position Sensor" parameter on the scan tool.

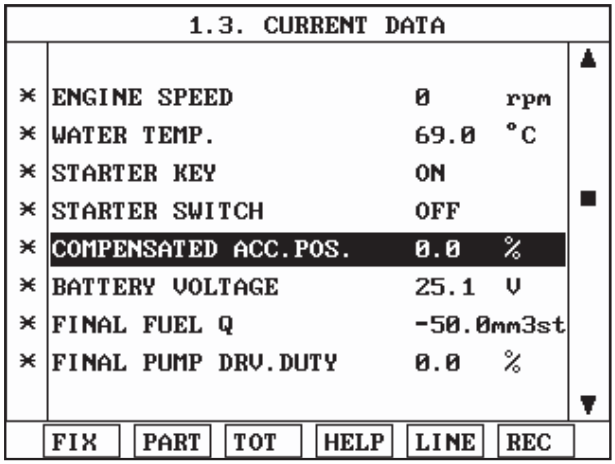


Fig. 1 Accelerator pedal position sensor data at ignition ON

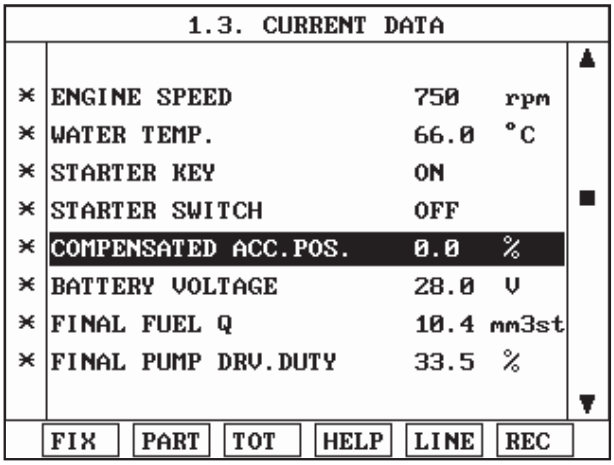


Fig. 2 Accelerator pedal position sensor data at idle

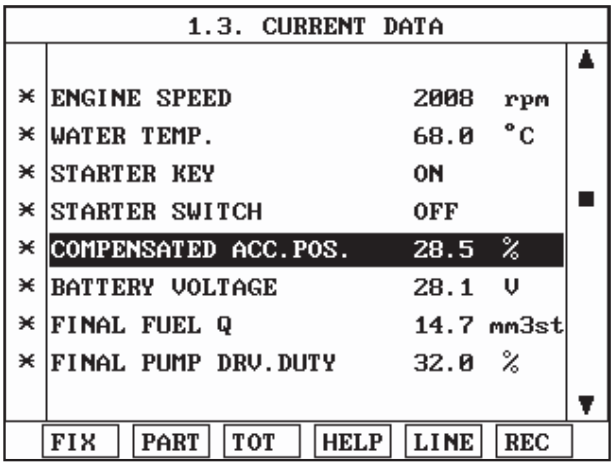


Fig. 3 Accelerator pedal position sensor data at 2,000rpm

SUDFL8049L

TERMINAL & CONNECTOR INSPECTION E87B71E7

Refer to DTC P0112.

SIGNAL INSPECTION E0AA4898

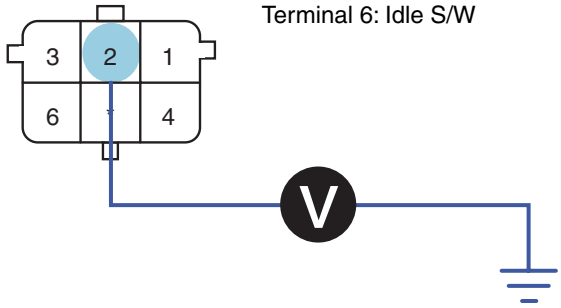
1. Signal Voltage Inspection

   1) Leave the accelerator pedal sensor connector(C08) and ECM(F39-4) installed.

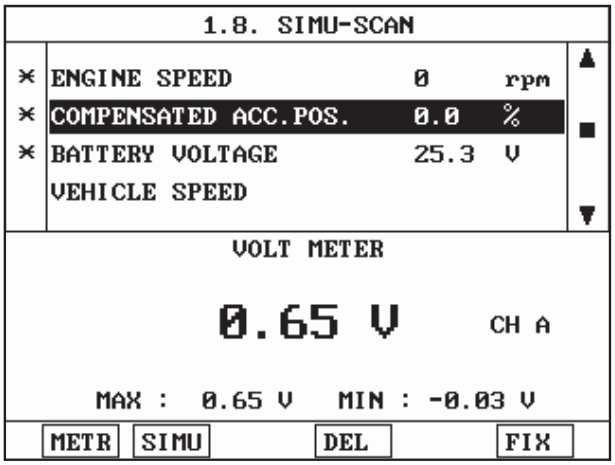
   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 2 of accelerator pedal position sensor harness connector and chassis ground.

[Sensor side]



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W

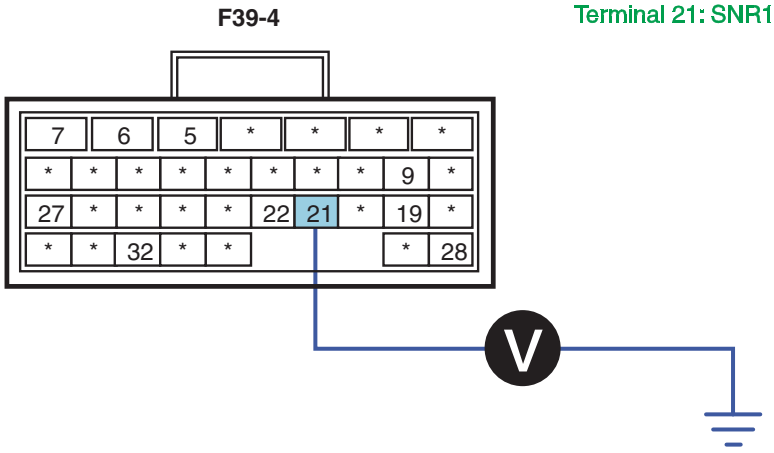


▶ With accelerator pedal position sensor connector installed (At IG ON)

SNBFL8021L

4) Measure voltage between terminal 21 of ECM connector and chassis ground.

[ECM]



Terminal 21: SNR1

SNBFL8022L

■ Specification: Accelerator pedal position signal power approx.0.13V(When not operating)

5) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

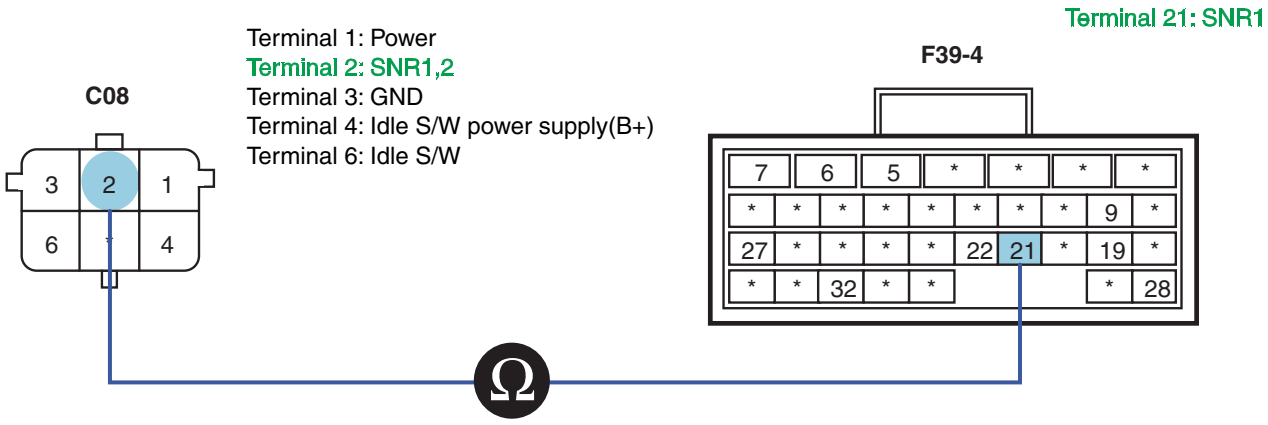
▶ Go to "Signal Open Inspection" procedure.

2. Signal Open Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 2 of accelerator pedal position sensor harness connector(C08) and terminal 21 of ECM connector(F39-4).



SNBFL8023L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Ground Inspection" procedure.

NO

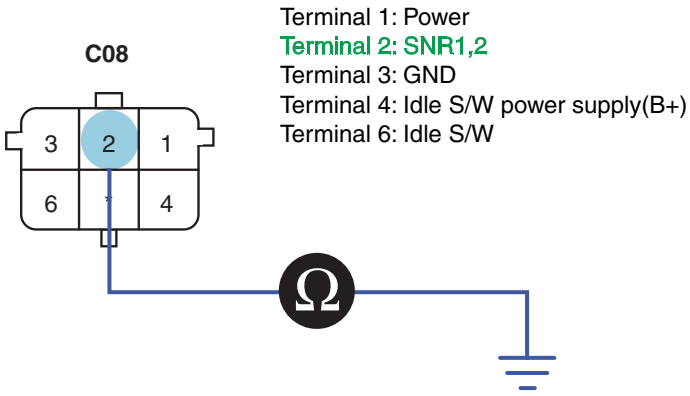
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Signal Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

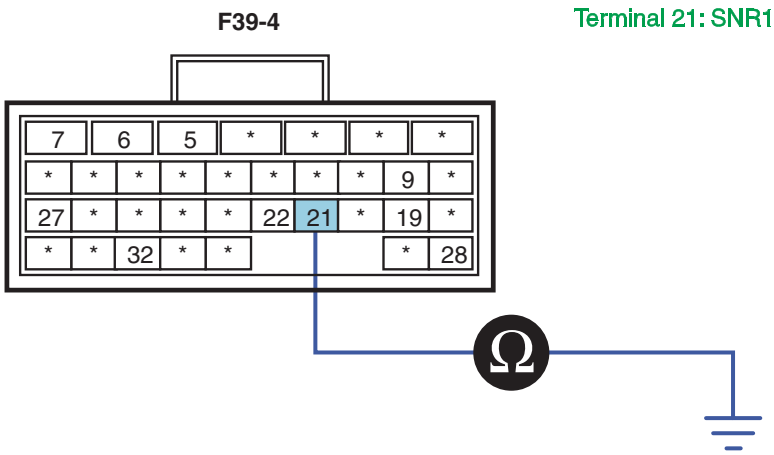
3) Measure resistance between terminal 2 of accelerator pedal position sensor harness connector(C08) and chassis ground.



SNBFL8025L

4) Measure resistance between terminal 21 of ECM connector and chassis ground.

[ECM]



SNBFL8026L

■ Specification: Infinite

5) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

POWER SUPPLY INSPECTION EC6B9B62

1. Power Supply Voltage Inspection

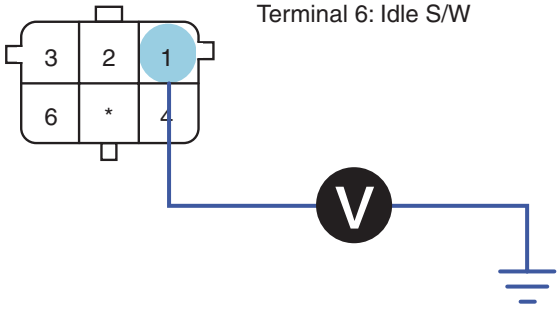
1) Leave accelerator pedal position sensor connector(C08) and ECM connector(F39-2) installed.

2) Turn the ignition ON. The engine stops.

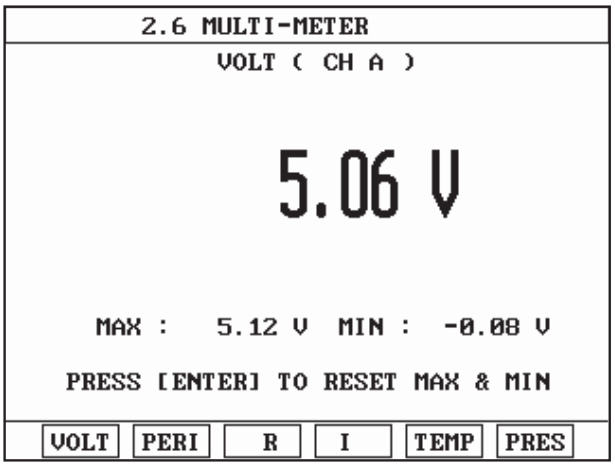
3) Measure voltage between terminal 1 of accelerator pedal position sensor harness connector(C08) and chassis ground.

[Sensor side]

C08



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W



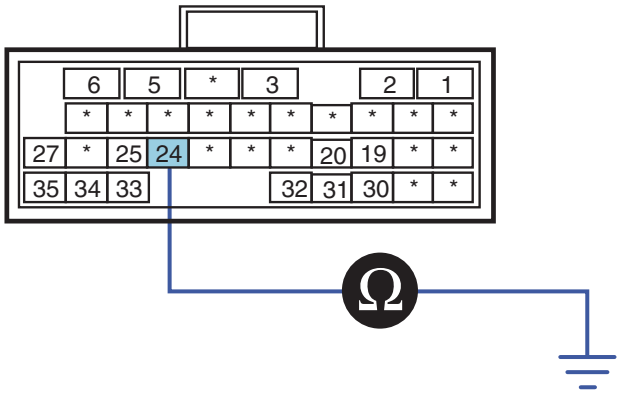
▶ With accelerator pedal position sensor connector disconnected/connected(At IG ON)

SNBFL8027L

4) Measure voltage between terminal 24 of ECM connector and chassis ground.

[ECM]

F39-2



Terminal 24: Power

SNBFL8032L

■ Specification: Accelerator pedal position sensor signal power approx. 5.21V

5) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

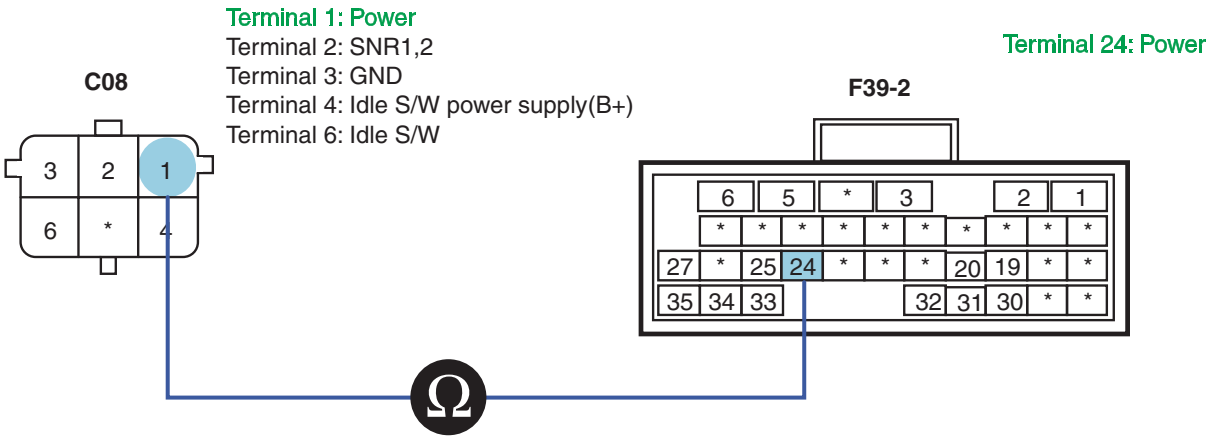
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply open Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 1 of accelerator pedal position sensor harness connector(C08) and terminals 24 of ECM connector(F39-2).



SNBFL8029L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

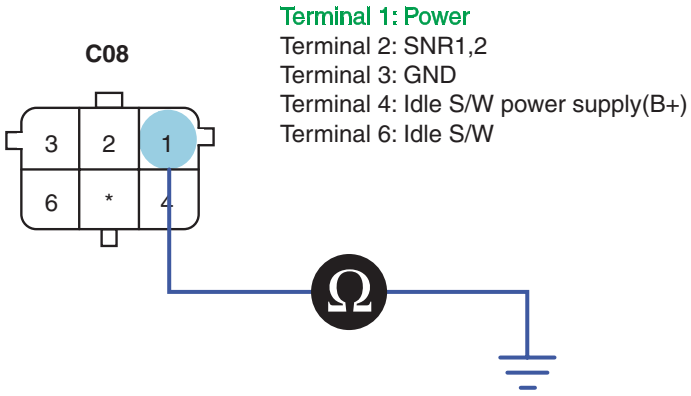
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 1 of accelerator pedal position sensor harness connector(C08) and chassis ground.



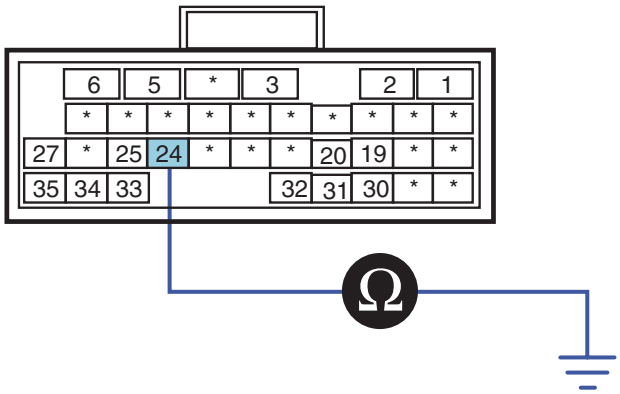
SNBFL8031L

4) Measure resistance between terminals 24 of ECM connector and chassis ground.

[ECM]

F39-2

Terminal 24: Power



SNBFL8032L

■ Specification: Continuity(Below1.0Ω)

5) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

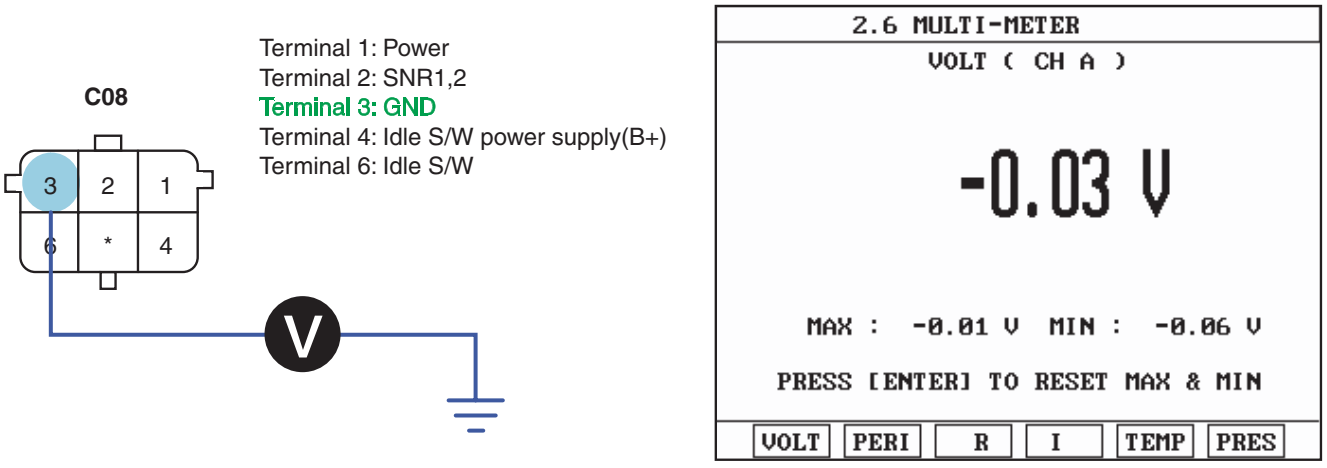
GROUND CIRCUIT INSPECTION EF025554

1. Ground Voltage Drop Inspection

   1) Disconnect accelerator pedal position sensor connector(C08).

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage drop between terminal 3 of accelerator pedal position sensor harness connector and chassis ground.



SNBFL8033L

■ Specification: Ground Voltage Drop - Within 200mV

4) Is the ground voltage drop measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

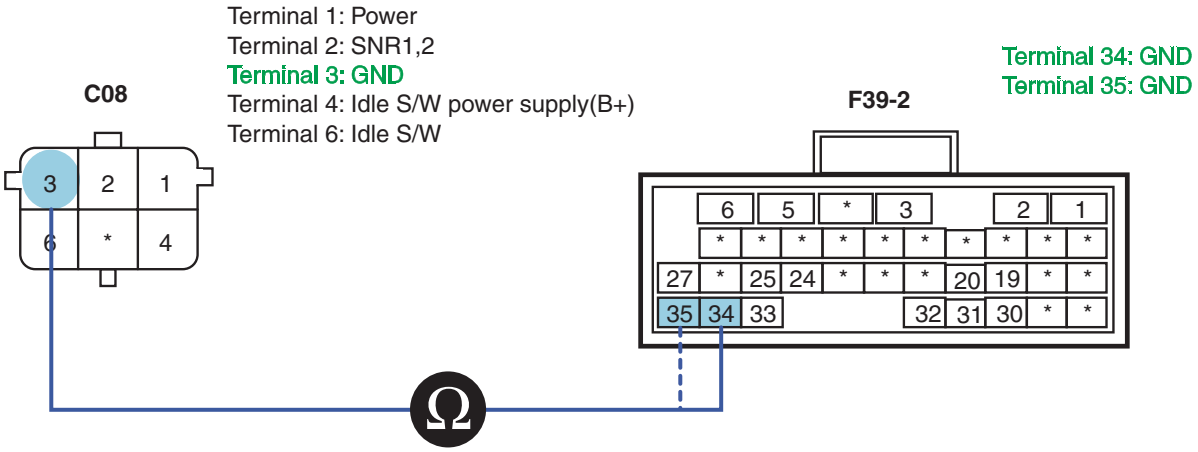
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 3 of accelerator pedal position sensor harness connector and terminals 34,35 of ECM connector(F39-2).



SNBFL8034L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

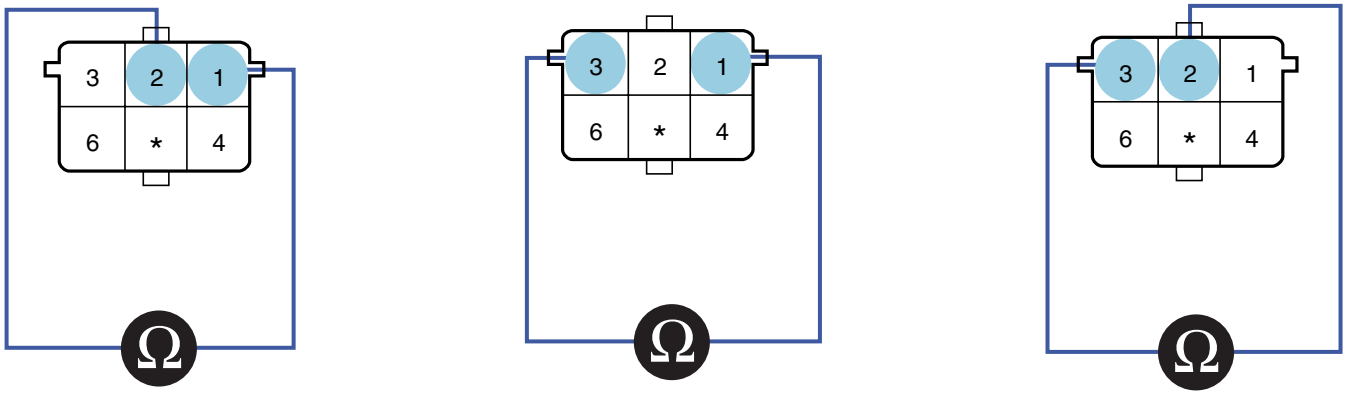
COMPONENT INSPECTION E83C04A2

1. Accelerator Pedal Position Sensor Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08).

3) Measure resistance between terminals 1-2, 2-3, 1-3 of accelerator pedal position sensor connector.



Resistance between terminals of accelerator pedal position sensor

Terminals 1-2(Not operating)	Terminals 1-2(Operating)	Terminals 1-3(Not operating)	Terminals 1-3(Operating)
Approx. 2.67kΩ	Approx. 1.06kΩ	Approx. 2.64kΩ	Approx. 2.64kΩ

Terminals 2-3(Not operating)	Terminals 2-3(Operating)
Approx. 0.732kΩ	Approx. 2.59kΩ

SUDFL8064L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace accelerator pedal position sensor and then go to "Verification of Vehicle Repair" procedure.

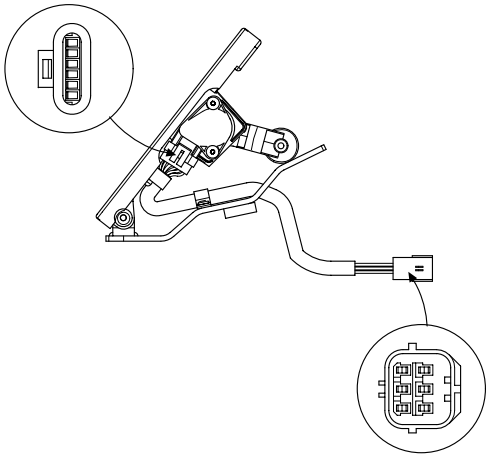
VERIFICATION OF VEHICLE REPAIR E720BD02

Refer to DTC P0112.

DTC P0123 PEDAL SENSOR NO.1 SIGNAL HIGH

COMPONENT LOCATION E60356F2

Accelerator pedal position sensor



SUDFL8046L

DESCRIPTION E1D030B1

1. GENERAL DESCRIPTION
   Electronic control fuel injection is injected by engine control module(ECM) via factors received from various components.
   The accelerator pedal position sensor detects pedal position and sends signal to ECM. It is composed of two potentiometers(dual variable resistor type). Power supply is provided separately to detect acceleration condition exactly. The voltage of accelerator pedal position sensor is generated by potentiometer and the position of accelerator pedal is calculated by using characteristic curve programmed beforehand.

2. DTC DESCRIPTION
   When the accelerator pedal sensor "1" outputs above 4.2V for more than 524.3ms, the ECM judges this as a fault and DTC is set. The possible causes are defective sensor, wiring problem etc. When the accelerator pedal sensor "1" is defective, ECM is controlled by using data of the accelerator pedal sensor "2" and the vehicle is being driven in normal condition.

DTC DETECTING CONDITION EA6C0F2A

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="5">• Wiring problem
• Defective sensor</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG ON/ Running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• Above 4.2V</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 524.3ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• When sensor "1" is defective, ECM uses data of sensor "2". Normal driving is possible.</td></tr>
<tr><td>Fuel Limit</td><td>No</td></tr>
<tr><td>MIL</td><td>OFF</td></tr>
</table>

SPECIFICATION E2602E40

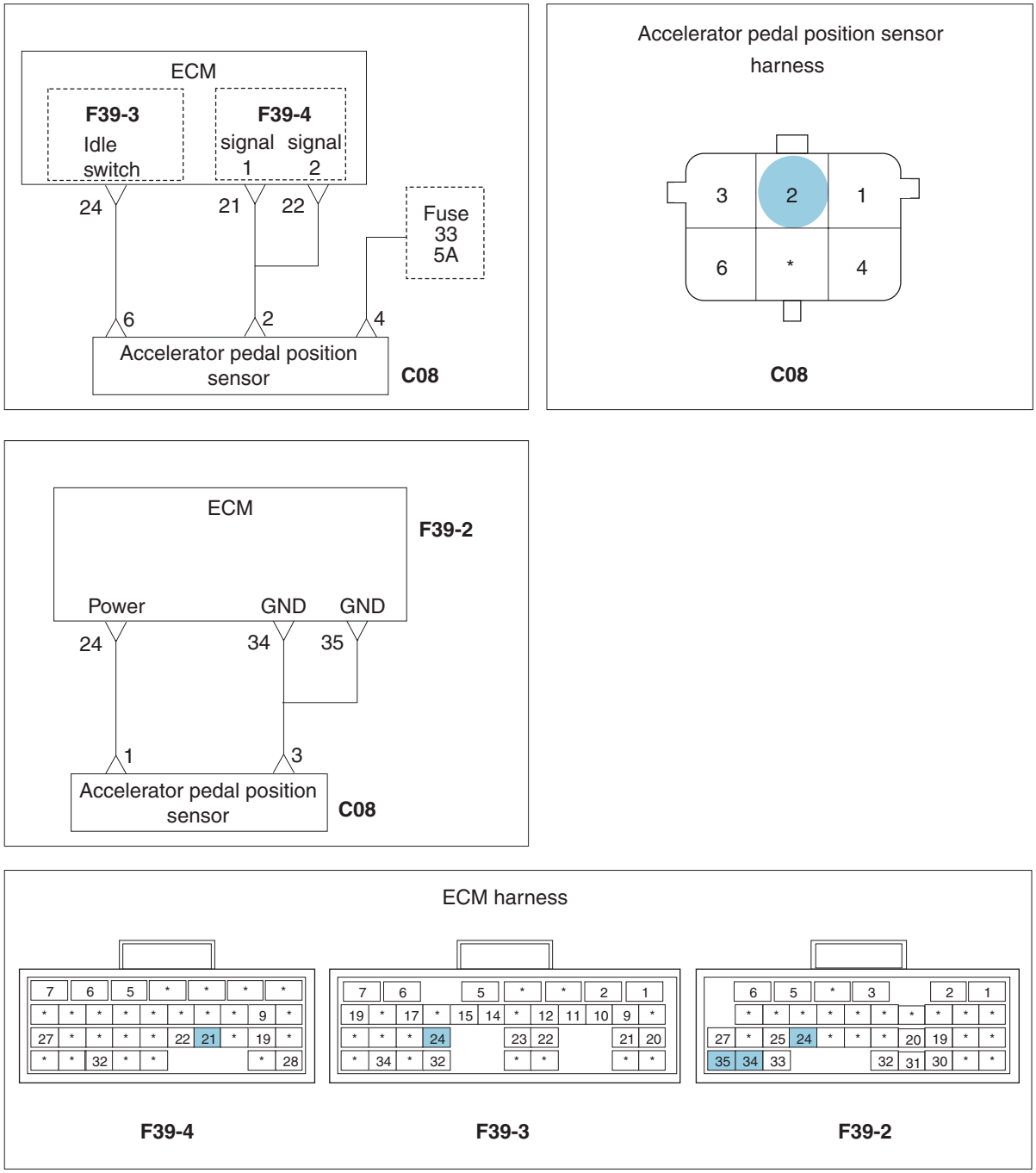
Terminals 1-2(Not operating)	Terminals 1-2(Operating)	Terminals 1-3(Not operating)	Terminals 1-3(Operating)
Approx. 2.67kΩ	Approx. 1.06kΩ	Approx. 2.64kΩ	Approx. 2.64kΩ

Terminals 2-3(Not operating)	Terminals 2-3(Operating)
Approx. 0.732kΩ	Approx. 2.59k

		3.85V

Sensor connector

SCHEMATIC DIAGRAM EB88848D



SNBFL8035L

MONITOR SCAN TOOL DATA E287EF98

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Accelerator Pedal Position Sensor" parameter on the scan tool.

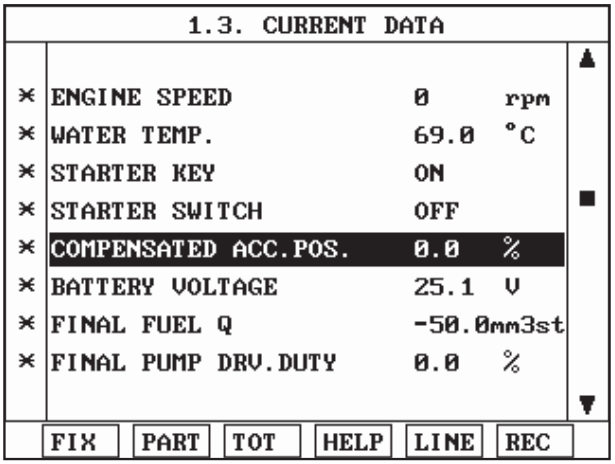


Fig. 1 Accelerator pedal position sensor data at ignition ON

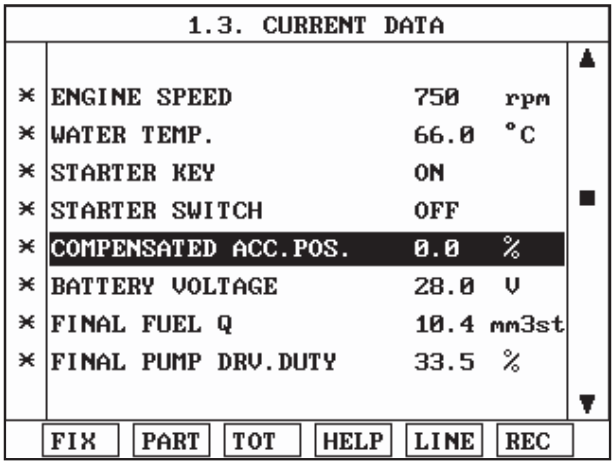


Fig. 2 Accelerator pedal position sensor data at idle

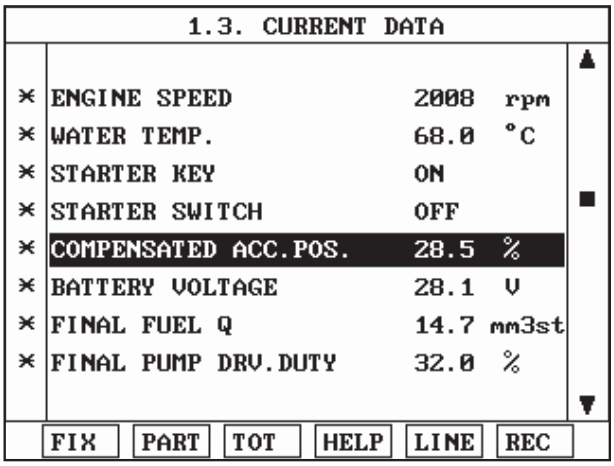


Fig. 3 Accelerator pedal position sensor data at 2,000rpm

SUDFL8049L

TERMINAL & CONNECTOR INSPECTION E719986F

Refer to DTC P0112.

SIGNAL INSPECTION EA584218

1. Signal Voltage Inspection

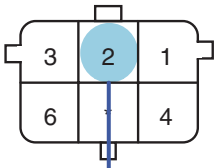
   1) Leave the accelerator pedal sensor connector(C08) and ECM(F39-4) installed.

   2) Turn the ignition ON. The engine stops.

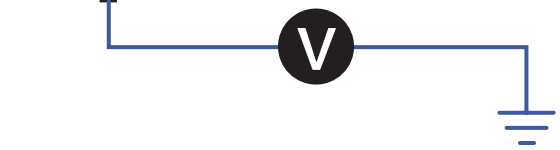
   3) Measure voltage between terminal 2 of accelerator pedal position sensor harness connector and chassis ground.

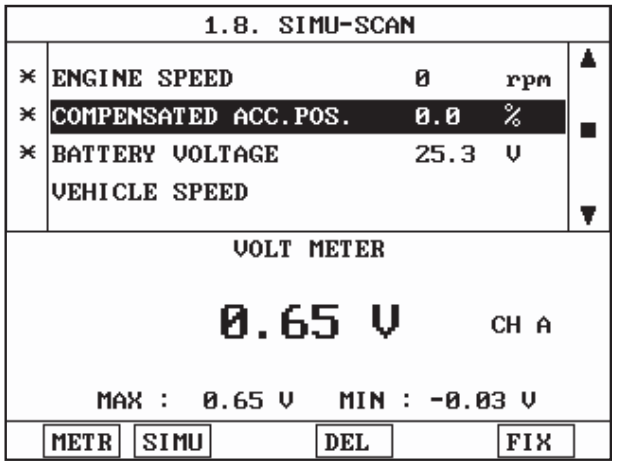
[Sensor side]

C08



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W





▶ With accelerator pedal position sensor connector installed (At IG ON)

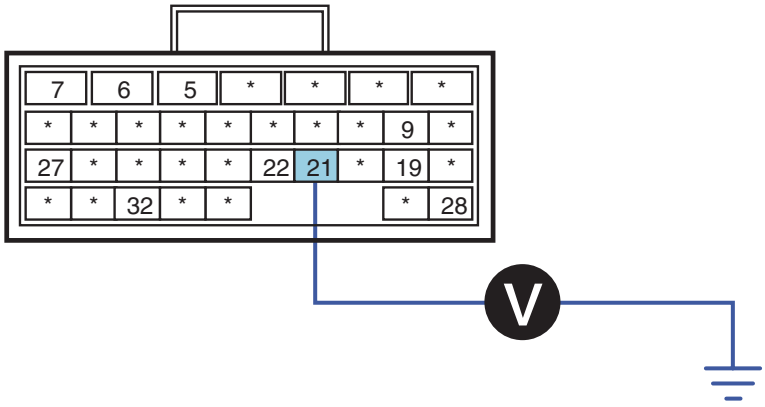
SNBFL8021L

4) Measure voltage between terminal 21 of ECM connector and chassis ground.

[ECM]

F39-4

Terminal 21: SNR1



SNBFL8022L

■ Specification: Accelerator pedal position signal power approx.0.13V(When not operating)

5) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

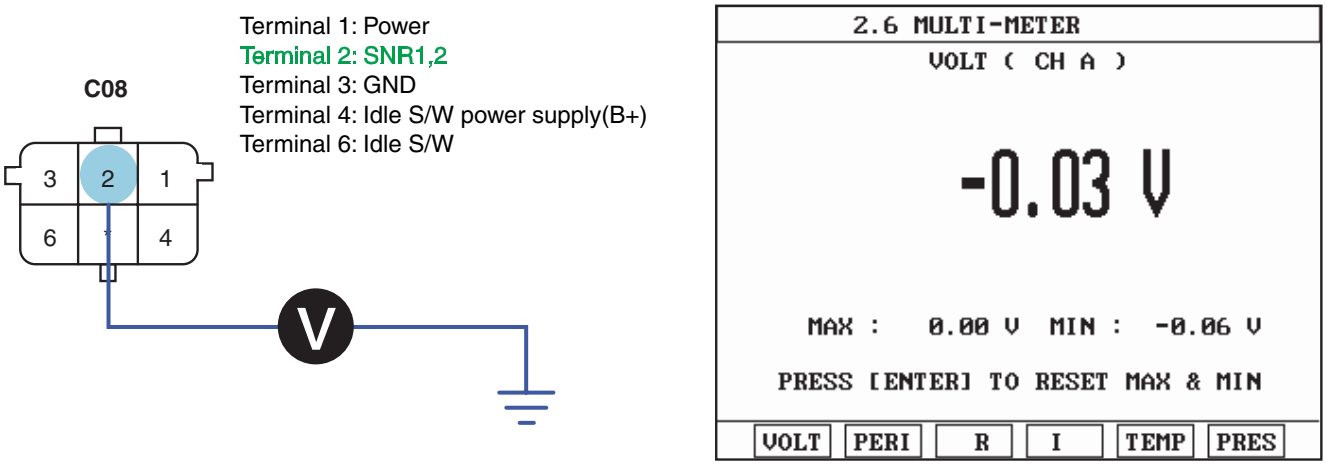
▶ Go to "Signal Short to Power Inspection" procedure.

2. Signal Short to Power Inspection

1) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

2) Turn the ignition ON. The engine stops.

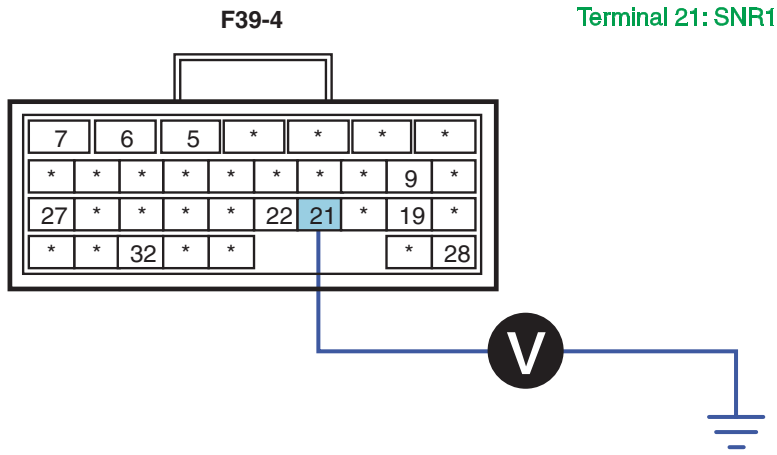
3) Measure voltage between terminal 2 of accelerator pedal position sensor harness connector(C08) and chassis ground.



SNBFL8024L

4) Measure voltage between terminal 21 of ECM connector and chassis ground.

[ECM]



SNBFL8022L

■ Specification: Below 0~0.1V

5) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

POWER SUPPLY INSPECTION E6C68CC1

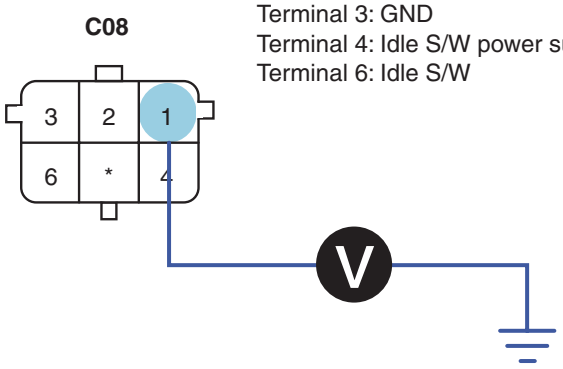
1. Power Supply Voltage Inspection

1) Leave accelerator pedal position sensor connector(C08) and ECM connector(F39-2) installed.

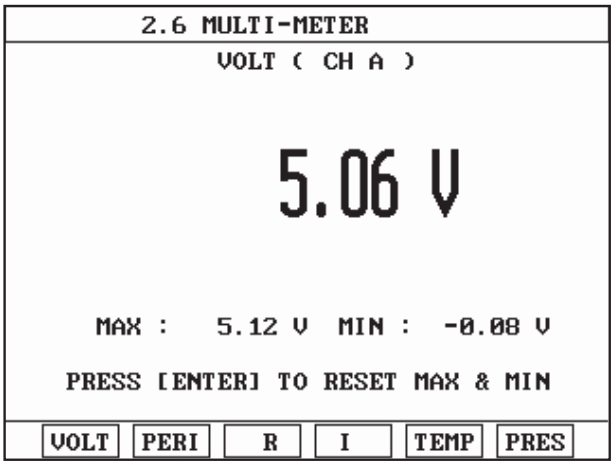
2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of accelerator pedal position sensor harness connector(C08) and chassis ground.

[Sensor side]



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W

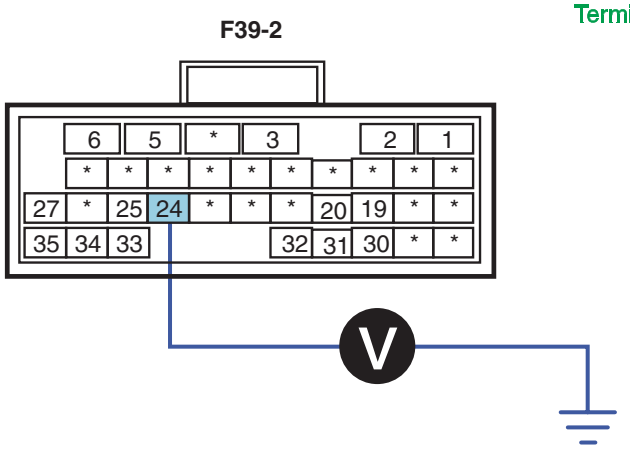


▶ With accelerator pedal position sensor connector disconnected/connected(At IG ON)

SNBFL8027L

4) Measure voltage between terminals 24 of ECM connector and chassis ground.

[ECM]



Terminal 24: Power

SNBFL8028L

■ Specification: Accelerator pedal position sensor signal power approx. 5.21V

5) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

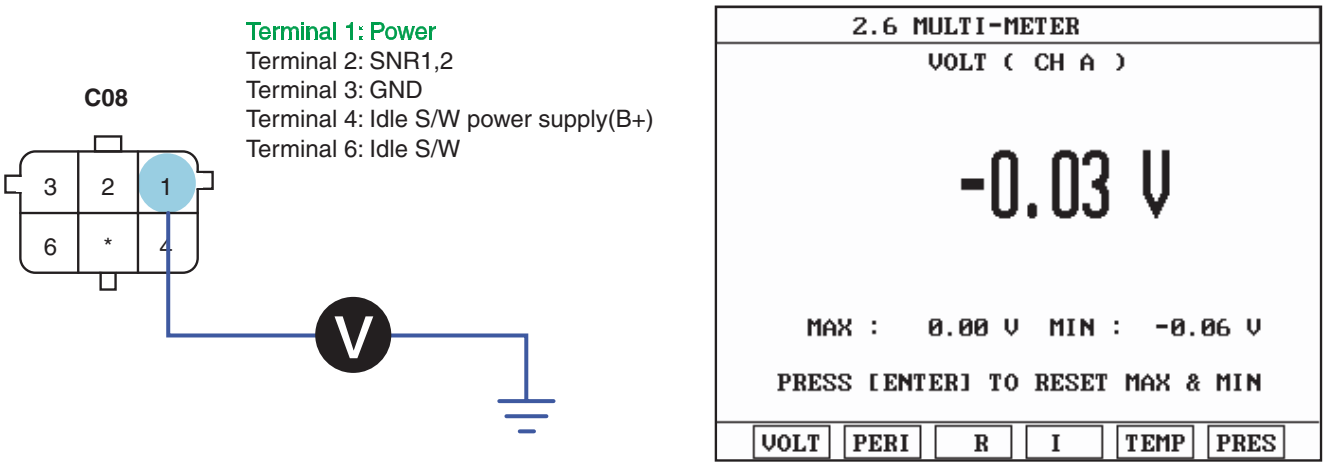
▶ Go to "Power Supply Short to Power Inspection" procedure.

2. Power Supply Short to Power Inspection

1) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

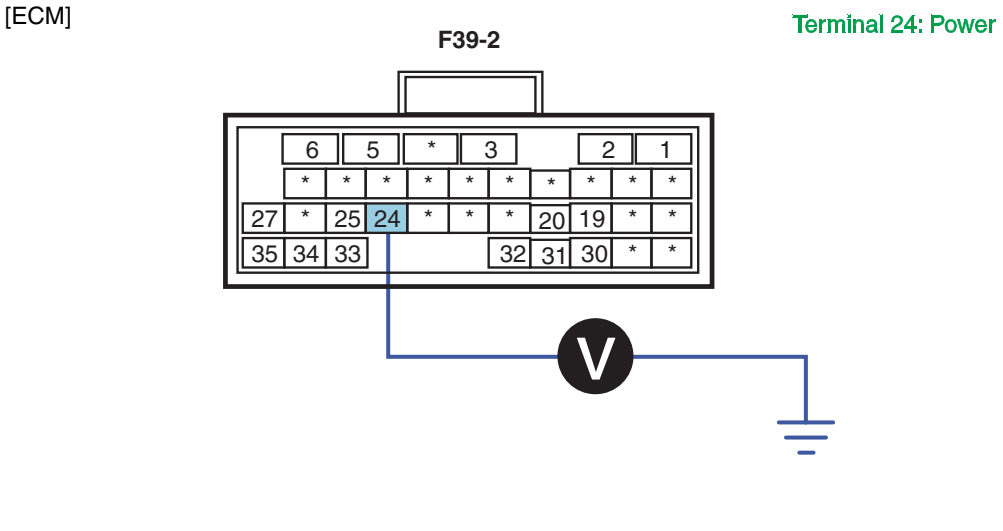
2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of accelerator pedal position sensor harness connector and chassis ground.



SNBFL8030L

4) Measure voltage between terminals 24 of ECM connector and chassis ground.



SNBFL8028L

■ Specification: Below 0~0.1V

5) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

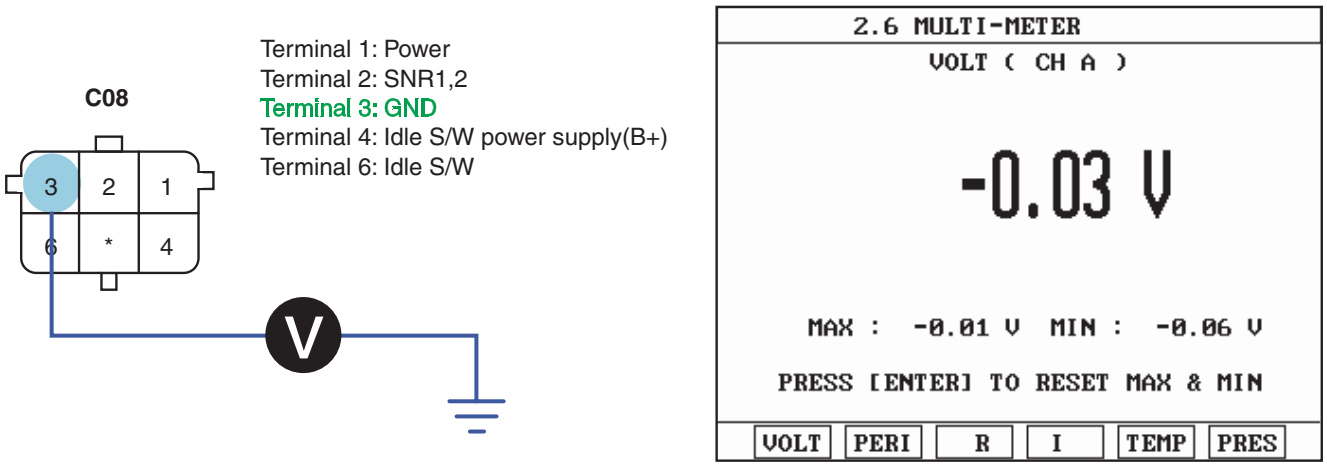
GROUND CIRCUIT INSPECTION E3500F63

1. Ground Voltage Drop Inspection

1) Disconnect accelerator pedal position sensor connector(C08).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 3 of accelerator pedal position sensor harness connector and chassis ground.



SNBFL8033L

■ Specification: Ground Voltage Drop - Within 200mV

4) Is the ground voltage drop measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

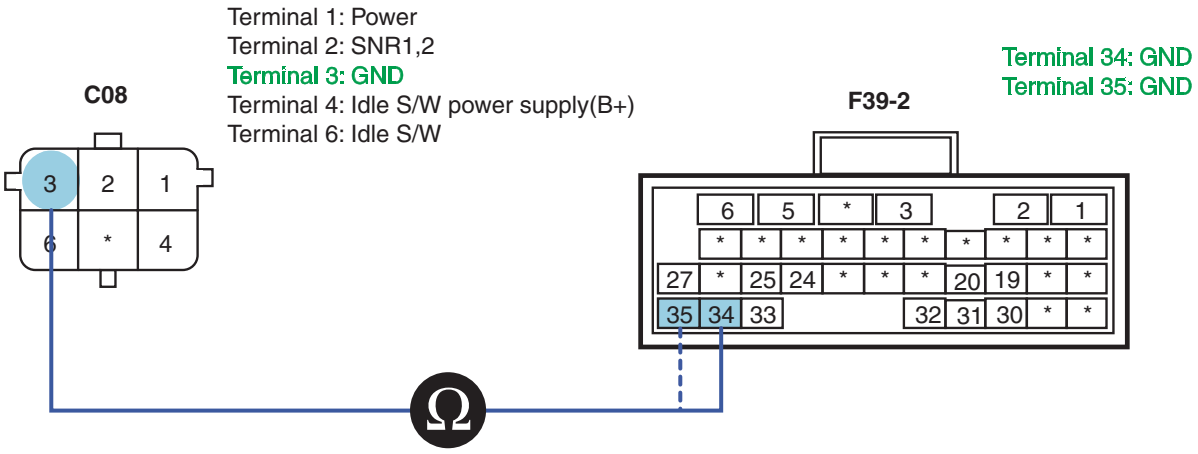
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 3 of accelerator pedal position sensor harness connector and terminals 34,35 of ECM connector(F39-2).



SNBFL8034L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

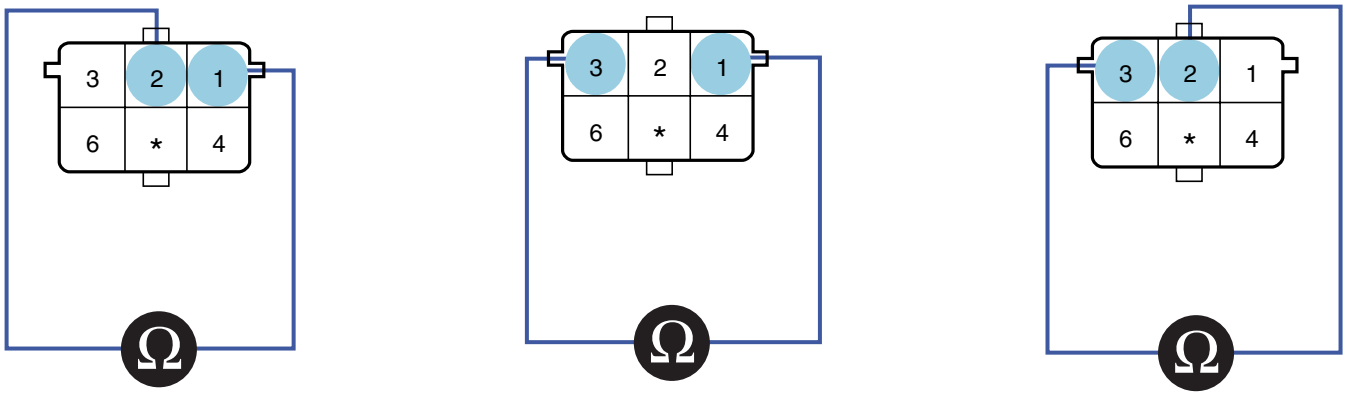
COMPONENT INSPECTION ECFE6DCC

1. Accelerator Pedal Position Sensor Inspection

   1) Turn the ignition OFF.

   2) Disconnect accelerator pedal position sensor connector(C08).

   3) Measure resistance between terminals 1-2, 2-3, 1-3 of accelerator pedal position sensor connector.



Resistance between terminals of accelerator pedal position sensor

Terminals 1-2(Not operating)	Terminals 1-2(Operating)	Terminals 1-3(Not operating)	Terminals 1-3(Operating)
Approx. 2.67kΩ	Approx. 1.06kΩ	Approx. 2.64kΩ	Approx. 2.64kΩ

Terminals 2-3(Not operating)	Terminals 2-3(Operating)
Approx. 0.732kΩ	Approx. 2.59kΩ

SUDFL8064L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace accelerator pedal position sensor and then go to "Verification of Vehicle Repair" procedure.

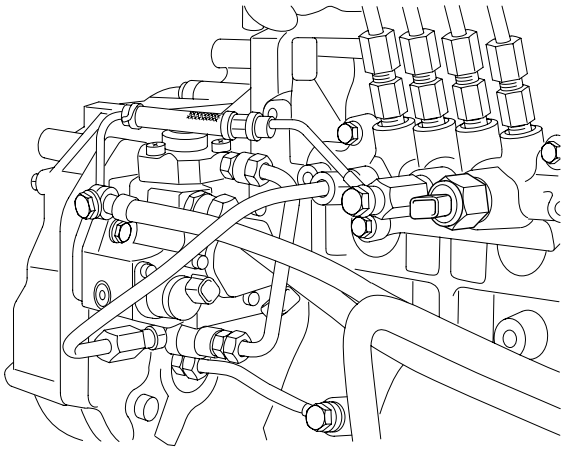
VERIFICATION OF VEHICLE REPAIR E4D14BC6

Refer to DTC P0112.

DTC P0182 FUEL TEMP. SENSOR LOW INPUT

COMPONENT LOCATION E556CB88

Fuel temperature sensor



SUDFL8067L

DESCRIPTION E6A5A25F

1. GENERAL DESCRIPTION
   Fuel temperature sensor is installed on the right side of fuel pump. The fuel temperature sensor measures fuel temperature and sends signal to ECM. ECM corrects fuel injection amount at cold engine or hot engine by using the signal.

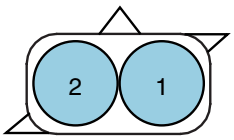
2. DTC DESCRIPTION
   When the fuel temperature sensor outputs below 0.15V for more than 9,986.3ms, the ECM judges this as a fault and DTC is set. The possible causes are defective sensor, wiring problem and short to terminal 27 of ECM connector(F39-1) etc. The vehicle is being driven, but black smoke and a lack of engine power may occur since fuel correction is stopped according to the fuel temperature.

DTC DETECTING CONDITION E8F5A2BB

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="5">• Wiring problem
• Defective sensor
• Short to terminal 27 of ECM(F39-1)</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG ON</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• Below 0.15V</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 9,986.3ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• At starting: -20°C(Fixing)
• At idle and driving: 40°C(Fixing)</td></tr>
<tr><td>Fuel Limit</td><td>Yes</td></tr>
<tr><td>MIL</td><td>OFF</td></tr>
</table>

SPECIFICATION E99B4A34

Temperature(℃)	Terminal 1,2 resistance(Ω)
0	5.74
10	3.70
20	2.45 ± 0.24
30	1.66
40	1.15
50	0.81
60	0.58

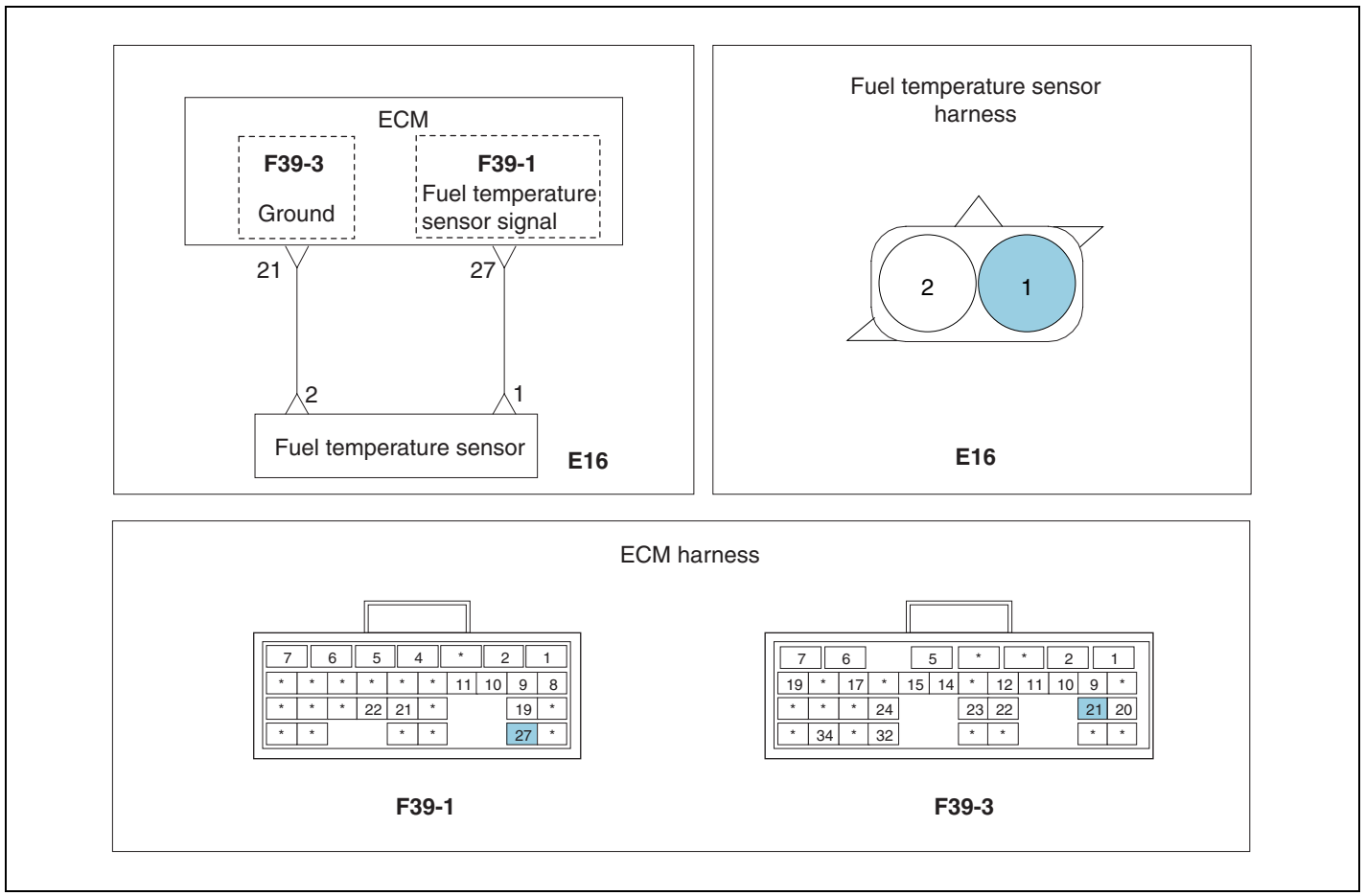


Sensor connector

Terminal 1: Fuel temperature sensor signal
Terminal 2: Sensor ground

SUDFL8068L

SCHEMATIC DIAGRAM E12F23DB



SNBFL8036L

MONITOR SCAN TOOL DATA E82F9643

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.

4. Monitor "Fuel temperature" parameter on the scan tool.

NOTE

Fuel temperature sensor data are changed by driving condition depending on DTC detecting condition. In case of fail safe. be sure to check that fuel temperature at starting is fixed at -20°C and fuel temperature at idle and running is fixed at 40°C.

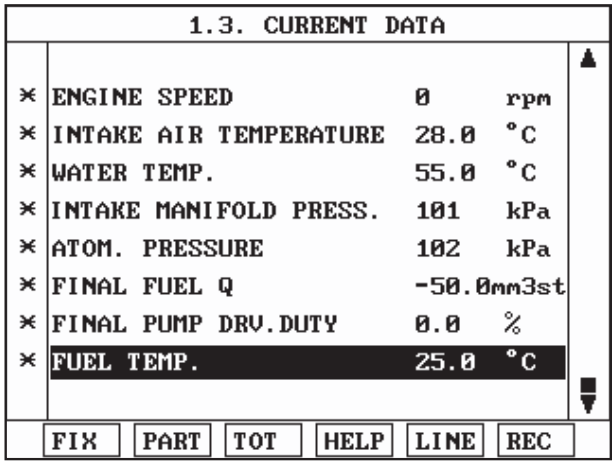


Fig. 1 Fuel temperature sensor data at ignition ON

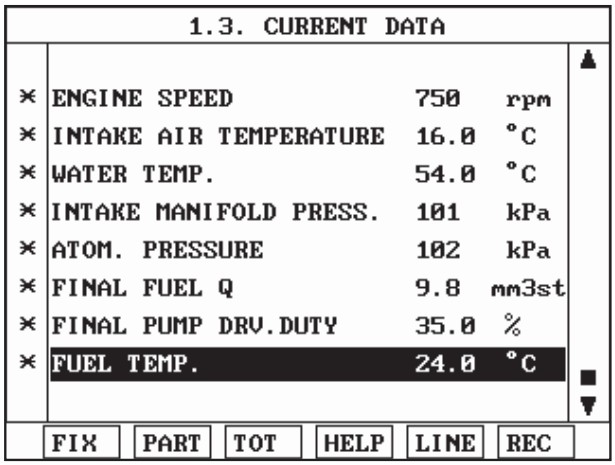


Fig. 2 Fuel temperature sensor data at idle

SUDFL8070L

TERMINAL & CONNECTOR INSPECTION E97A51E6

Refer to DTC P0112.

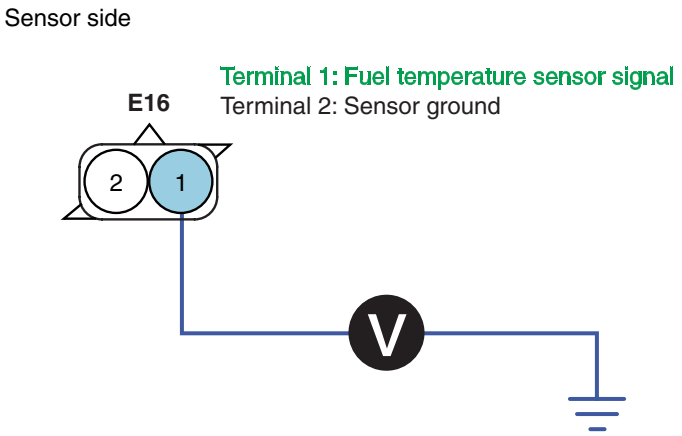
SIGNAL INSPECTION ECAE1C19

1. Signal Voltage Inspection

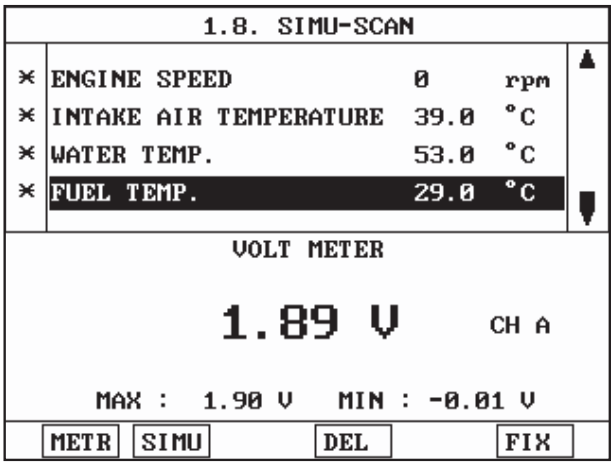
   1) Leave the fuel temperature sensor connector(E16) installed.

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 1 of fuel temperature sensor harness connector and chassis ground.



Terminal 1: Fuel temperature sensor signal
Terminal 2: Sensor ground



▶ With fuel temperature sensor connector installed (At IG ON)

SUDFL8071L

■ Specification: Fuel temperature sensor signal power approx.1.25V(When installing)
Note: Voltage value is changed depending on fuel temperature.

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Go to "Signal Open Inspection" procedure.

2. Signal Open Inspection

1) Turn the ignition OFF.

2) Disconnect fuel temperature sensor connector(E16) and terminal 27 of ECM connector(F39-1).

3) Measure resistance between terminal 1 of fuel temperature sensor harness connector(E16) and terminal 27 of ECM connector(F39-1).

Terminal 1: Fuel temperature sensor signal

YES

▶ Go to "Signal Short to Ground Inspection" procedure.

NO

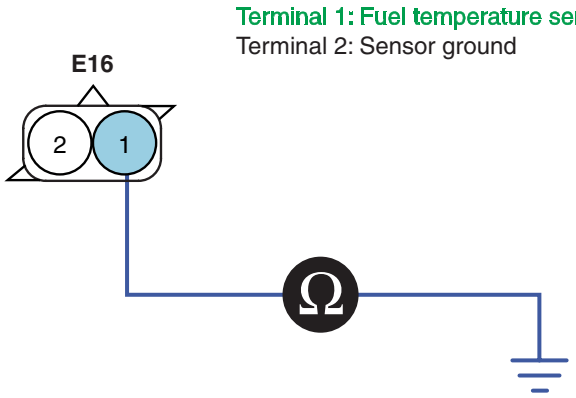
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Signal Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect fuel temperature sensor connector(E16) and ECM connector(F39-1).

3) Measure resistance between terminal 1 of fuel temperature sensor harness connector(E16) and chassis ground.



SUDFL8073L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

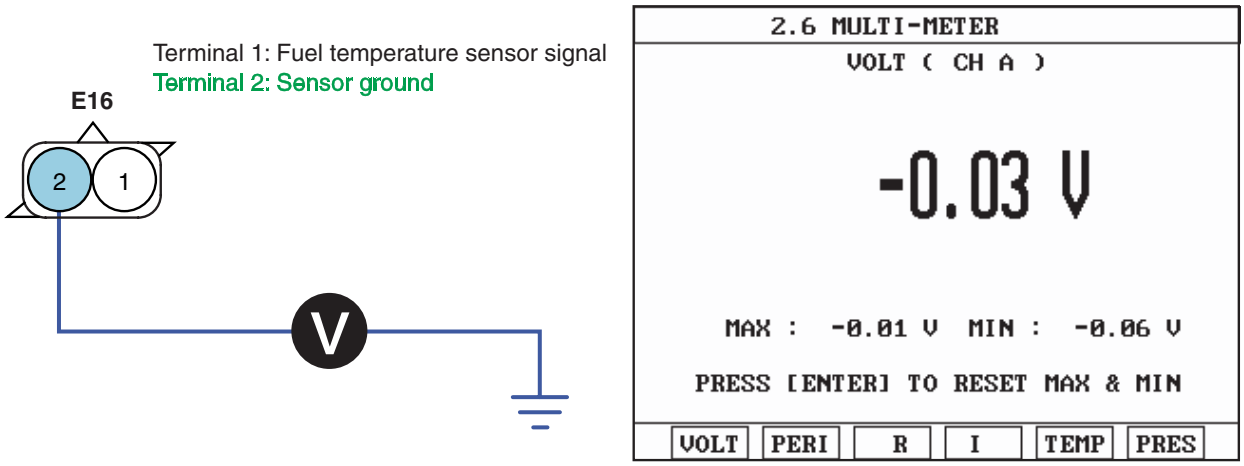
GROUND CIRCUIT INSPECTION E19508CE

1. Ground Voltage Drop Inspection

1) Disconnect fuel temperature sensor connector(E16).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 2 of fuel temperature sensor harness connector and chassis ground.



SUDFL8074L

■ Specification: Ground Voltage Drop - Within 200mV

4) Is the ground voltage drop measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

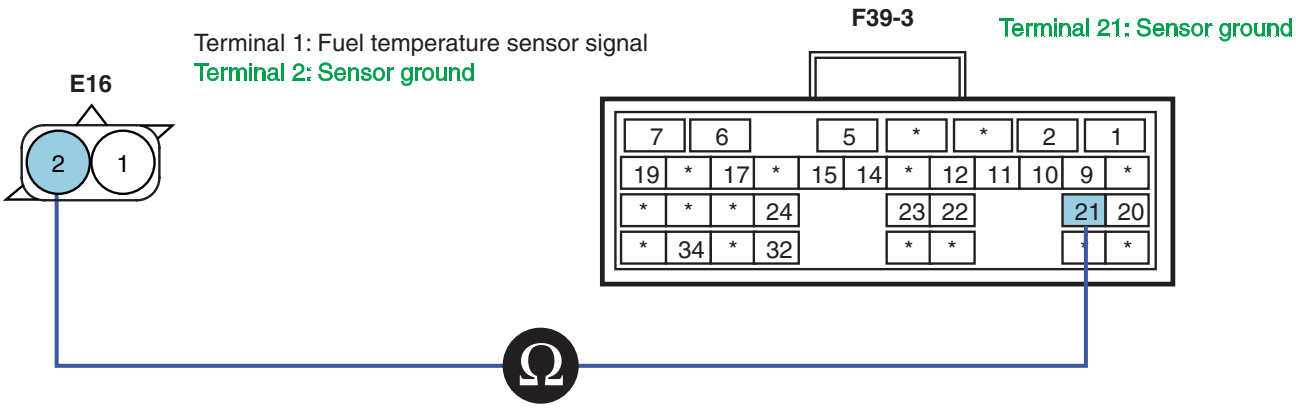
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect fuel temperature sensor connector(E16) and ECM connector(F39-3).

3) Measure resistance between terminal 2 of fuel temperature sensor harness connector and terminals 21 of ECM connector(F39-3).



SNBFL8038L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E7FF047E

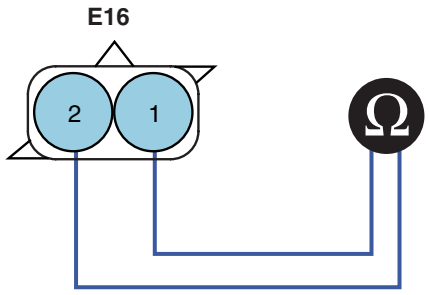
1. Fuel temperature Sensor Inspection

   1) Turn the ignition OFF.

   2) Disconnect fuel temperature sensor connector(E16).

   3) Measure resistance between terminal 1 and 2 of fuel temperature sensor connector.

Temperature(℃)	Terminal 1,2 resistance(Ω)
0	5.74
10	3.70
20	2.45 ± 0.24
30	1.66
40	1.15
50	0.81
60	0.58



Terminal 1: Fuel temperature sensor signal
Terminal 2: Sensor ground

SUDFL8076L

   4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace fuel temperature sensor and then go to "Verification of Vehicle Repair" procedure.

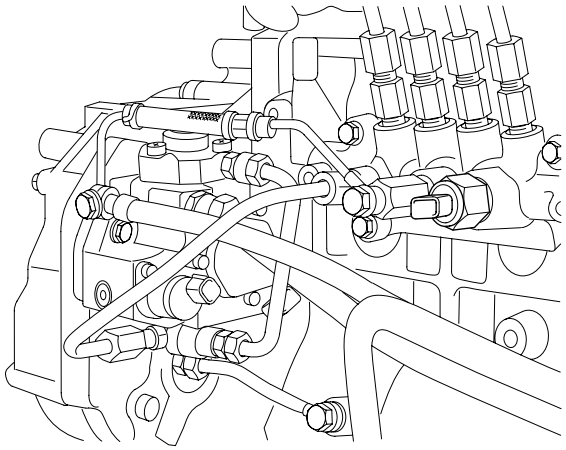
VERIFICATION OF VEHICLE REPAIR E0359C68

Refer to DTC P0112.

DTC P0183 FUEL TEMP. SENSOR HIGH INPUT

COMPONENT LOCATION E192A9A7

Fuel temperature sensor



SUDFL8067L

DESCRIPTION EC2612C2

1. GENERAL DESCRIPTION
   Fuel temperature sensor is installed on the right side of fuel pump. The fuel temperature sensor measures fuel temperature and sends signal to ECM. ECM corrects fuel injection amount at cold engine or hot engine by using the signal.

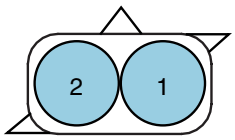
2. DTC DESCRIPTION
   When the fuel temperature sensor outputs above 4.85V for more than 9,986.3ms, the ECM judges this as a fault and DTC is set. The possible causes are defective sensor, wiring problem and open in terminal 27 of ECM connector(F39-1) etc. The vehicle is being driven, but black smoke and a lack of engine power may occur since fuel correction is stopped according to the fuel temperature.

DTC DETECTING CONDITION E0098F97

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="5">• Wiring problem
• Defective sensor
• Open in terminal 27 of ECM(F39-1)</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG ON</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• Above 4.85V</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 9,986.3ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• At starting: -20°C(Fixing)
• At idle and driving: 40°C(Fixing)</td></tr>
<tr><td>Fuel Limit</td><td>Yes</td></tr>
<tr><td>MIL</td><td>OFF</td></tr>
</table>

SPECIFICATION E337824C

Temperature(℃)	Terminal 1,2 resistance(Ω)
0	5.74
10	3.70
20	2.45 ± 0.24
30	1.66
40	1.15
50	0.81
60	0.58

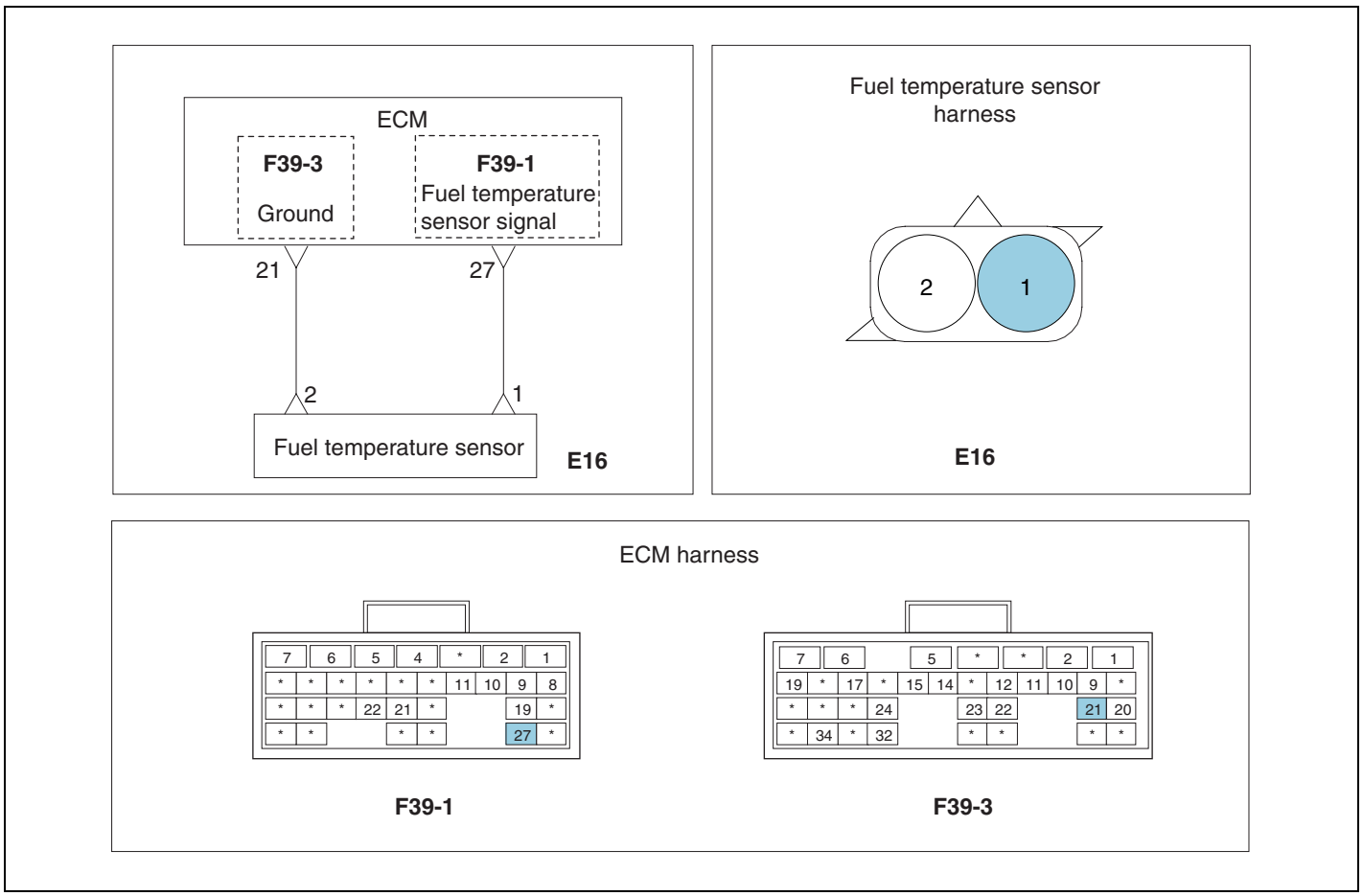


Sensor connector

Terminal 1: Fuel temperature sensor signal
Terminal 2: Sensor ground

SUDFL8068L

SCHEMATIC DIAGRAM EB73B8C2



SNBFL8036L

MONITOR SCAN TOOL DATA E605CF76

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.

4. Monitor "Fuel temperature" parameter on the scan tool.

NOTE

Fuel temperature sensor data are changed by driving condition depending on DTC detecting condition. In case of fail safe. be sure to check that fuel temperature at starting is fixed at -20°C and fuel temperature at idle and running is fixed at 40°C.

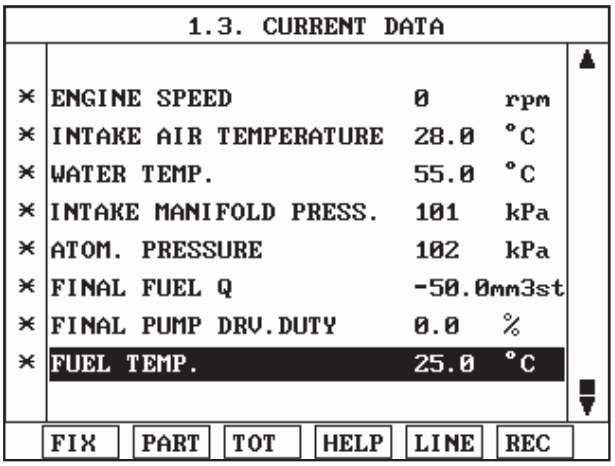


Fig. 1 Fuel temperature sensor data at ignition ON

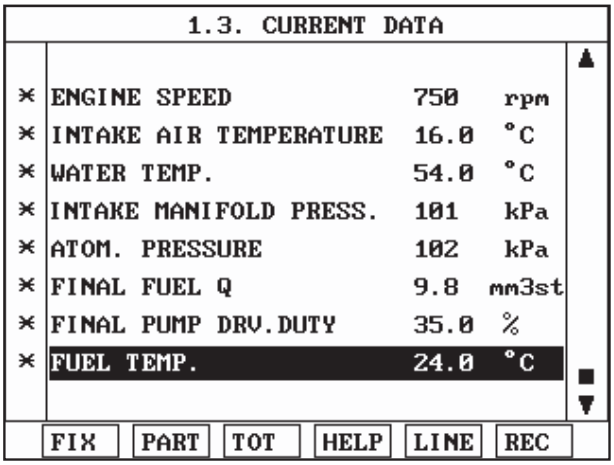


Fig. 2 Fuel temperature sensor data at idle

SUDFL8077L

TERMINAL & CONNECTOR INSPECTION ED22C36A

Refer to DTC P0112.

SIGNAL INSPECTION ED50D02F

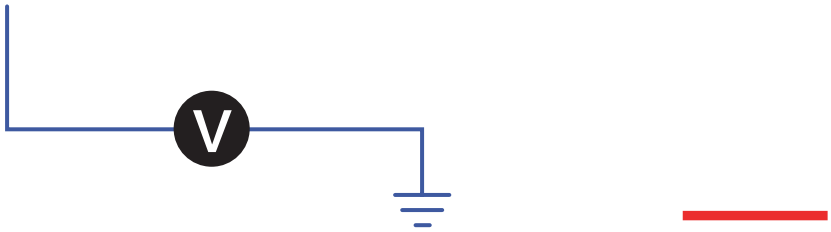
1. Signal Voltage Inspection

   1) Leave the fuel temperature sensor connector(E16) installed.

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 1 of fuel temperature sensor harness connector and chassis ground.

Terminal 1: Fuel temper



4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

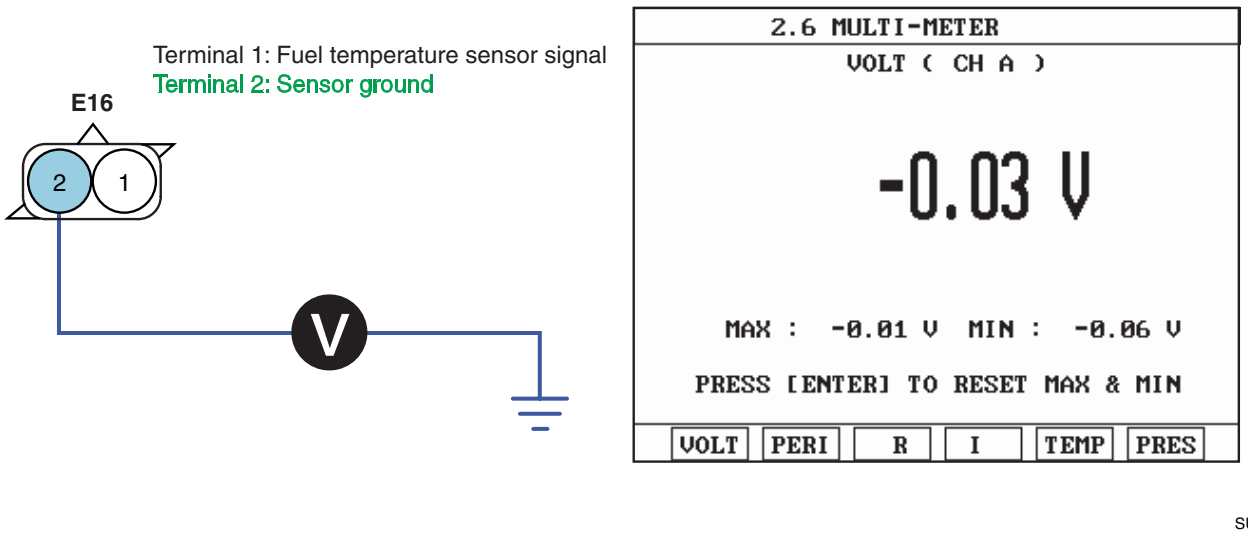
GROUND CIRCUIT INSPECTION E934A365

1. Ground Voltage Drop Inspection

1) Disconnect fuel temperature sensor connector(E16).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 2 of fuel temperature sensor harness connector and chassis ground.



SUDFL8074L

■ Specification: Ground Voltage Drop - Within 200mV

4) Is the ground voltage drop measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

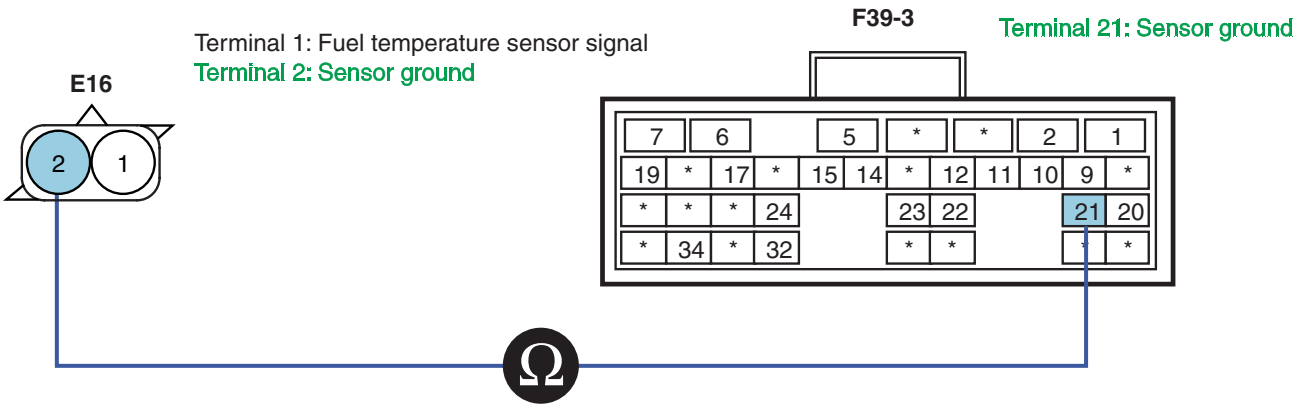
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect fuel temperature sensor connector(E16) and ECM connector(F39-3).

3) Measure resistance between terminal 2 of fuel temperature sensor harness connector and terminals 21 of ECM connector(F39-3).



SNBFL8038L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EEDBA598

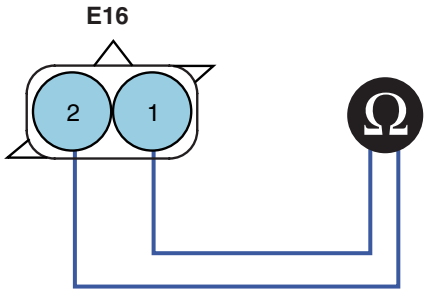
1. Fuel temperature Sensor Inspection

1) Turn the ignition OFF.

2) Disconnect fuel temperature sensor connector(E16).

3) Measure resistance between terminal 1 and 2 of fuel temperature sensor connector.

Temperature(℃)	Terminal 1,2 resistance(Ω)
0	5.74
10	3.70
20	2.45 ± 0.24
30	1.66
40	1.15
50	0.81
60	0.58



Terminal 1: Fuel temperature sensor signal
Terminal 2: Sensor ground

SUDFL8076L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace fuel temperature sensor and then go to "Verification of Vehicle Repair" procedure.

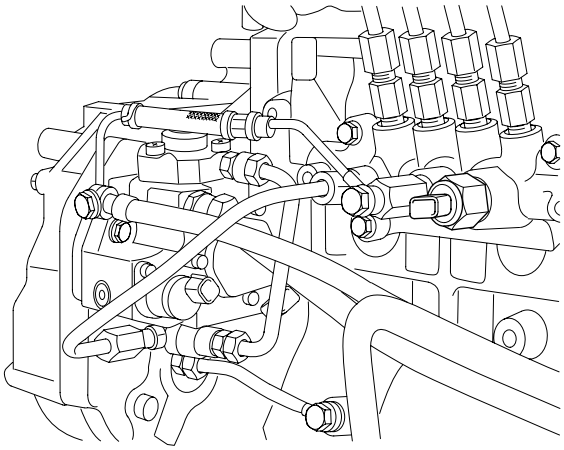
VERIFICATION OF VEHICLE REPAIR E3275B99

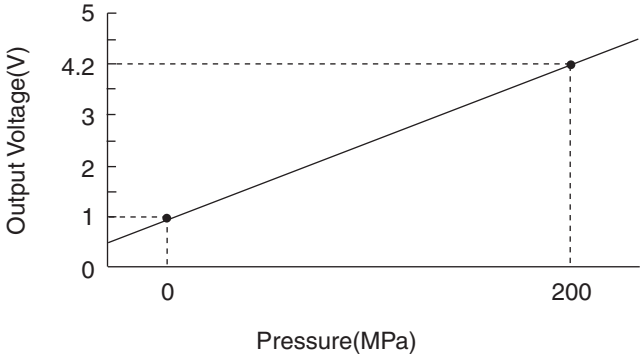
Refer to DTC P0112.

DTC P0192 C/RAIL PRESSURE SENSOR SIGNAL LOW

COMPONENT LOCATION EA41ABE7

Fuel rail pressure sensor





SUDFL8079L

DESCRIPTION E1F9D177

1. GENERAL DESCRIPTION
   Rail pressure sensor converts fuel pressure in rail into voltage signal and sends signal to ECM. ECM uses the signal to determine fuel amount. The sensor element which converts pressure into electric signal is connected to diaphragm and is activated like a analog resistance. The resistance changes with diaphragm change of rail pressure At this time, rail pressure is converted into electric signal. The bridge circuit of diaphragm is amplified into 0.5~4.2V(0~2,000bar) and is displayed into voltage.

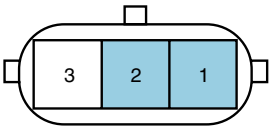
2. DTC DESCRIPTION
   If rail pressure sensor is detected below 0.7V for 200ms or more, ECM judges this as a fault and DTC is set. The possible causes may be faulty common rail pressure sensor, defective wiring & resistance, short to terminals 20, 25, 31 of ECM connector(F39-2). The vehicle can be driven but lack of engine power will occur since ECM controls fuel amount to below 63㎣/st at 450 bar of fuel pressure in case of fail safe.

DTC DETECTING CONDITION E049D6AD

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="5">• Faulty common rail pressure sensor
• Defective wiring & resistance
• Short to terminals 20, 25, 31 of ECM connector(F39-2)</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• Below 0.7V</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 200ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• Fuel amount is limited to below 63mm³/st at 450 bar.
• Lack of engine power</td></tr>
<tr><td>Fuel Limit</td><td>Yes</td></tr>
<tr><td>MIL</td><td>ON</td></tr>
</table>

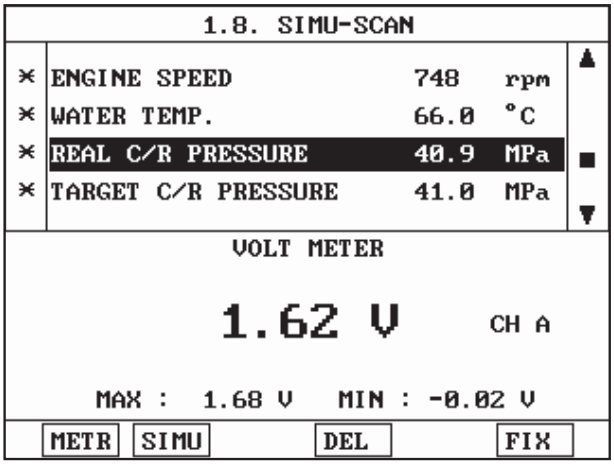
SPECIFICATION E4005CDD

Rail pressure sensor	Specification
Output voltage	Below 1.7V (At idle after engine warming-up)
Rail pressure	350~500 bar(Engine idling)



Sensor connector

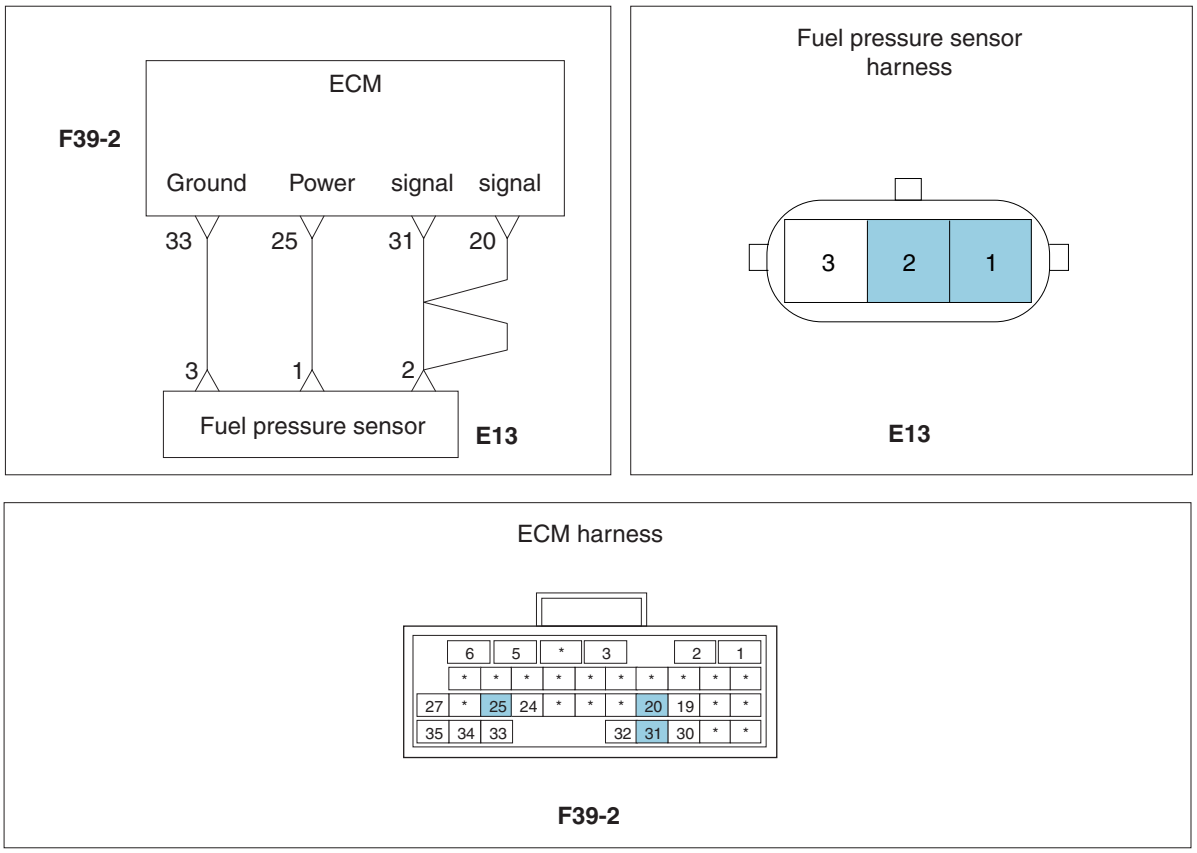
Terminal 1: Power
Terminal 2: Signal
Terminal 3: Ground



Resistance	Specification(20˚C)
1, 2	3 KΩ
1, 3	13 KΩ
2, 3	16.4 KΩ

SUDFL8080L

SCHEMATIC DIAGRAM E8E42289



SNBFL8039L

WAVEFORM EF524C95

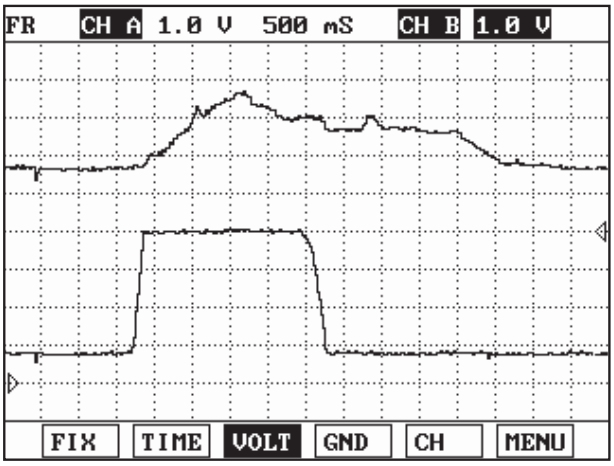


Fig. 1 Check with oscilloscope waveform

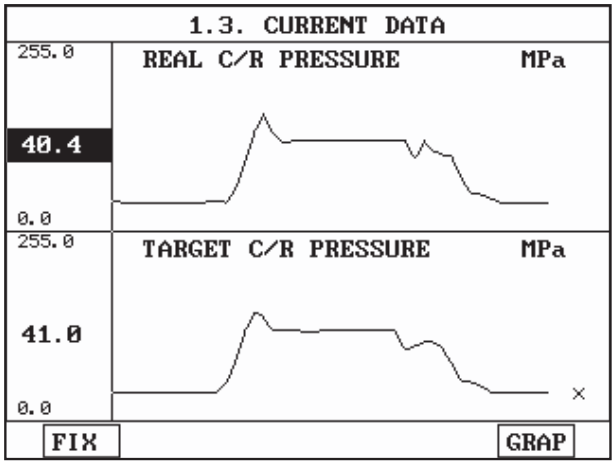


Fig. 2 Check with control information

Fig1) This is waveform checked together with accelerator pedal position sensor 1 and rail pressure sensor and it is confirmable that rail pressure sensor output is increased at sudden acceleration.

SUDFL8082L

MONITOR SCAN TOOL DATA E8E926E1

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Rail Pressure" parameter on the scan tool.

NOTE

The rail pressure changes with driving conditions depending on DTC detecting condition. In case of fail safe, be sure to check that fuel pressure is fixed to 450 bar and fuel amount is limited to below 60㎣/st.

■ Specification: 400±20 bar at idle

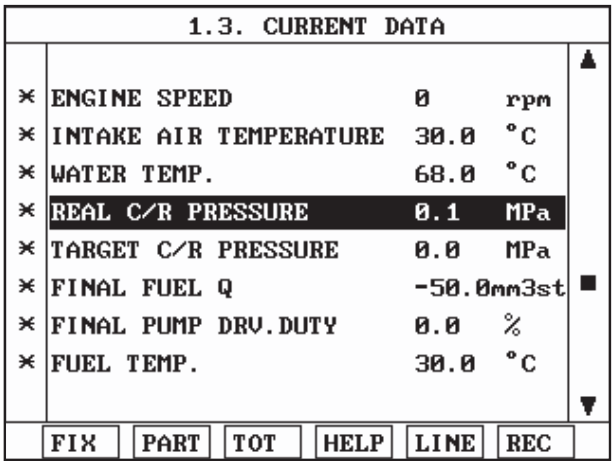


Fig. 1 Fuel pressure sensor data at ignition ON

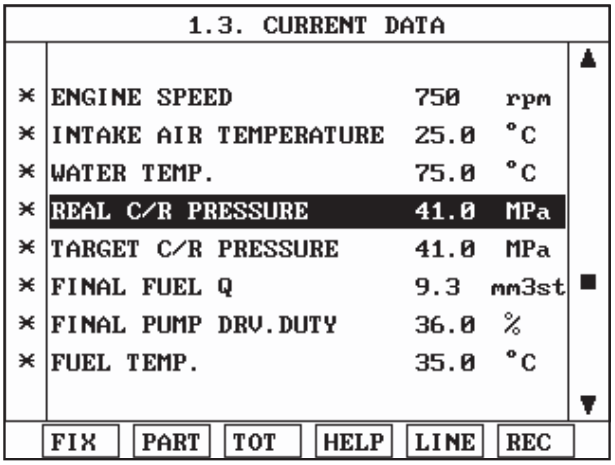


Fig. 2 Fuel pressure sensor data at idle

SUDFL8083L

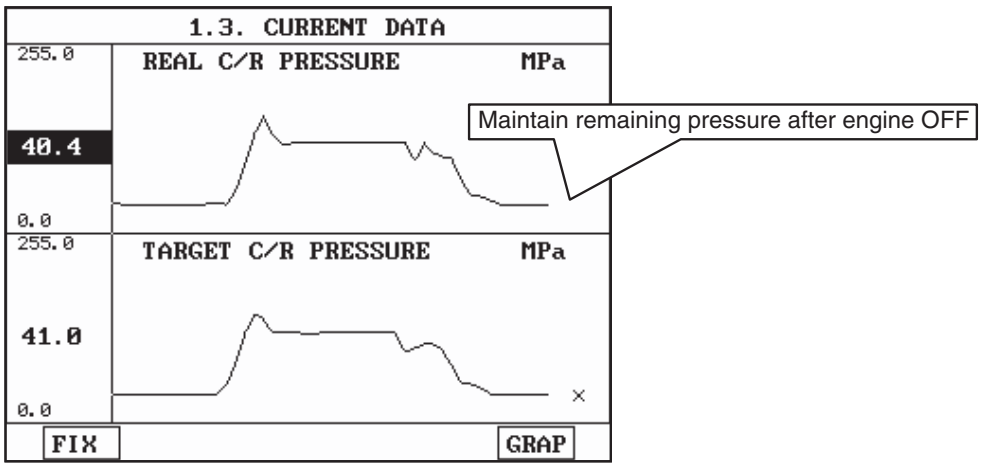
Fig. 1)~2) Check "Rail pressure" item at idle after engine warming-up.
Monitor pressure change of rail pressure sensor after starting the engine. Approx. 400 bar of pressure occurs at hot idle(750rpm) and it is important to check duty of rail pressure regulator. Check that duty ratio of 36.5% shown above service data is displayed. The service data increase depending on acceleration and load condition and rail pressure increases to max. 1,400bar, duty of rail pressure regulator increases up to 95%.

TROUBLESHOOTING AIDS E05F6059

It is necessary for DTC related to rail pressure to diagnose high pressure fuel system and low pressure fuel system collectively.
High pressure fuel pressure: Poor high pressure of high pressure fuel pump, the ball valve seat of rail pressure regulator poor contact or stuck, overflow valve clogged, fuel leak of injector nozzle and return circuit
Low pressure fuel pressure: Poor fuel supply of low pressure fuel pump, fuel filter clogged

NOTE

Overflow valve plays a role to return fuel to fuel tank by opening valve to protect fuel system when common rail fuel pressure is generated excessively more than 2,210 bar.



SUDFL8084L

Above waveform indicates pressure change of rail pressure at starting and engine OFF. It is possible to diagnose fuel system by checking that internal pressure of common rail maintains at engine OFF and how long pressure of approx. 400 bar in common rail will take at starting.

1. It is important for rail pressure to rise rapidly at starting.
   ▶ It is easy to diagnose what condition supply of low pressure fuel pump is, how high pressure of high pressure fuel pump is made, that air tightness of rail pressure regulator remains, and that air tightness of injector nozzle and return side remains.

2. It is important to maintain air tightness at below 101 bar of common rail pressure regulator and decrease fuel pressure little by little at engine OFF.
   ▶ It is easy to diagnose that air tightness of rail pressure regulator remains, and that air tightness of injector nozzle and return side remains.

   NOTE

   Check after the ignition is in ON again not to lose data due to communication cut-off between scan tool and ECM since main relay turns OFF at engine OFF.

TERMINAL & CONNECTOR INSPECTION EB4BA7F1

Refer to DTC P0112.

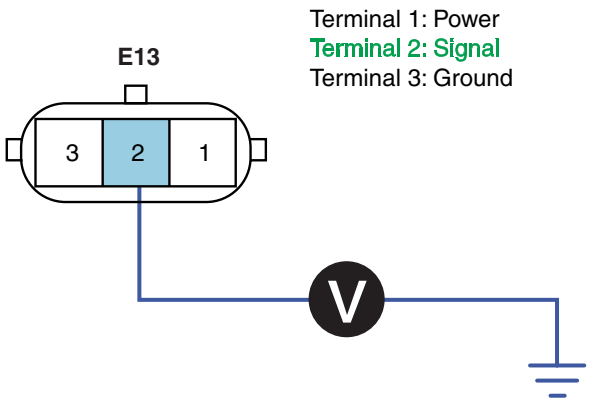
SIGNAL CIRCUIT INSPECTION E3D391AD

1. Signal Voltage Inspection

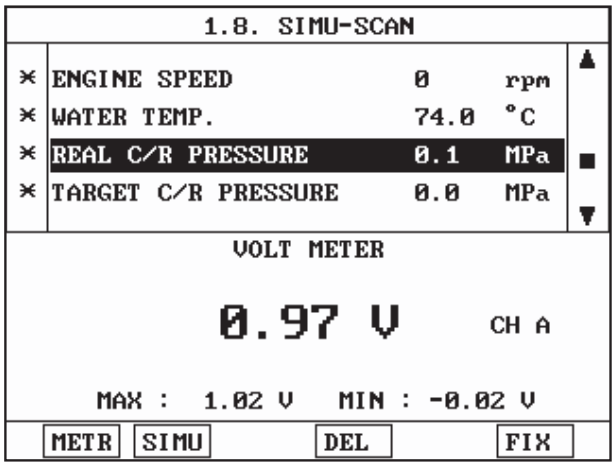
   1) Leave fuel pressure sensor connector(E13) connected.

   2) Turn ignition ON. The engine stops.

   3) Measure voltage between terminal 2 of fuel pressure sensor harness connector and chassis ground.



Terminal 1: Power
Terminal 2: Signal
Terminal 3: Ground



▶ With fuel pressure connector connected at ignition ON

SUDFL8085L

■ Specification: Fuel pressure sensor signal power approx. 1.0V
Note : Signal power can be measured differently depending on rail pressure change.

   4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

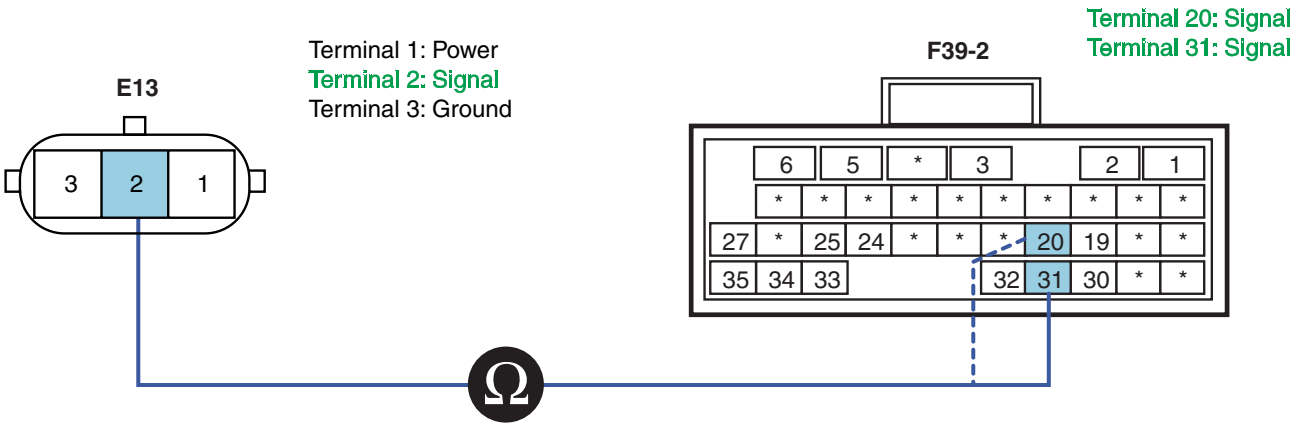
▶ Go to "Signal Open Inspection" procedure.

2. Signal Open Inspection

1) Turn the ignition OFF.

2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

3) Measure resistance between terminal 2 of fuel pressure sensor harness connector and terminals 20,31 of ECM connector(F39-2).



SNBFL8040L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Ground Inspection" procedure.

NO

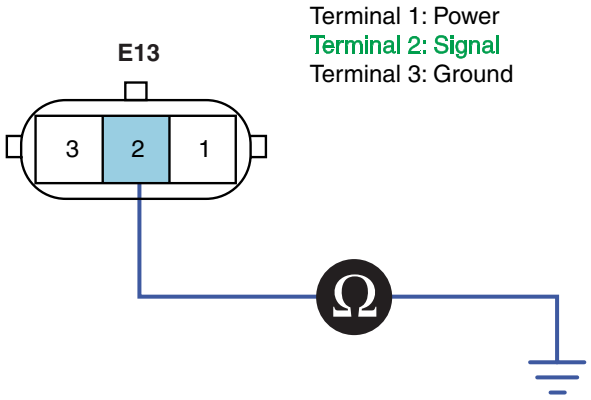
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Signal Short to Ground Inspection

1) Turn the ignition OFF.

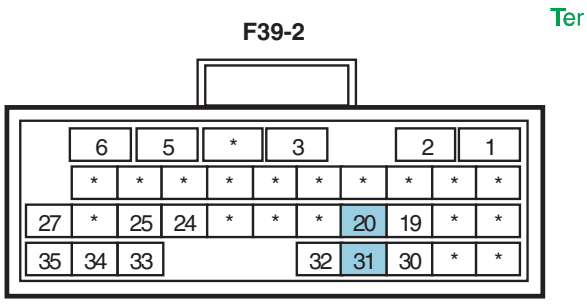
2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

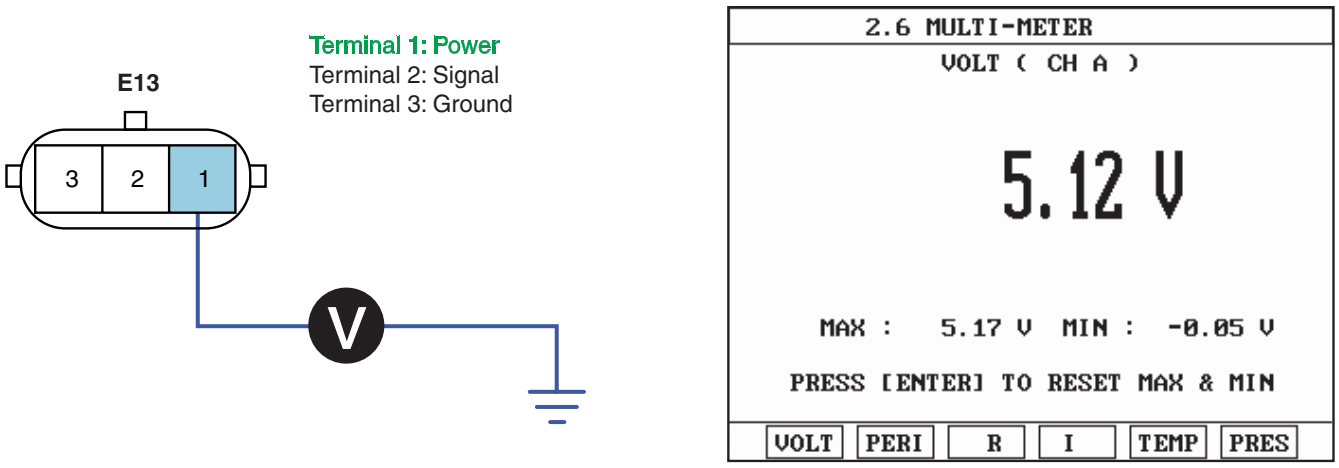
3) Measure resistance between terminal 2 of fuel pressure sensor harness connector and chassis ground.



SUDFL8087L

4) Measure resistance between terminals 20,31 of ECM harness connector(F39-2) and chassis ground.





SUDFL8089L

■ Specification: ECM output approx. 5.27V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

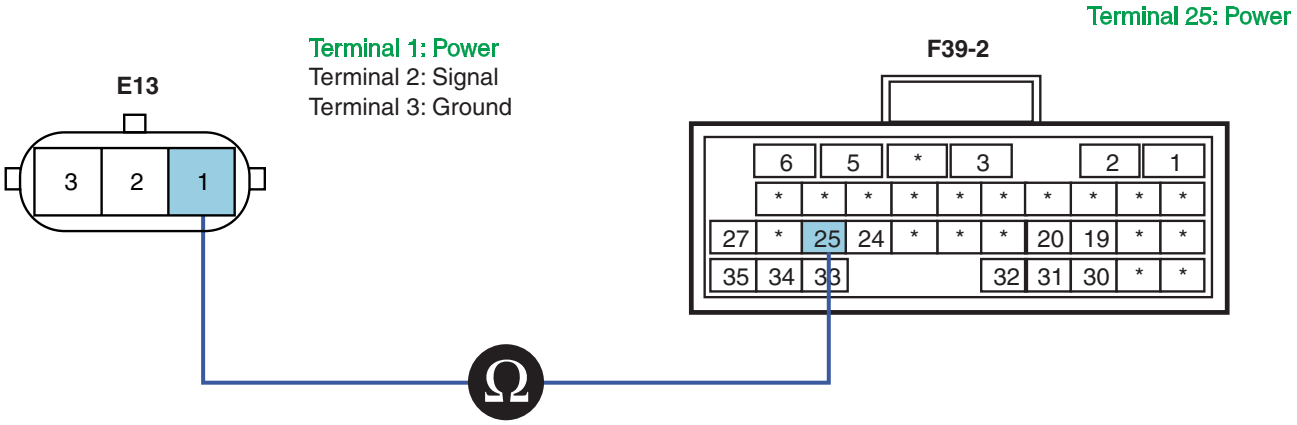
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn the ignition OFF.

2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of fuel pressure sensor harness connector and terminal 25 of ECM connector(F39-2).



SNBFL8042L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

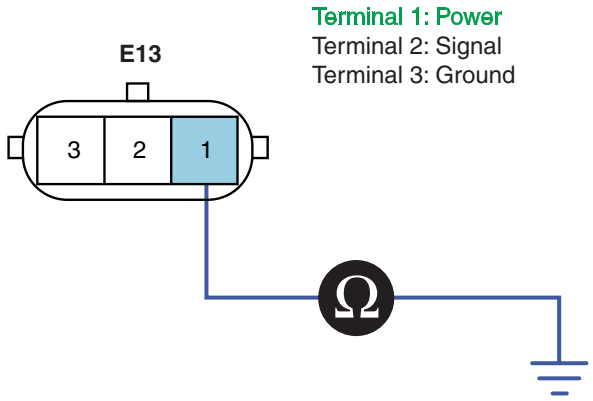
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Power Supply Short to Power Inspection

1) Turn ignition OFF.

2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of fuel pressure sensor harness connector and chassis ground.



SUDFL8091L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

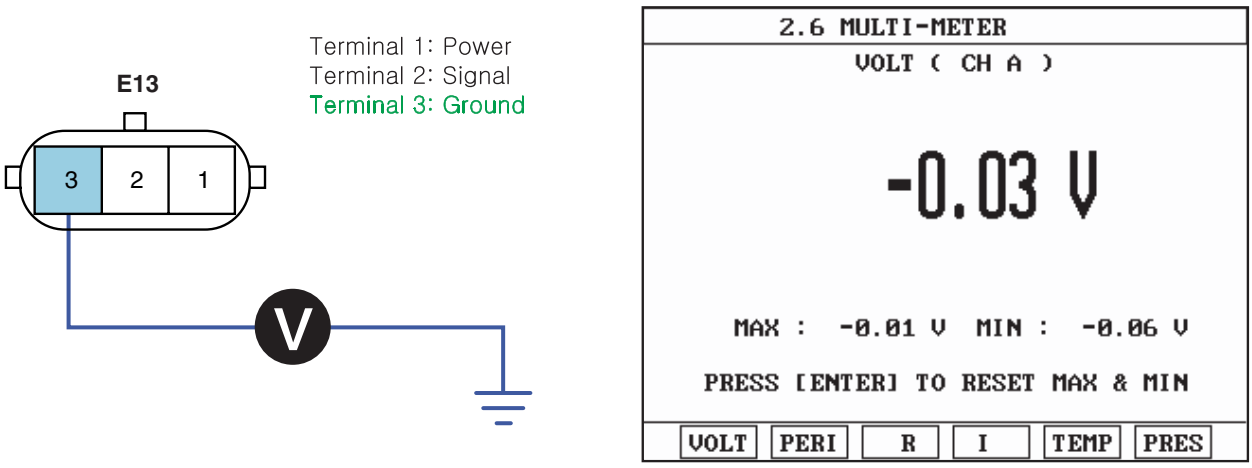
GROUND CIRCUIT INSPECTION E4F22B2D

1. Ground Voltage Drop Inspection

1) Disconnect fuel pressure sensor connector(E13).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 3 of fuel pressure sensor harness connector and chassis ground.



SUDFL8092L

■ Specification: Ground voltage drop - Within 200mV

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

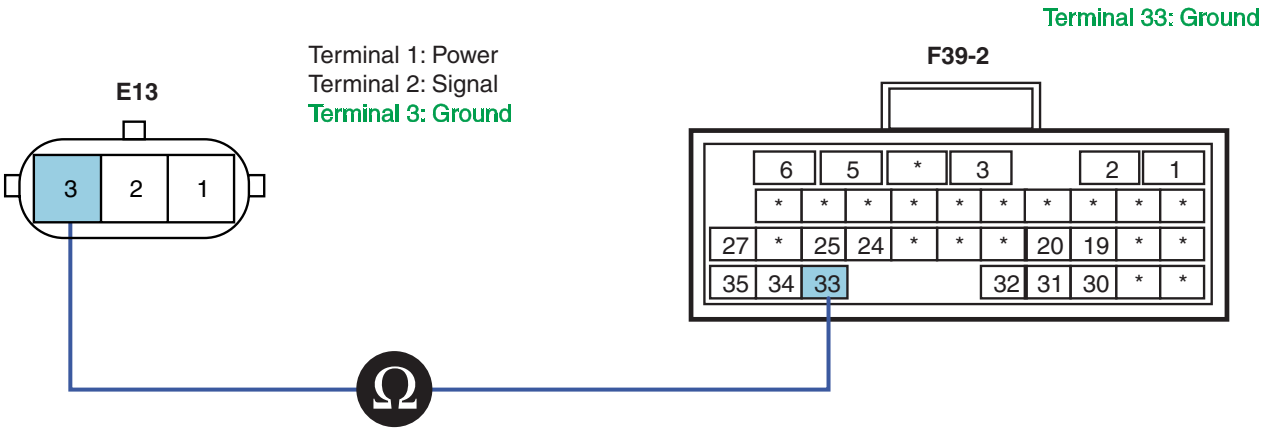
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

3) Measure resistance between terminal 3 of fuel pressure sensor harness connector and terminal 33 of ECM connector(F39-2).



SNBFL8043L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EA79A373

1. Fuel Pressure Sensor Inspection

   1) Turn the ignition OFF.

   2) Leave the fuel pressure sensor connector(E13) installed.

   3) Start the engine and compare fuel pressure and fuel pressure signal voltage according to detecting condition.

NOTE

The value of fuel pressure and signal voltage changes with driving conditions depending on DTC detecting condition. In case of fail safe, be sure to check that fuel pressure is fixed at 400 Kpa.

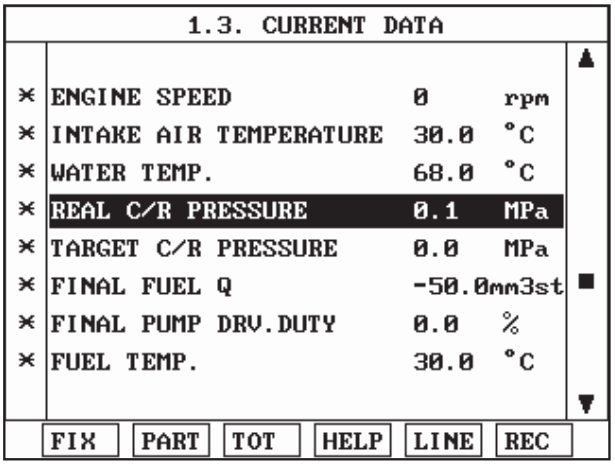


Fig. 1 Fuel pressure sensor data at IG ON

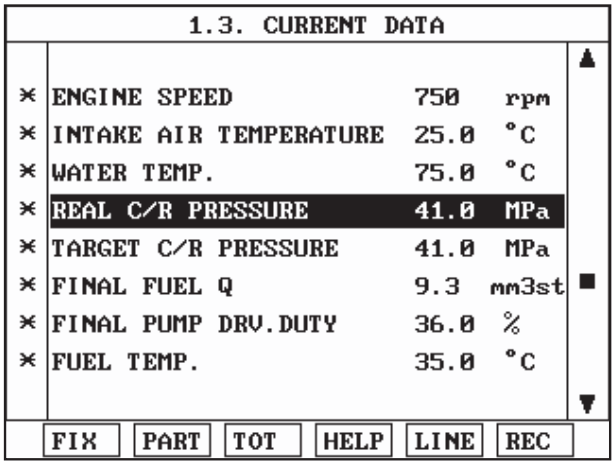


Fig. 2 Fuel pressure sensor data at idle

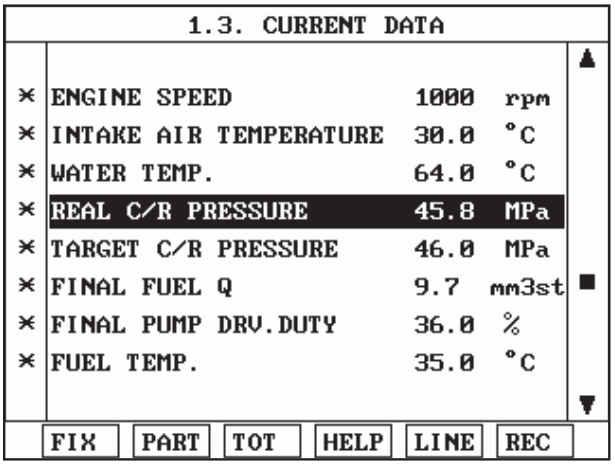


Fig. 3 Fuel pressure sensor data at 1,000rpm

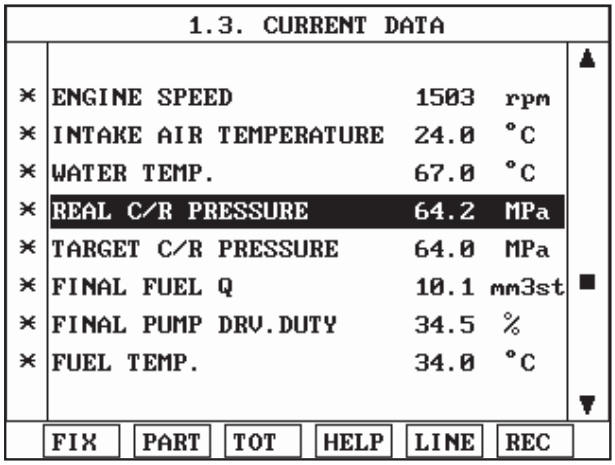


Fig. 4 Fuel pressure sensor data at 1,500rpm

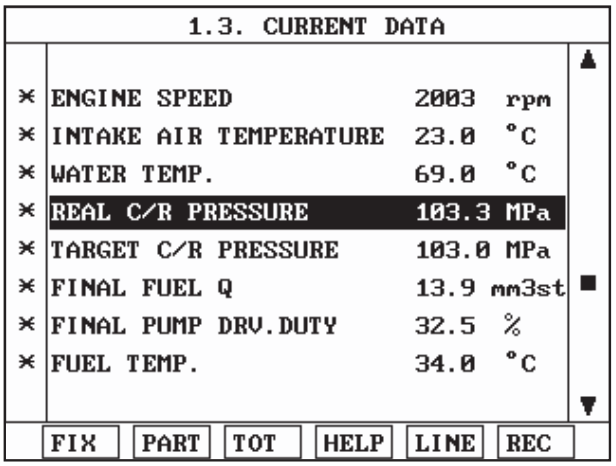


Fig. 5 Fuel pressure sensor data at 2,000rpm

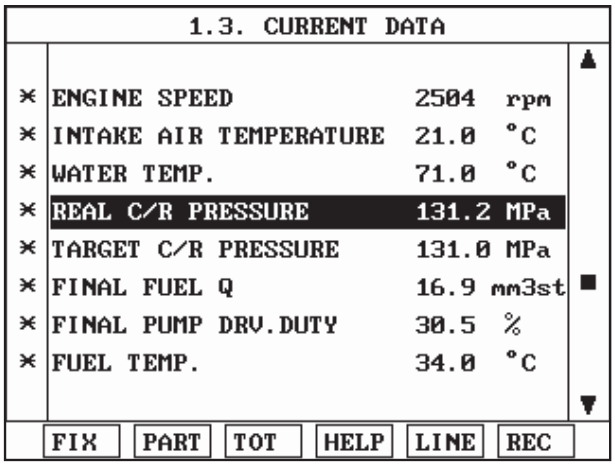


Fig. 6 Fuel pressure sensor data at 2,500rpm

SUDFL8016L

4) Is the measured output value within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the fuel pressure sensor and then go to "Verification of Vehicle Repair" procedure.

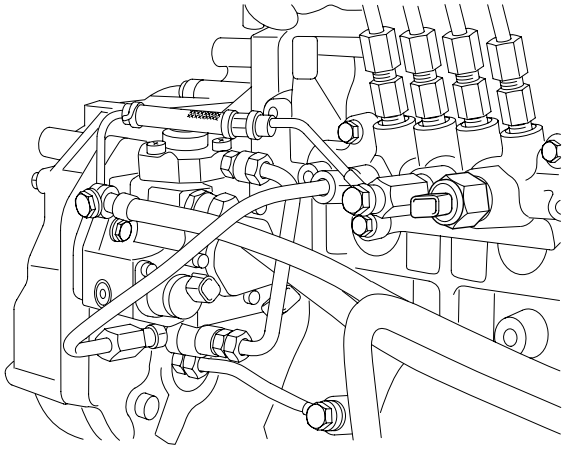
VERIFICATION OF VEHICLE REPAIR E9C0DFDE

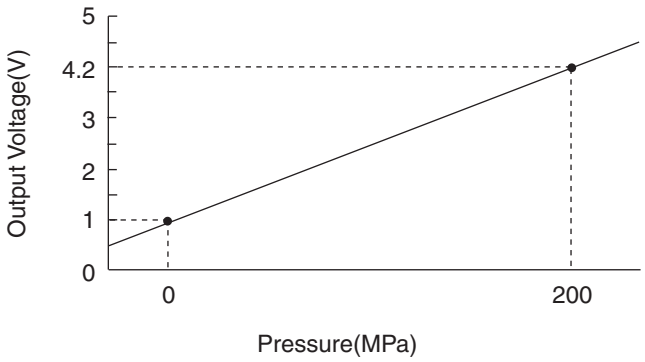
Refer to DTC P0112.

DTC P0193 C/RAIL PRESSURE SENSOR SIGNAL HIGH

COMPONENT LOCATION E7F86CAB

Fuel rail pressure sensor





SUDFL8079L

DESCRIPTION ECE0C36B

1. GENERAL DESCRIPTION
   Rail pressure sensor converts fuel pressure in rail into voltage signal and sends signal to ECM. ECM uses the signal to determine fuel amount. The sensor element which converts pressure into electric signal is connected to diaphragm and is activated like a analog resistance. The resistance changes with diaphragm change of rail pressure At this time, rail pressure is converted into electric signal. The bridge circuit of diaphragm is amplified into 0.5~4.2V(0~2,000bar) and is displayed into voltage.

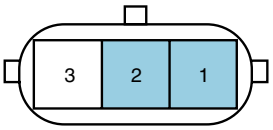
2. DTC DESCRIPTION
   If rail pressure sensor is detected above 4.7V for 200ms or more, ECM judges this as a fault and DTC is set. The possible causes may be faulty common rail pressure sensor, defective wiring & resistance, open in terminals 20, 31, 33 of ECM connector(F39-2). The vehicle can be driven but lack of engine power will occur since ECM controls fuel amount to below 63㎣/st at 450 bar of fuel pressure in case of fail safe.

DTC DETECTING CONDITION EBC1867F

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="5">• Poor connection of connector
• Short to ground
• Open in terminal 20,31,33 of ECM(F39-2)</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• Above 4.7V</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 200ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• Fuel amount is limited to below 63mm³/st at 450 bar.
• Lack of engine power</td></tr>
<tr><td>Fuel Limit</td><td>Yes</td></tr>
<tr><td>MIL</td><td>ON</td></tr>
</table>

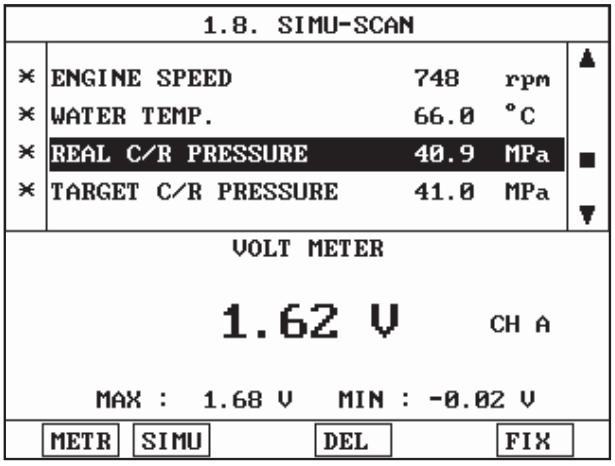
SPECIFICATION EC4A897C

Rail pressure sensor	Specification
Output voltage	Below 1.7V (At idle after engine warming-up)
Rail pressure	350~500 bar(Engine idling)



Sensor connector

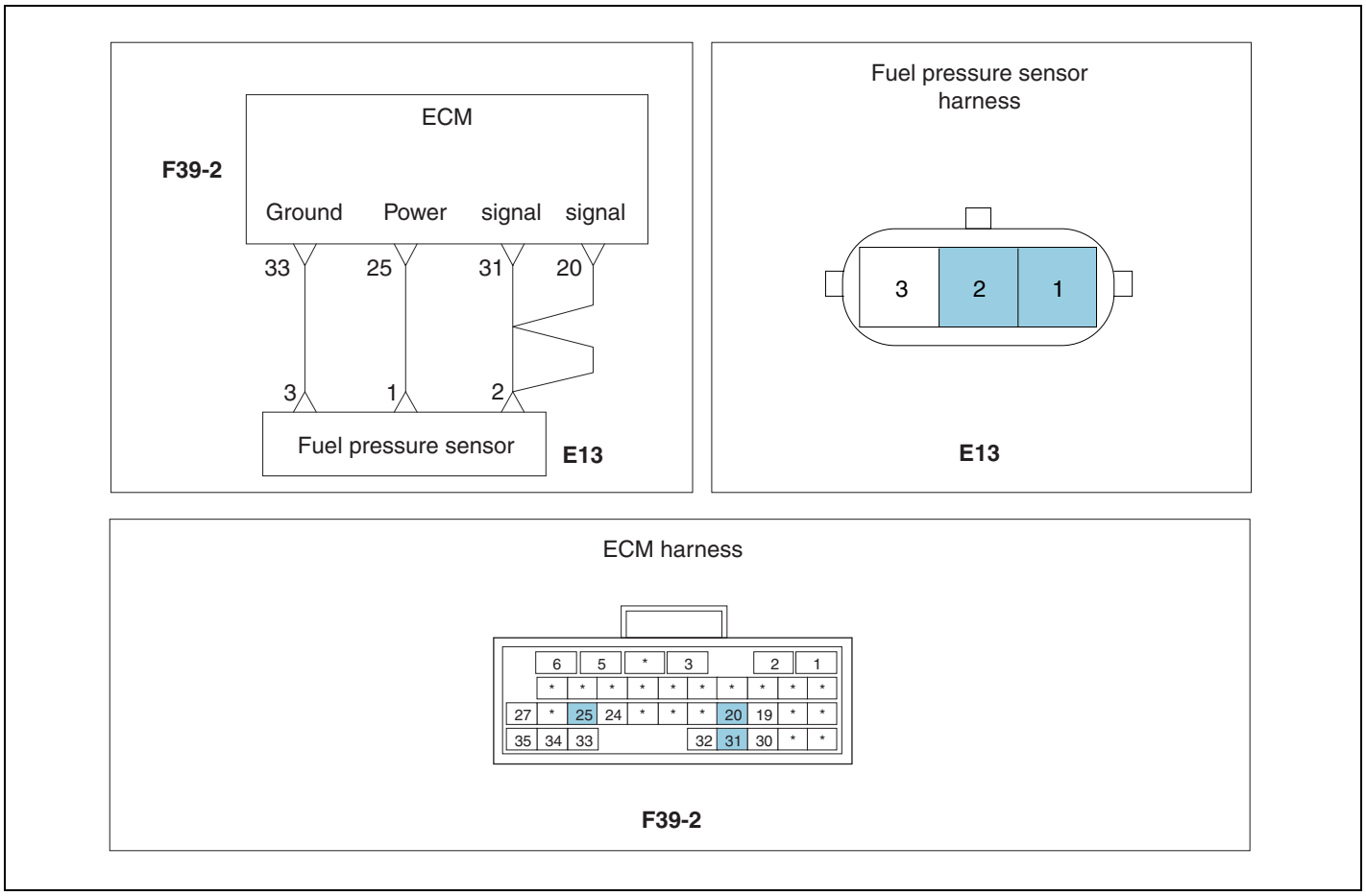
Terminal 1: Power
Terminal 2: Signal
Terminal 3: Ground



Resistance	Specification(20˚C)
1, 2	3 KΩ
1, 3	13 KΩ
2, 3	16.4 KΩ

SUDFL8080L

SCHEMATIC DIAGRAM EA29DFD1



SNBFL8039L

WAVEFORM E5E25DE0

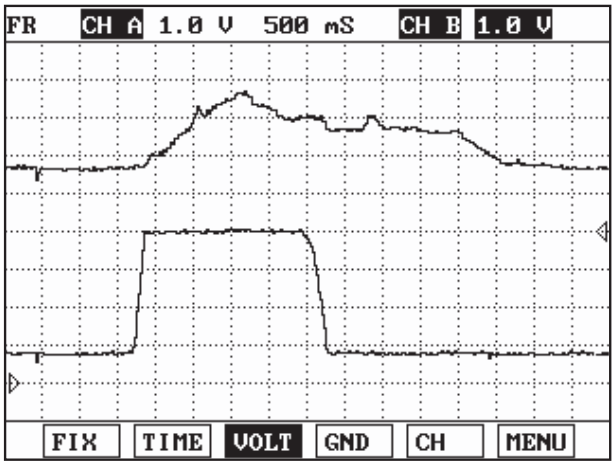


Fig. 1 Check with oscilloscope waveform

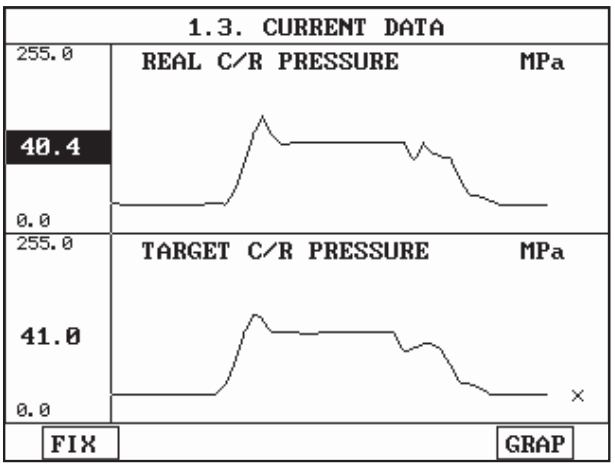


Fig. 2 Check with control information

Fig1) This is waveform checked together with accelerator pedal position sensor 1 and rail pressure sensor and it is confirmable that rail pressure sensor output is increased at sudden acceleration.

SUDFL8082L

MONITOR SCAN TOOL DATA E3B926D5

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Rail Pressure" parameter on the scan tool.

NOTE

The rail pressure changes with driving conditions depending on DTC detecting condition. In case of fail safe, be sure to check that fuel pressure is fixed to 450 bar and fuel amount is limited to below 63㎣/st.

■ Specification: 400±20 bar at idle

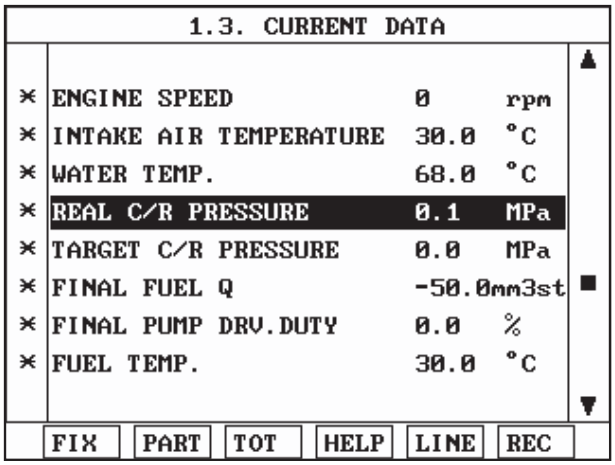


Fig. 1 Fuel pressure sensor data at ignition ON

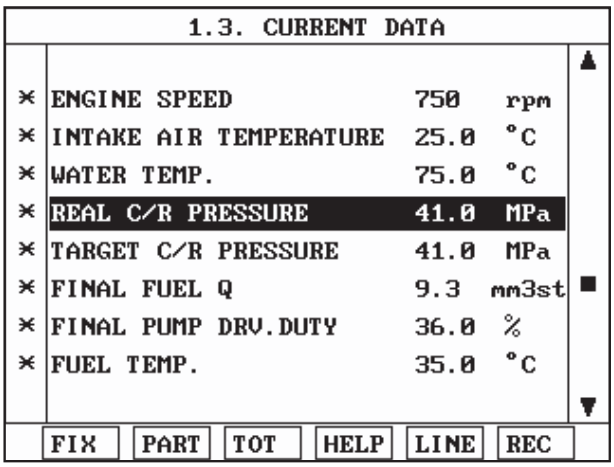


Fig. 2 Fuel pressure sensor data at idle

SUDFL8083L

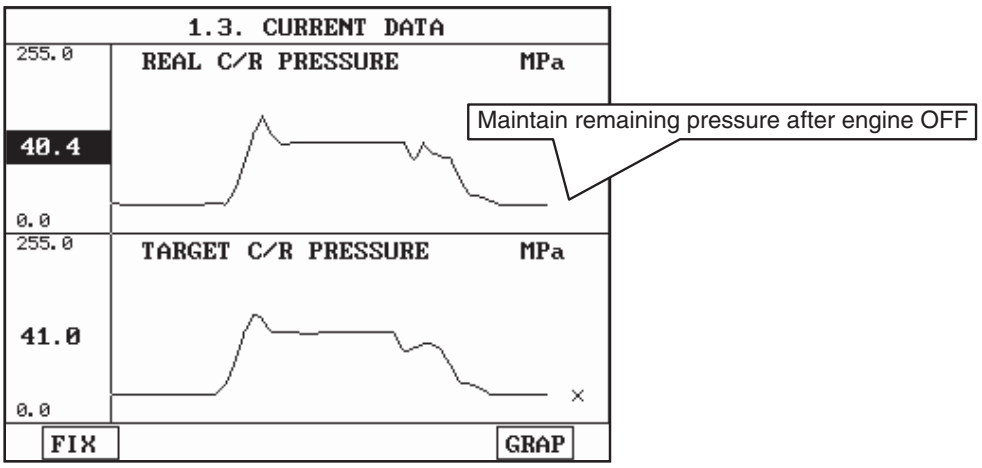
Fig. 1)~2) Check "Rail pressure" item at idle after engine warming-up.
Monitor pressure change of rail pressure sensor after starting the engine. Approx. 400 bar of pressure occurs at hot idle(750rpm) and it is important to check duty of rail pressure regulator. Check that duty ratio of 36.5% shown above service data is displayed. The service data increase depending on acceleration and load condition and rail pressure increases to max. 1,400bar, duty of rail pressure regulator increases up to 95%.

TROUBLESHOOTING AIDS E5AFC0E5

It is necessary for DTC related to rail pressure to diagnose high pressure fuel system and low pressure fuel system collectively.
High pressure fuel pressure: Poor high pressure of high pressure fuel pump, the ball valve seat of rail pressure regulator poor contact or stuck, overflow valve clogged, fuel leak of injector nozzle and return circuit
Low pressure fuel pressure: Poor fuel supply of low pressure fuel pump, fuel filter clogged

NOTE

Overflow valve plays a role to return fuel to fuel tank by opening valve to protect fuel system when common rail fuel pressure is generated excessively more than 2,210 bar.



SUDFL8084L

Above waveform indicates pressure change of rail pressure at starting and engine OFF. It is possible to diagnose fuel system by checking that internal pressure of common rail maintains at engine OFF and how long pressure of approx. 400 bar in common rail will take at starting.

1. It is important for rail pressure to rise rapidly at starting.
   ▶ It is easy to diagnose what condition supply of low pressure fuel pump is, how high pressure of high pressure fuel pump is made, that air tightness of rail pressure regulator remains, and that air tightness of injector nozzle and return side remains.

2. It is important to maintain air tightness at below 101 bar of common rail pressure regulator and decrease fuel pressure little by little at engine OFF.
   ▶ It is easy to diagnose that air tightness of rail pressure regulator remains, and that air tightness of injector nozzle and return side remains.

NOTE

Check after the ignition is in ON again not to lose data due to communication cut-off between scan tool and ECM since main relay turns OFF at engine OFF.

TERMINAL & CONNECTOR INSPECTION ED80974C

Refer to DTC P0112.

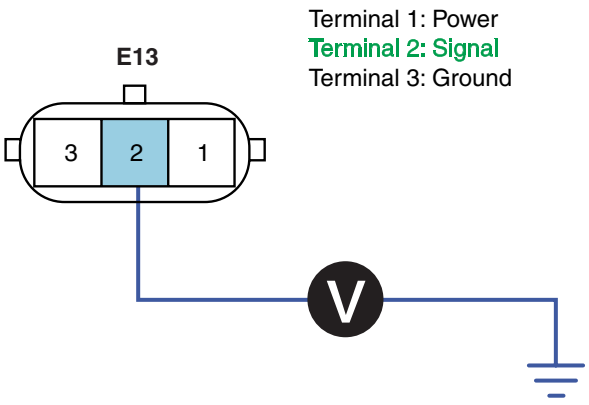
SIGNAL CIRCUIT INSPECTION E41A1319

1. Signal Voltage Inspection

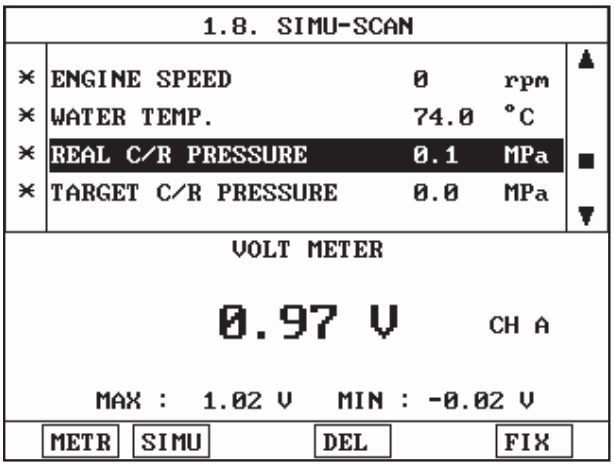
   1) Leave fuel pressure sensor connector(E13) connected.

   2) Turn ignition ON. The engine stops.

   3) Measure voltage between terminal 2 of fuel pressure sensor harness connector and chassis ground.



Terminal 1: Power
Terminal 2: Signal
Terminal 3: Ground



▶ With fuel pressure connector connected at ignition ON

SUDFL8085L

■ Specification: Fuel pressure sensor signal power approx. 1.0V
Note : Signal power can be measured differently depending on rail pressure change.

   4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

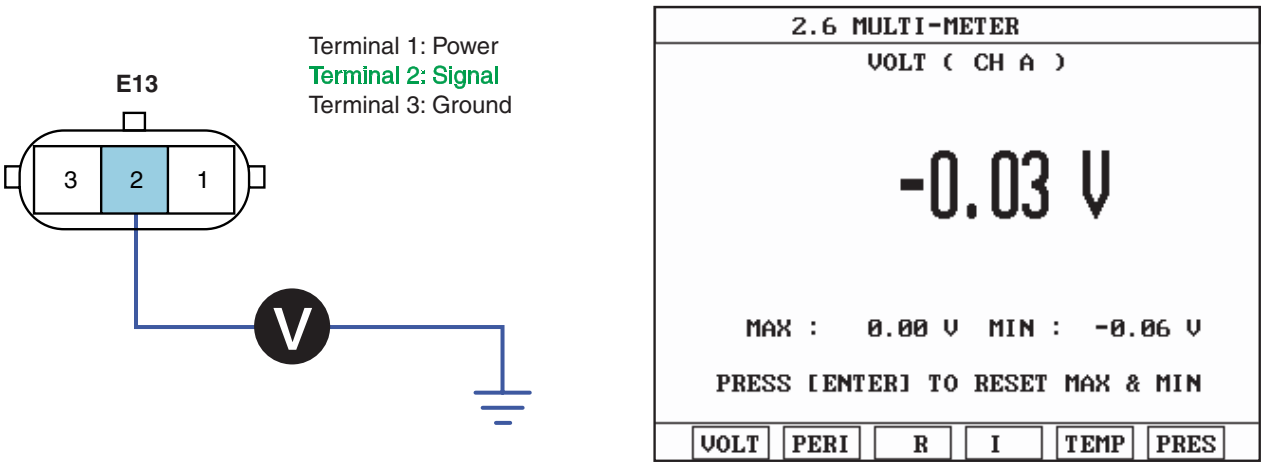
▶ Go to "Signal Short to Power Inspection" procedure.

2. Signal Short to Power Inspection

1) Turn the ignition OFF.

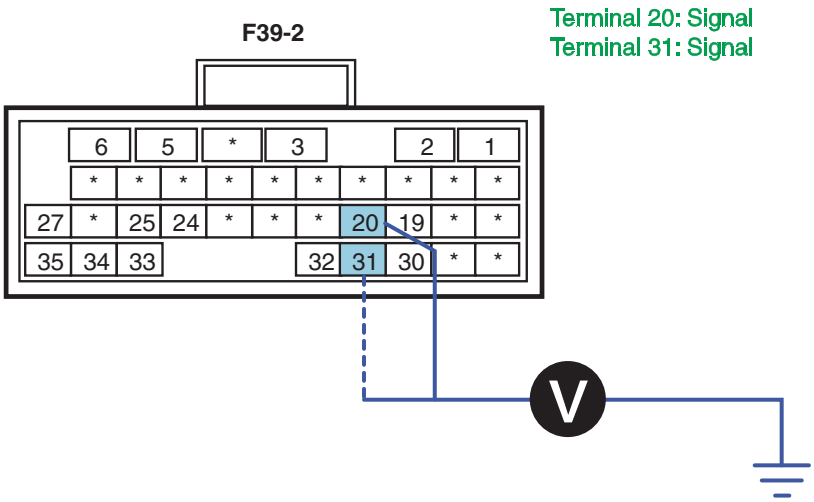
2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

3) Measure resistance between terminal 2 of fuel pressure sensor harness connector and chassis ground.



SUDFL8094L

4) Measure voltage between terminals 20,31 of ECM harness connector(F39-2) and chassis ground.



SNBFL8044L

■ Specification: Below 0~0.1V

5) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

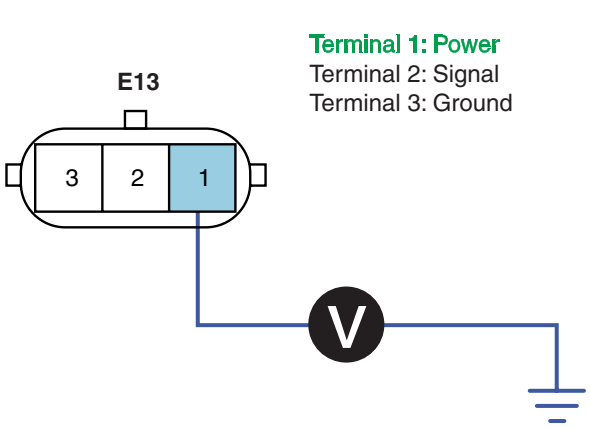
POWER SUPPLY INSPECTION EF6AFA97

1. Power Supply Voltage Inspection

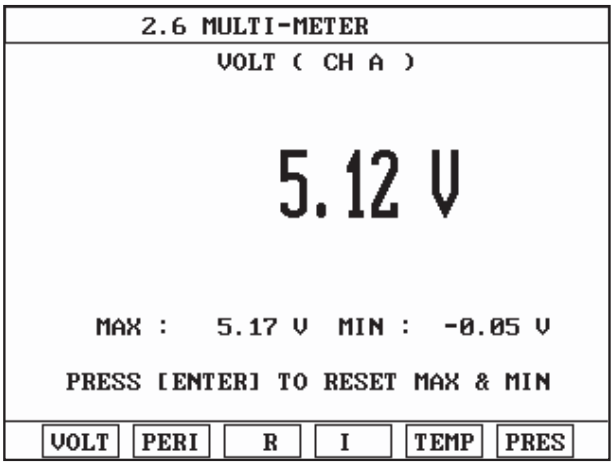
   1) Disconnect fuel pressure sensor connector(E13).

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 1 of fuel pressure sensor harness connector and chassis ground.



Terminal 1: Power
Terminal 2: Signal
Terminal 3: Ground



SUDFL8089L

   ■ Specification: ECM output approx. 5.27V

   4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

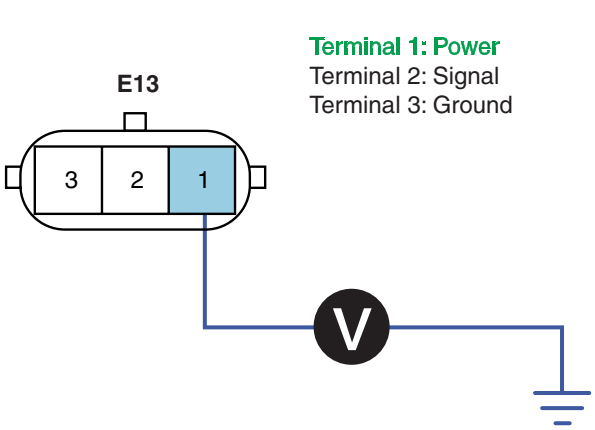
▶ Go to "Power Supply Short to Power Inspection" procedure.

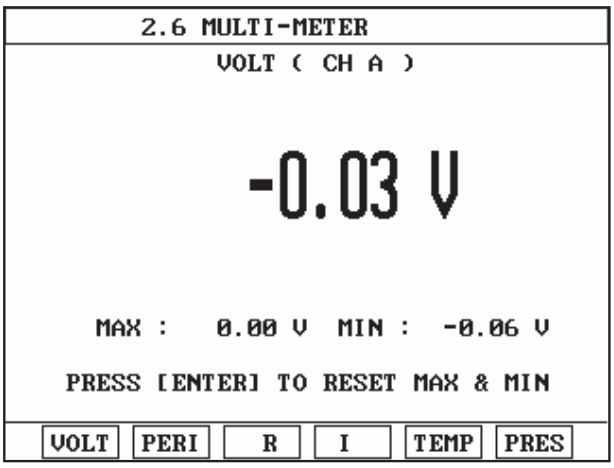
2. Power Supply Short to Power Inspection

   1) Turn the ignition OFF.

   2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

   3) Measure voltage between terminal 1 of fuel pressure sensor harness connector and chassis ground.





SUDFL8096L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

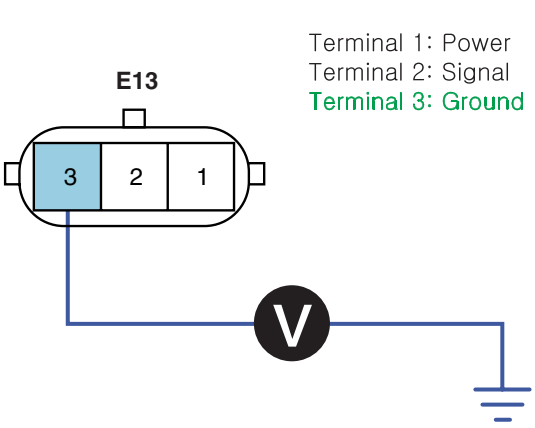
GROUND CIRCUIT INSPECTION E5DDF6DE

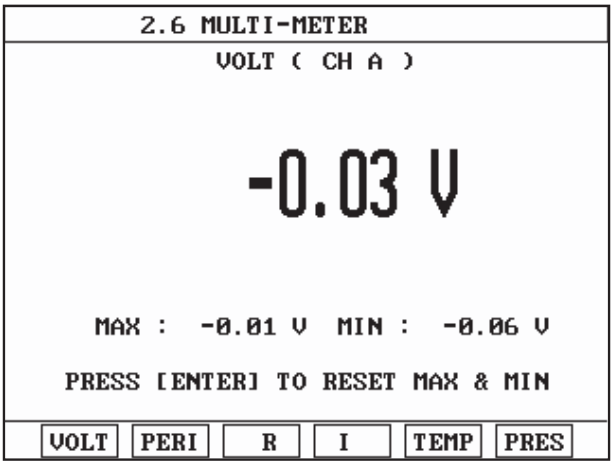
1. Ground Voltage Drop Inspection

1) Disconnect fuel pressure sensor connector(E13).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 3 of fuel pressure sensor harness connector and chassis ground.





SUDFL8092L

■ Specification: Ground voltage drop - Within 200mV

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

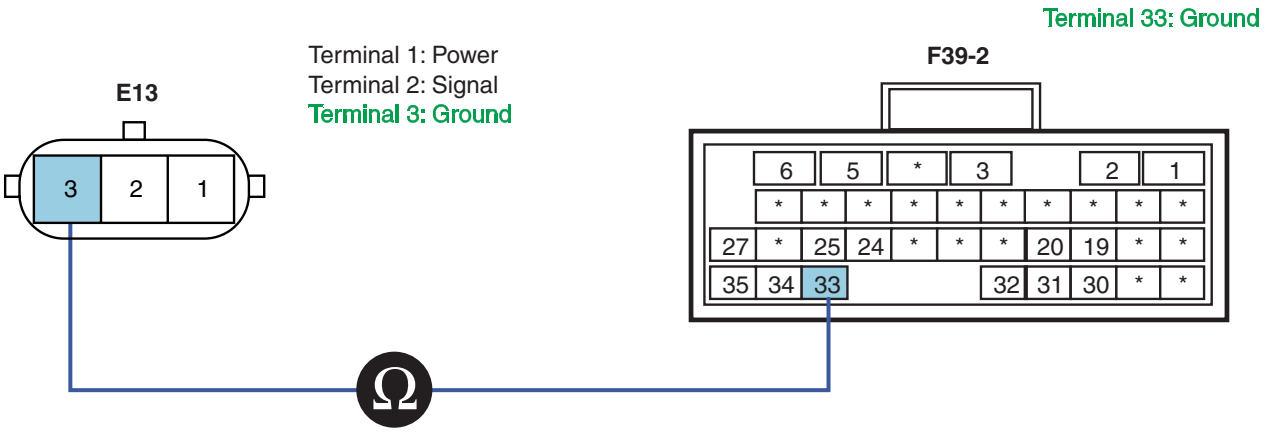
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

3) Measure resistance between terminal 3 of fuel pressure sensor harness connector and terminal 33 of ECM connector(F39-2).



SNBFL8043L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E37A35E5

1. Fuel Pressure Sensor Inspection

1) Turn the ignition OFF.

2) Leave the fuel pressure sensor connector(E13) installed.

3) Start the engine and compare fuel pressure and fuel pressure signal voltage according to detecting condition.

4) Is the measured output value within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the fuel pressure sensor and then go to "Verification of Vehicle Repair" procedure.

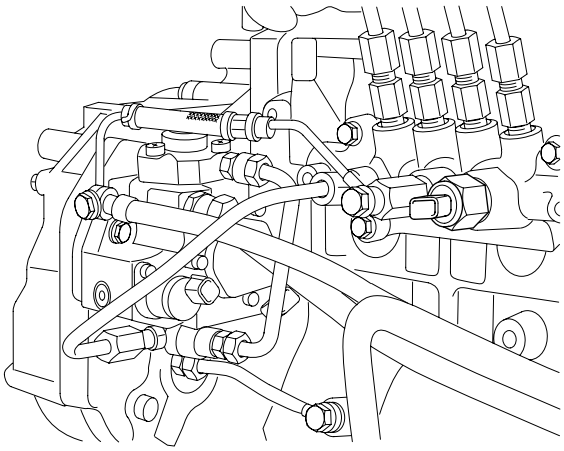
VERIFICATION OF VEHICLE REPAIR EC674AFB

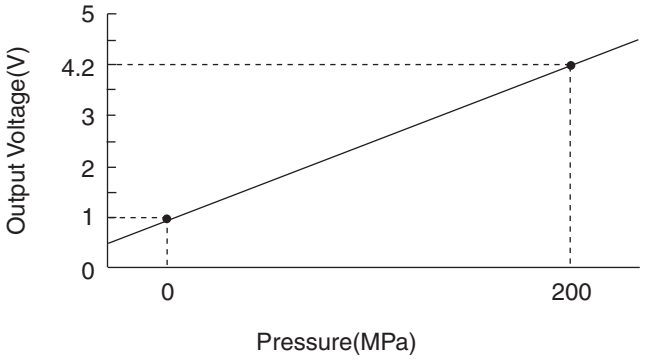
Refer to DTC P0112.

DTC P0194 C/RAIL PRESSURE SENSOR INTERMITTENT

COMPONENT LOCATION E14B48C6

Fuel rail pressure sensor





SUDFL8079L

DESCRIPTION EB782EBC

1. GENERAL DESCRIPTION
   Rail pressure sensor converts fuel pressure in rail into voltage signal and sends signal to ECM. ECM uses the signal to determine fuel amount. The sensor element which converts pressure into electric signal is connected to diaphragm and is activated like a analog resistance. The resistance changes with diaphragm change of rail pressure At this time, rail pressure is converted into electric signal. The bridge circuit of diaphragm is amplified into 0.5~4.2V(0~2,000bar) and is displayed into voltage.

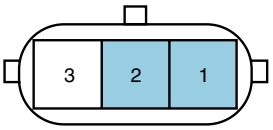
2. DTC DESCRIPTION
   Even though target rail pressure is more 200 bar than actual rail pressure at cranking, when voltage change of rail pressure sensor is below 0.0001V or the difference between target rail pressure and actual rail pressure is more than 200 bar after starting, ECM judges this as a fault and DTC is set if voltage change of rail pressure sensor is below 0.0001V for 16008.5ms or more. It is related to faulty sensor output value. Check sensor output value if output value of this sensor is still the same when value of other sensors(barometric pressure sensor, intake air temperature sensor etc.) changes.
   Lack of engine power will occur since fuel amount is limited to below 40㎣/st in case of fail safe.

DTC DETECTING CONDITION E6B19905

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Check sensor output value
Enable Conditions	• Running			
Threshold Value	• Below 0.0001V			
Diagnosis Time	• 16008.5 ms or more			
Fail Safe	Fuel Cut	No	• Fuel amount is limited to below 40mm³/st . • Lack of engine power	
	Fuel Limit	Yes		
	MIL	ON		

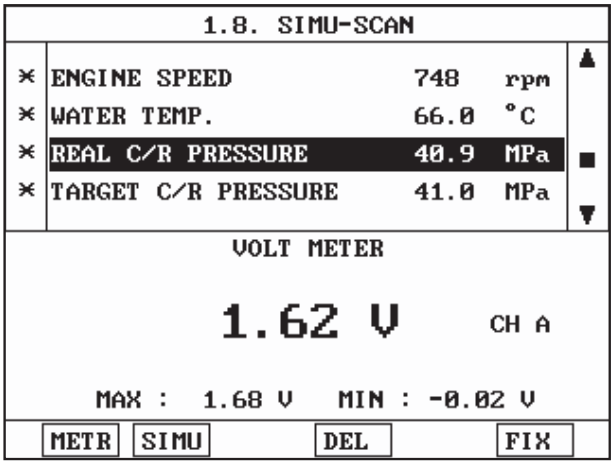
SPECIFICATION E378C6A5

Rail pressure sensor	Specification
Output voltage	Below 1.7V (At idle after engine warming-up)
Rail pressure	350~500 bar(Engine idling)



Sensor connector

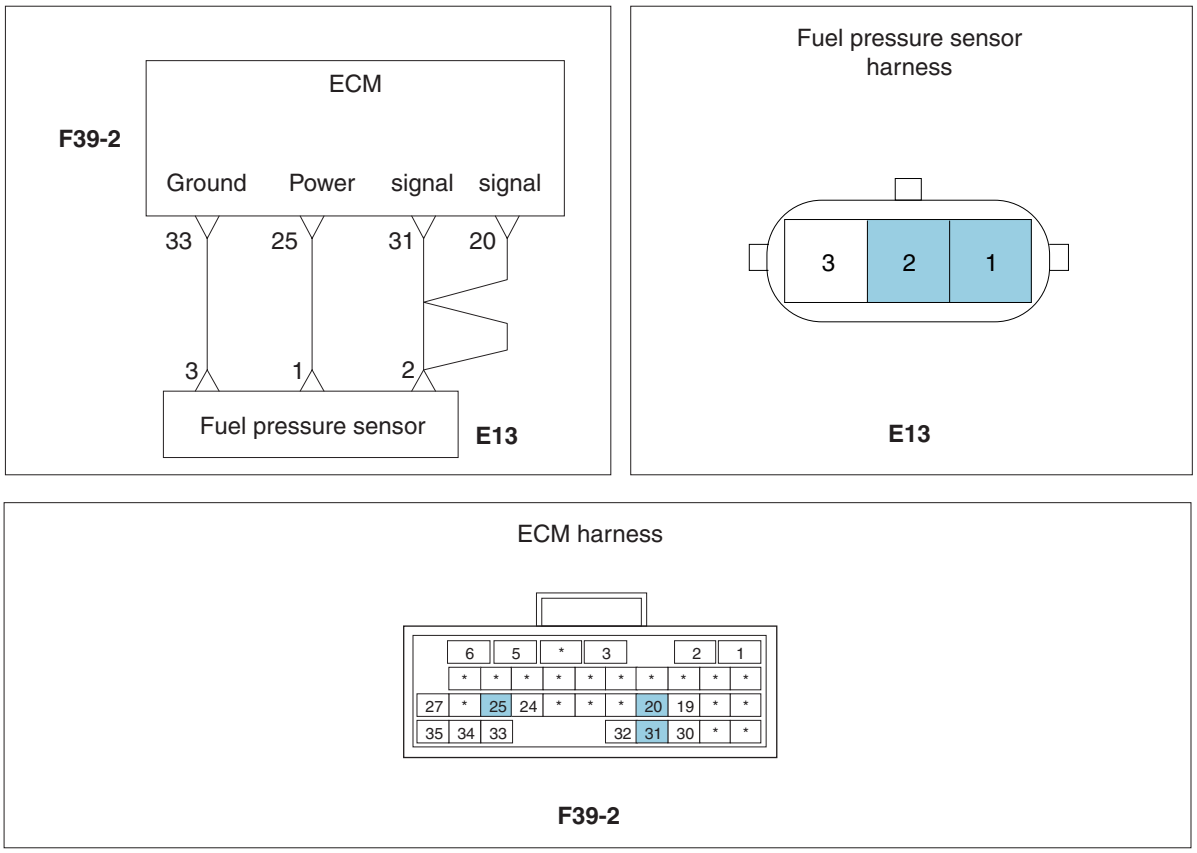
Terminal 1: Power
Terminal 2: Signal
Terminal 3: Ground



Resistance	Specification(20˚C)
1, 2	3 KΩ
1, 3	13 KΩ
2, 3	16.4 KΩ

SUDFL8080L

SCHEMATIC DIAGRAM EEEE3BA9



SNBFL8039L

WAVEFORM E762D2E8

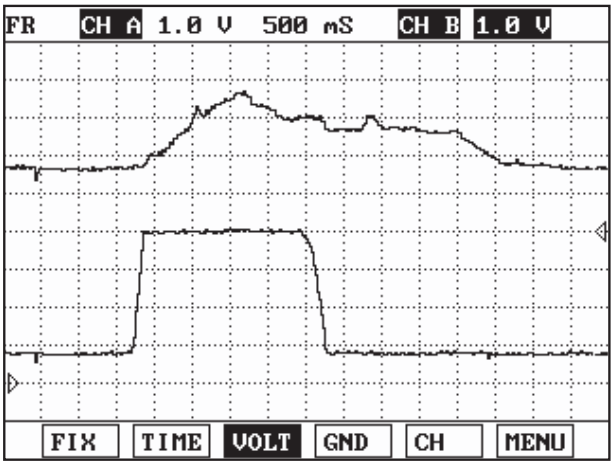


Fig. 1 Check with oscilloscope waveform

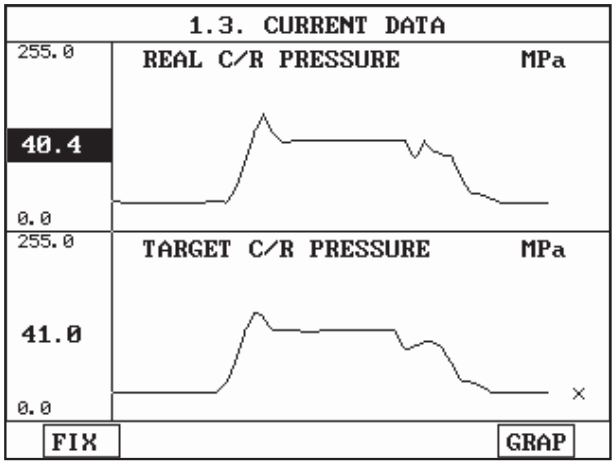


Fig. 2 Check with control information

Fig1) This is waveform checked together with accelerator pedal position sensor 1 and rail pressure sensor and it is confirmable that rail pressure sensor output is increased at sudden acceleration.

SUDFL8082L

MONITOR SCAN TOOL DATA E2B8A2A5

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Rail Pressure" parameter on the scan tool.

NOTE

The rail pressure changes with driving conditions depending on DTC detecting condition. In case of fail safe, be sure to check that fuel amount is limited to below 40㎣/st.

■ Specification: 400±20 bar at idle

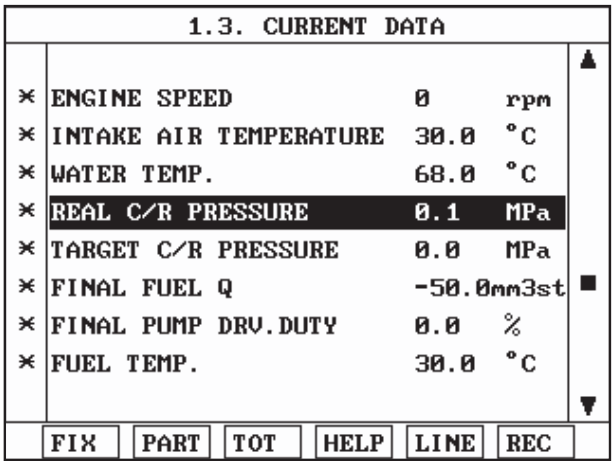


Fig. 1 Fuel pressure sensor data at ignition ON

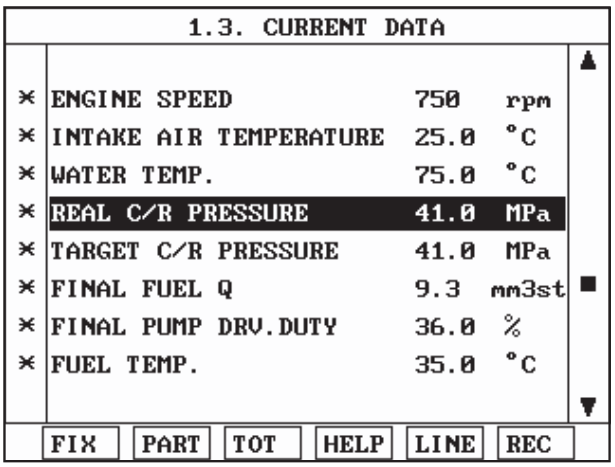


Fig. 2 Fuel pressure sensor data at idle

SUDFL8083L

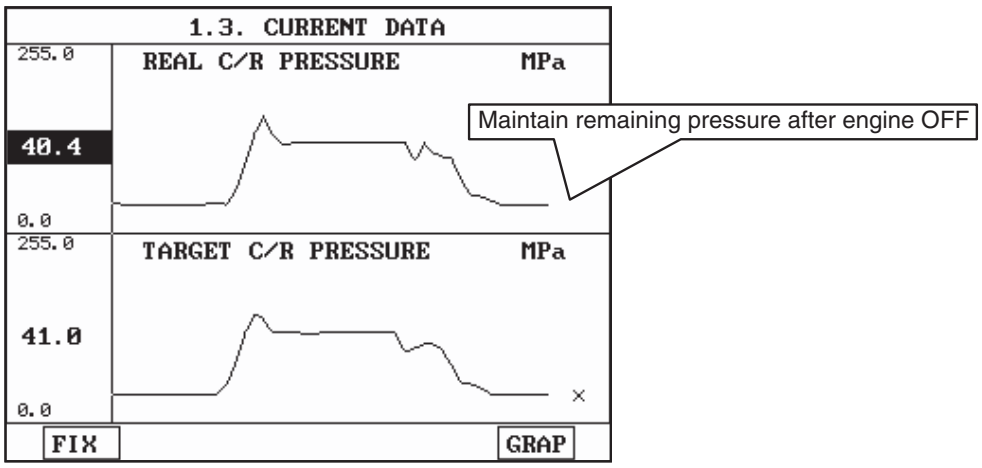
Fig. 1)~2) Check "Rail pressure" item at idle after engine warming-up.
Monitor pressure change of rail pressure sensor after starting the engine. Approx. 400 bar of pressure occurs at hot idle(750rpm) and it is important to check duty of rail pressure regulator. Check that duty ratio of 36.5% shown above service data is displayed. The service data increase depending on acceleration and load condition and rail pressure increases to max. 1,400bar, duty of rail pressure regulator increases up to 95%.

TROUBLESHOOTING AIDS E8074646

It is necessary for DTC related to rail pressure to diagnose high pressure fuel system and low pressure fuel system collectively.
High pressure fuel pressure: Poor high pressure of high pressure fuel pump, the ball valve seat of rail pressure regulator poor contact or stuck, overflow valve clogged, fuel leak of injector nozzle and return circuit
Low pressure fuel pressure: Poor fuel supply of low pressure fuel pump, fuel filter clogged

NOTE

Overflow valve plays a role to return fuel to fuel tank by opening valve to protect fuel system when common rail fuel pressure is generated excessively more than 2,210 bar.



SUDFL8084L

Above waveform indicates pressure change of rail pressure at starting and engine OFF. It is possible to diagnose fuel system by checking that internal pressure of common rail maintains at engine OFF and how long pressure of approx. 400 bar in common rail will take at starting.

1. It is important for rail pressure to rise rapidly at starting.
   ▶ It is easy to diagnose what condition supply of low pressure fuel pump is, how high pressure of high pressure fuel pump is made, that air tightness of rail pressure regulator remains, and that air tightness of injector nozzle and return side remains.

2. It is important to maintain air tightness at below 101 bar of common rail pressure regulator and decrease fuel pressure little by little at engine OFF.
   ▶ It is easy to diagnose that air tightness of rail pressure regulator remains, and that air tightness of injector nozzle and return side remains.

   NOTE

   Check after the ignition is in ON again not to lose data due to communication cut-off between scan tool and ECM since main relay turns OFF at engine OFF.

TERMINAL & CONNECTOR INSPECTION E4A28287

Refer to DTC P0112.

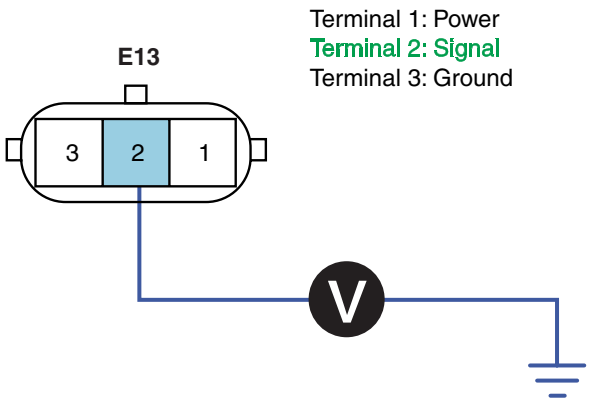
SIGNAL CIRCUIT INSPECTION E74617D6

1. Signal Voltage Inspection

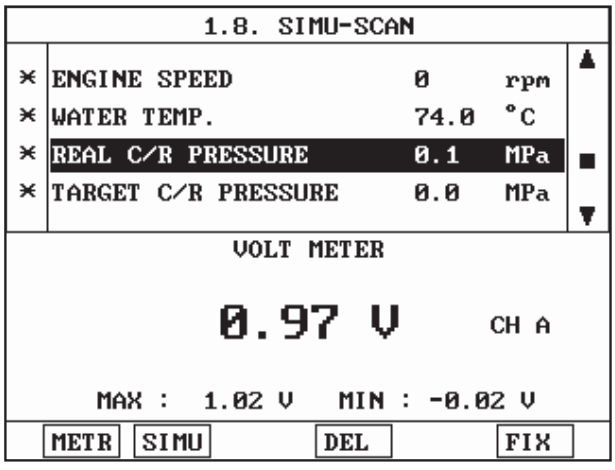
   1) Leave fuel pressure sensor connector(E13) connected.

   2) Turn ignition ON. The engine stops.

   3) Measure voltage between terminal 2 of fuel pressure sensor harness connector and chassis ground.



Terminal 1: Power
Terminal 2: Signal
Terminal 3: Ground



▶ With fuel pressure connector connected at ignition ON

SUDFL8085L

■ Specification: Fuel pressure sensor signal power approx. 1.0V
Note : Signal power can be measured differently depending on rail pressure change.

   4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

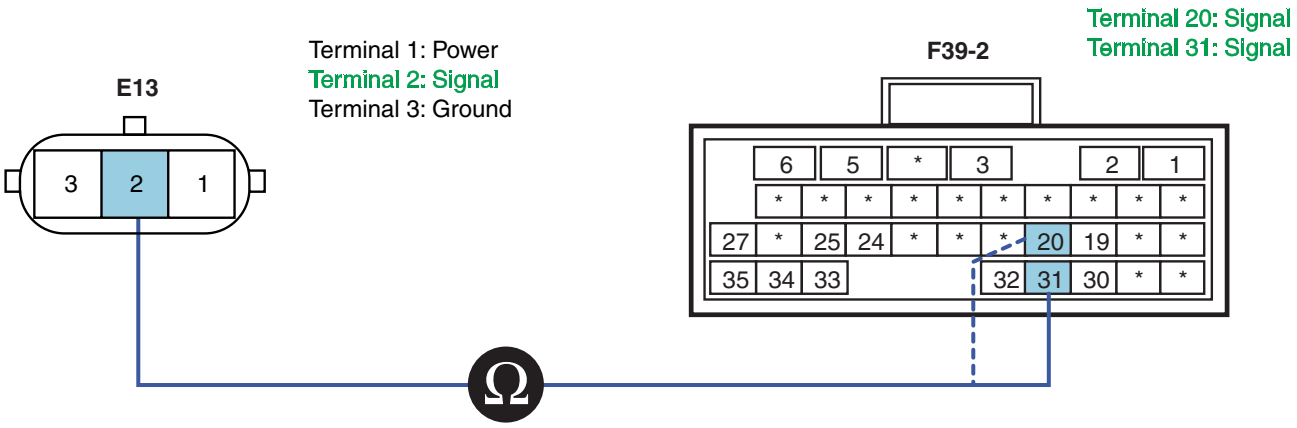
▶ Go to "Signal Open Inspection" procedure.

2. Signal Open Inspection

1) Turn the ignition OFF.

2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

3) Measure resistance between terminal 2 of fuel pressure sensor harness connector and terminals 20,31 of ECM connector(F39-2).



SNBFL8040L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Ground Inspection" procedure.

NO

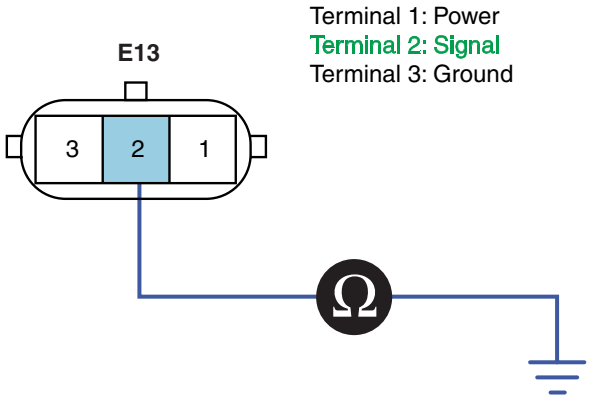
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Signal Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

3) Measure resistance between terminal 2 of fuel pressure sensor harness connector and chassis ground.



SUDFL8087L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Power Inspection" procedure.

NO

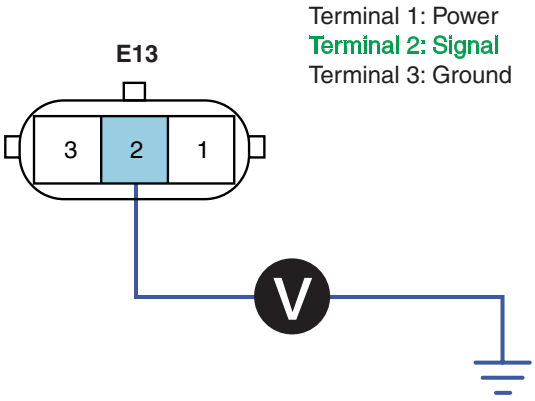
▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

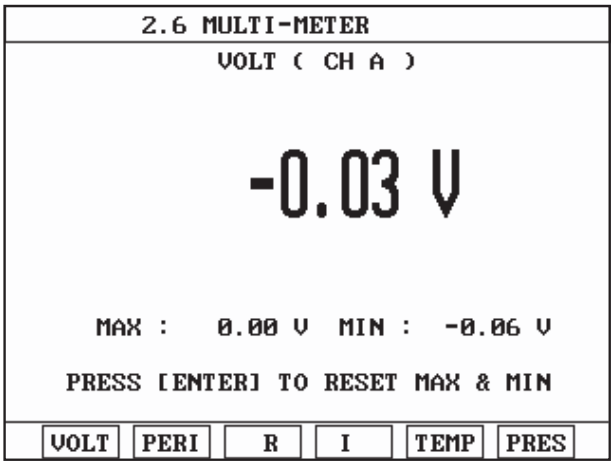
4. Signal Short to Power Inspection

1) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 2 of fuel pressure sensor harness connector and chassis ground.





SUDFL8094L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

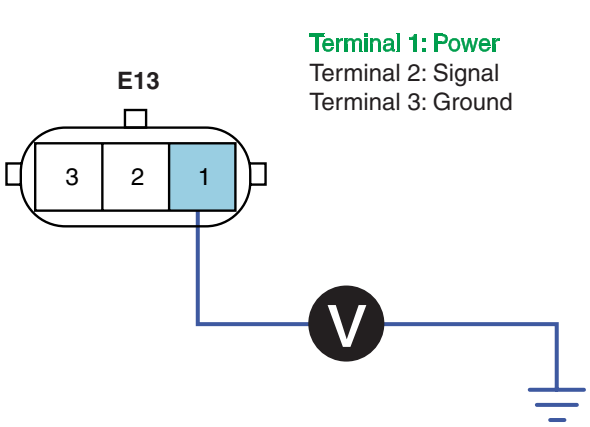
POWER SUPPLY INSPECTION E5AEF9B4

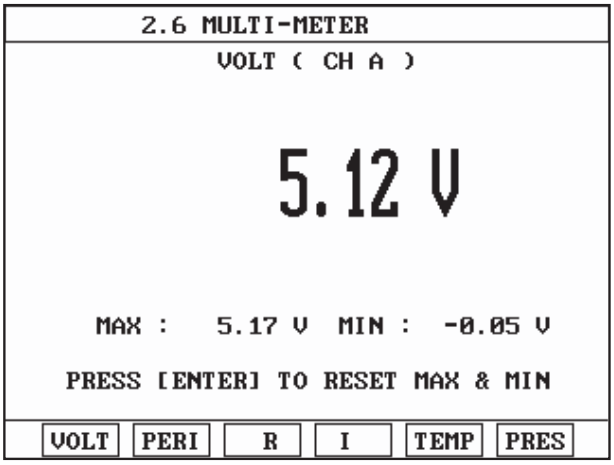
1. Power Supply Voltage Inspection

   1) Disconnect fuel pressure sensor connector(E13).

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 1 of fuel pressure sensor harness connector and chassis ground.





SUDFL8089L

■ Specification: ECM output approx. 5.27V

   4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

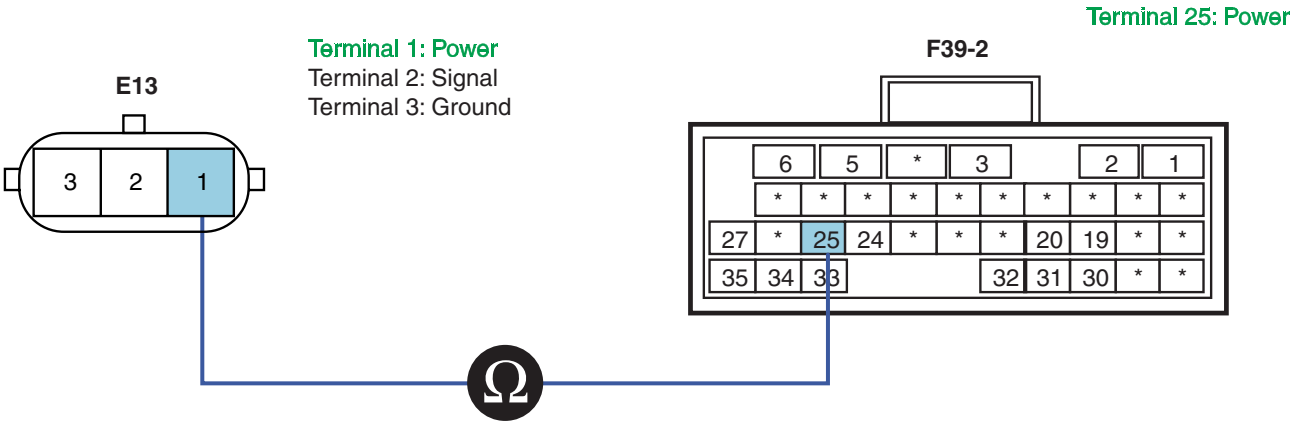
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

   1) Turn the ignition OFF.

   2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

   3) Measure voltage between terminal 1 of fuel pressure sensor harness connector and terminal 25 of ECM connector(F39-2).



SNBFL8042L

■ Specification: Continuity(Below1.0Ω)

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

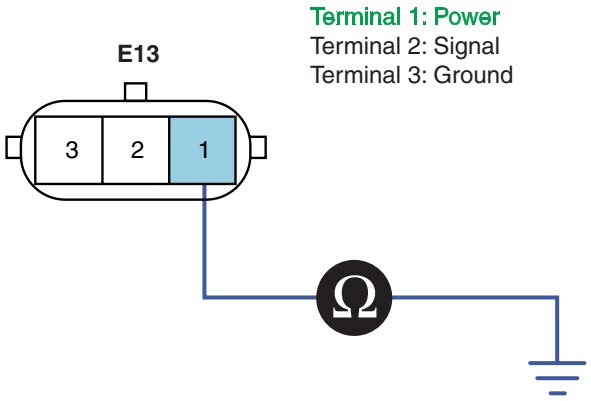
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of fuel pressure sensor harness connector and chassis ground.



SUDFL8091L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

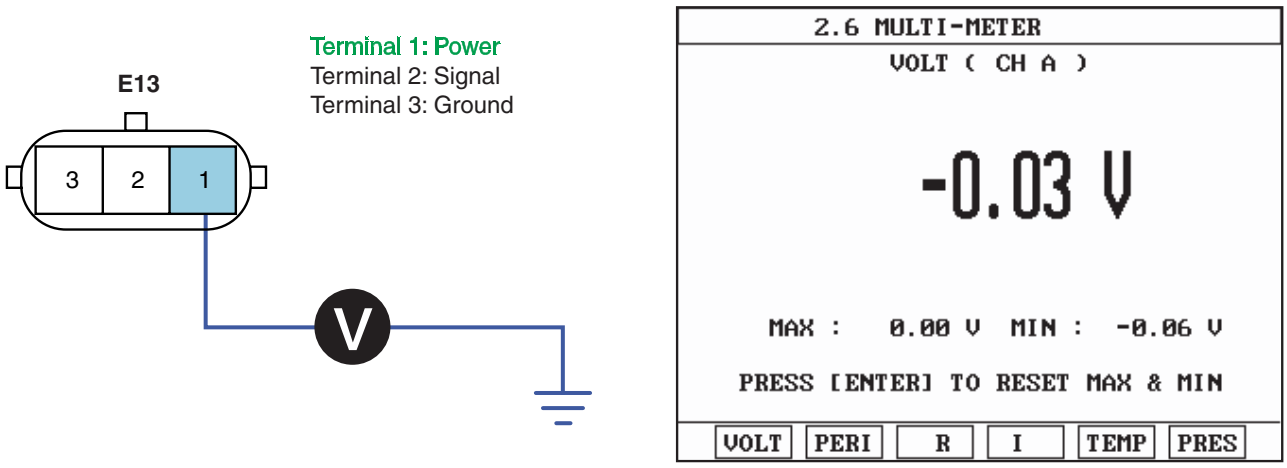
▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

4. Power Supply Short to Power Inspection

1) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of fuel pressure sensor harness connector and chassis ground.



SUDFL8096L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

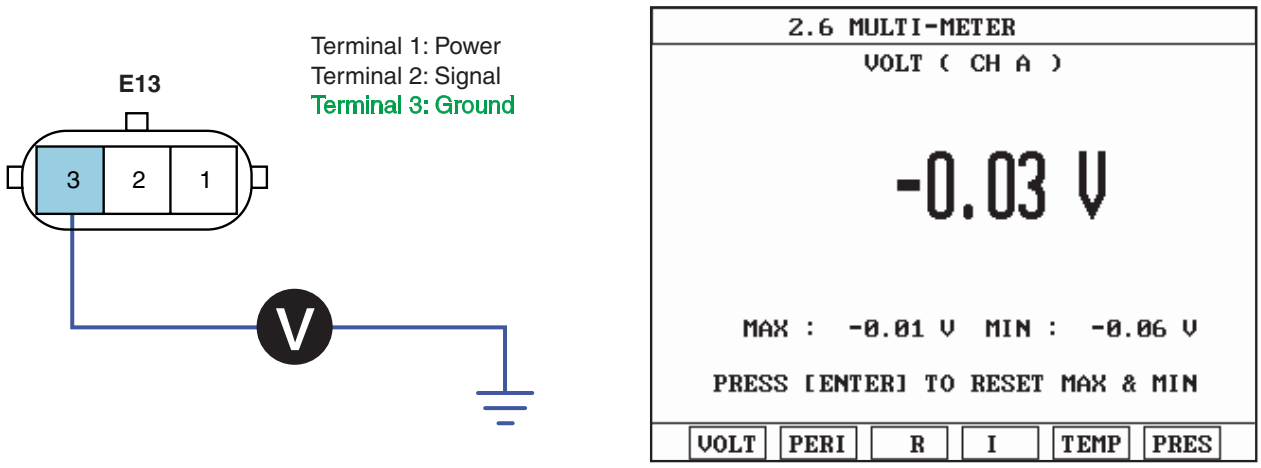
GROUND CIRCUIT INSPECTION EA4F1293

1. Ground Voltage Drop Inspection

1) Disconnect fuel pressure sensor connector(E13).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 3 of fuel pressure sensor harness connector and chassis ground.



SUDFL8097L

■ Specification: Ground voltage drop - Within 200mV

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

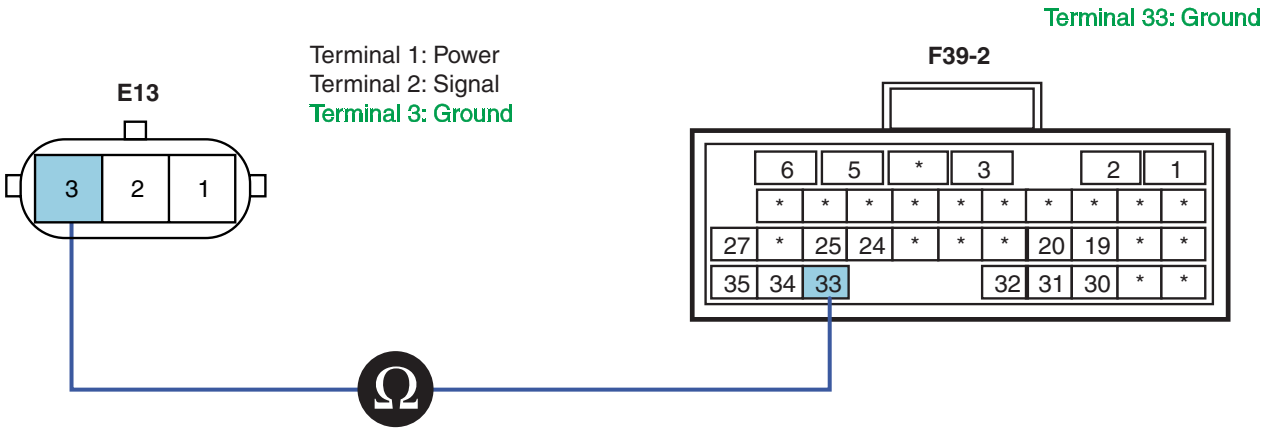
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect fuel pressure sensor connector(E13) and ECM connector(F39-2).

3) Measure resistance between terminal 3 of fuel pressure sensor harness connector and terminal 33 of ECM connector(F39-2).



SNBFL8043L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EED6F608

1. Fuel Pressure Sensor Inspection

   1) Turn the ignition OFF.

   2) Leave the fuel pressure sensor connector(E13) installed.

   3) Start the engine and compare fuel pressure and fuel pressure signal voltage according to detecting condition.

NOTE

The value of fuel pressure and signal voltage changes with driving conditions depending on DTC detecting condition. In case of fail safe, be sure to check that fuel amount is limited to below 40㎣/st.

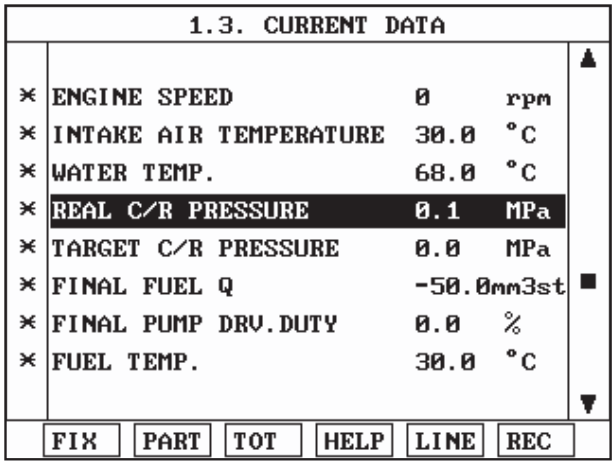


Fig. 1 Fuel pressure sensor data at IG ON

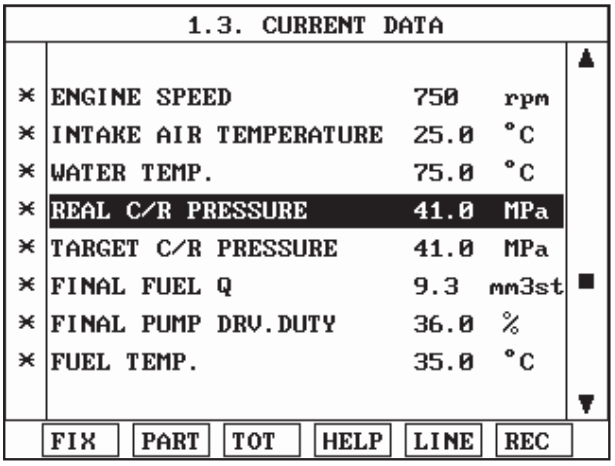


Fig. 2 Fuel pressure sensor data at idle

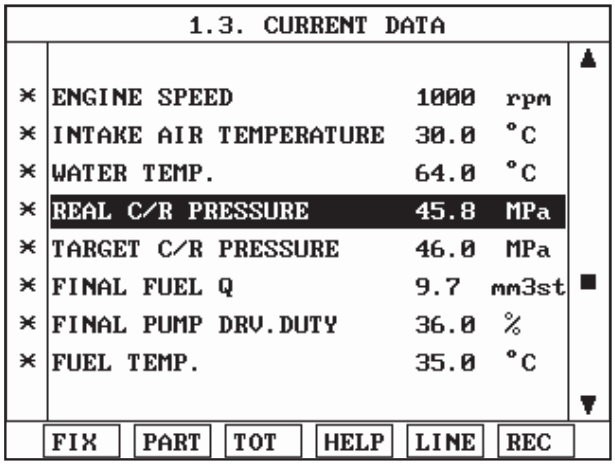


Fig. 3 Fuel pressure sensor data at 1,000rpm

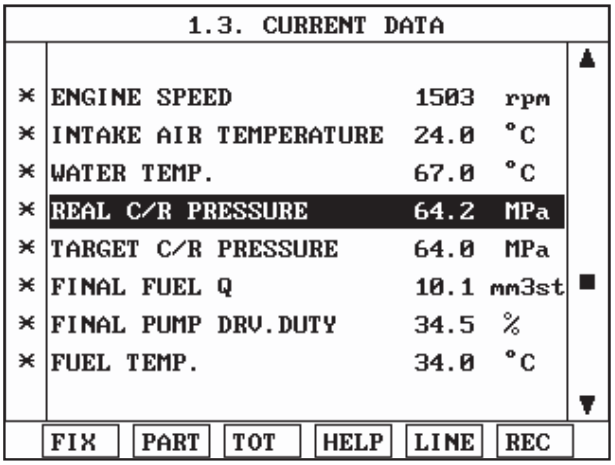


Fig. 4 Fuel pressure sensor data at 1,500rpm

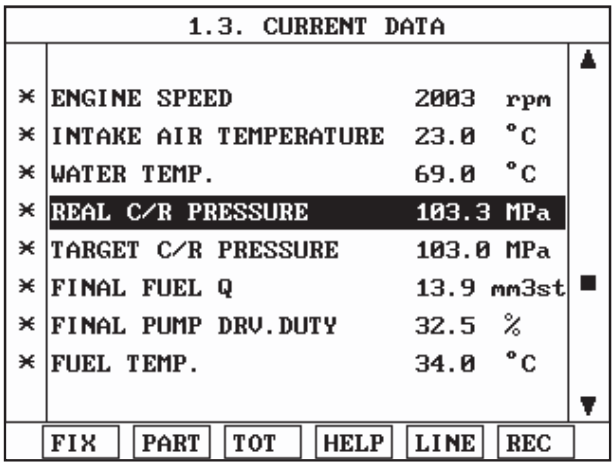


Fig. 5 Fuel pressure sensor data at 2,000rpm

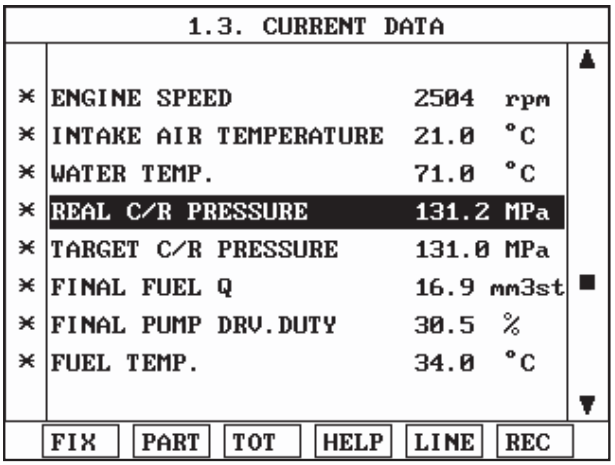


Fig. 6 Fuel pressure sensor data at 2,500rpm

SUDFL8016L

4) Is the measured output value within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the fuel pressure sensor and then go to "Verification of Vehicle Repair" procedure.

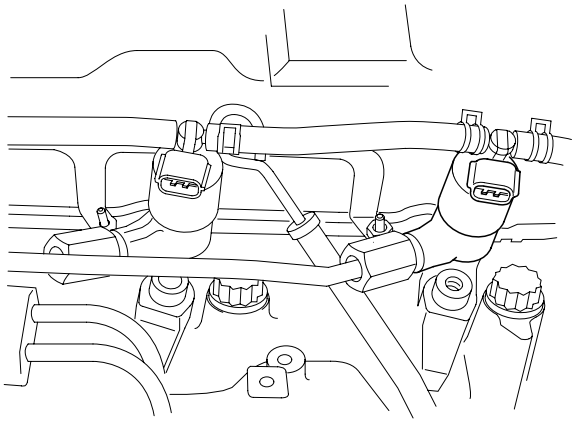
VERIFICATION OF VEHICLE REPAIR E39483F3

Refer to DTC P0112.

DTC P0201 INJECTOR #1 COIL OPEN

COMPONENT LOCATION EB9143B0

Injector



SUDFL8098L

DESCRIPTION EFFF41B5

1. GENERAL DESCRIPTION
   Injector carries out function to inject fuel amount calculated by ECM by making diesel spread with small particles to combustion chamber compressed with high pressure. Fuel injected generates power through combustion process.
   Purpose to increase fuel pressure of common rail diesel engine up to Max. 1,600 bar is to make fuel into small particles, small particles of fuel are related to smoke reduction, high power of engine, fuel consumption improvement etc.
   Also, hydraulic servo type is used to control fuel pressure of 1,600 bar with solenoid, injector solenoid is driven by current after increasing solenoid driving voltage up to 135V.
   Multi injection is possible by applying fuel injection which is not mechanic injector but electric control injector.
   ECM injects fuel after dividing into two stages of pilot injection and main injection and it is possible to control Injection time and injection amount independently to each cylinder. Power, torque, exhaust gas, fuel consumption improvement etc. can be optimized by controlling engine to optimum fuel injection amount.

2. DTC DESCRIPTION
   If crank rotating angle is 4499.0 degree or more due to the open in harness of injector #1, ECM judges this as a fault and DTC is set. The possible causes are open circuit #2 of ECM connector(F39-2), open in injector coil, excessive resistance of injector pin, poor connection of wiring etc.
   Lack of engine power will occur since fuel amount is limited to below 40mm^3/st in case of fail safe. There may cause damage to engine if the vehicle is driven for a long time with faulty injector.

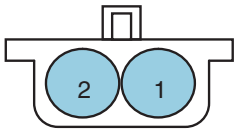
DTC DETECTING CONDITION E2256909

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Open in harness of terminal 2 of ECM connector(F39-2) • Open in injector coil • Injector pin resistance • Wiring problem
Enable Conditions	• Ignition ON/ Running			
Threshold Value	• Open in harness of injector #1			
Diagnosis Time	• 4499.0 CA(Crank angle) or more			
Fail Safe	Fuel Cut	No	• Fuel amount is limited to below 40mm³/st. • Lack of engine power	
	Fuel Limit	Yes		
	MIL	ON		

SPECIFICATION E9C59E88

Item	Specification
Resistance	0.45Ω (At 20˚C)
Injector driving voltage	135V
Injector driving current	20A
Injector control type	Current control

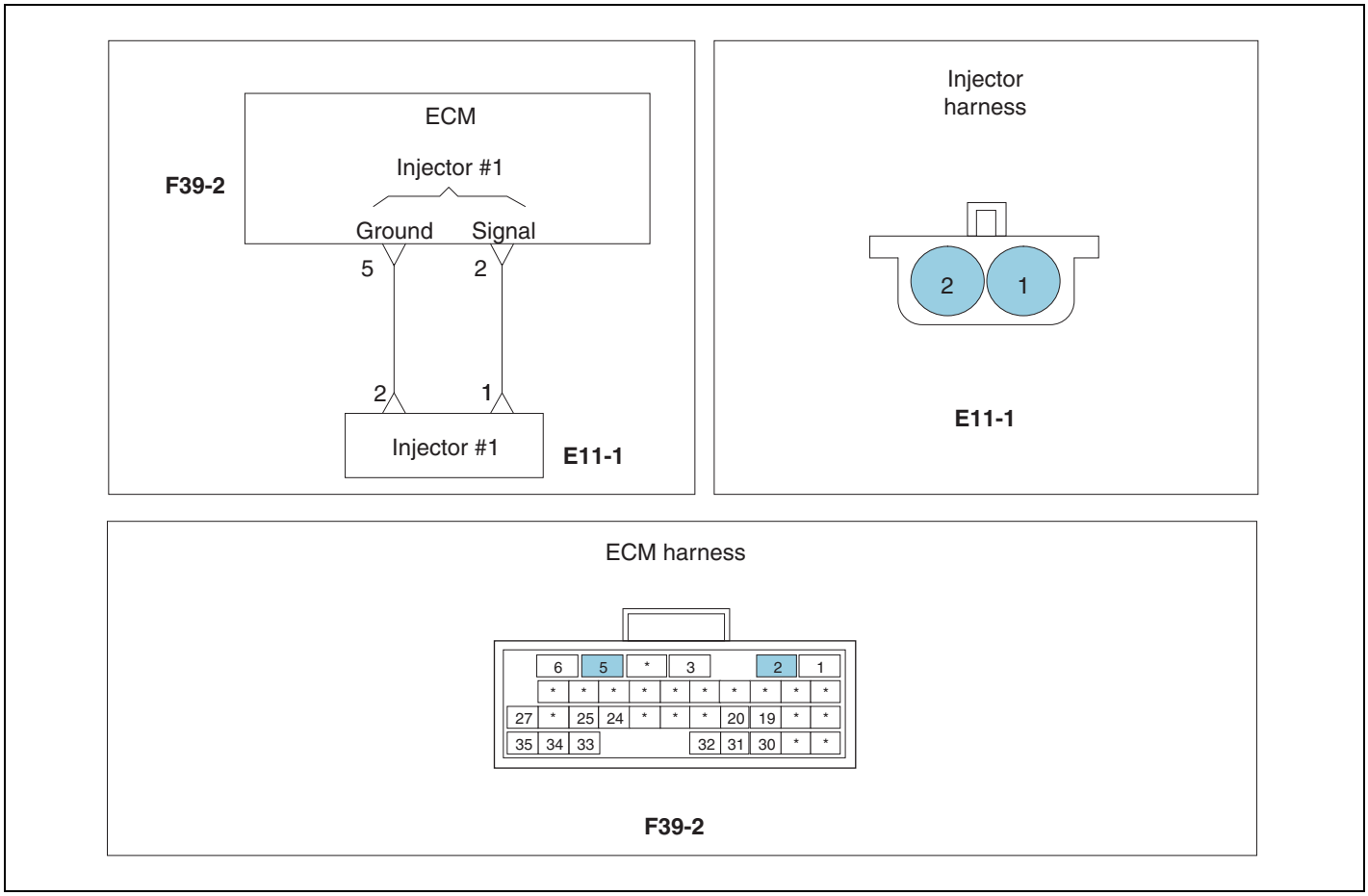
Terminal 1: Signal
Terminal 2: Ground



Sensor connector

SUDFL8099L

SCHEMATIC DIAGRAM E2D3533D



SNBFL8045L

SIGNAL WAVEFORM EDBABAB5

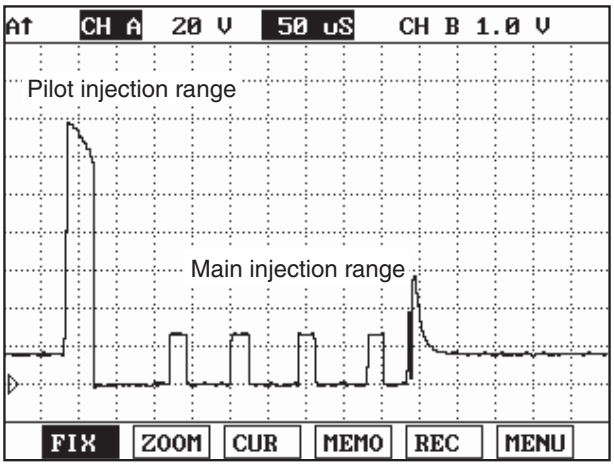


Fig. 1 Low side waveform when activating injector(Ground side)

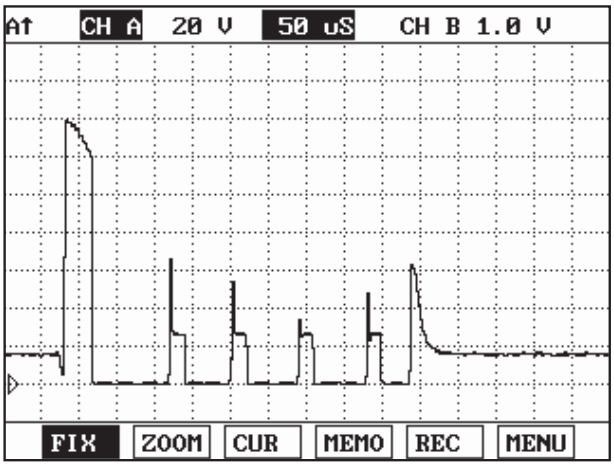


Fig. 2 High side injector power waveform(Signal side)

Fig.1) is divided into pilot injection range and main injection range as low side waveform when activating injector.
Fig.2) is high side injector power waveform.

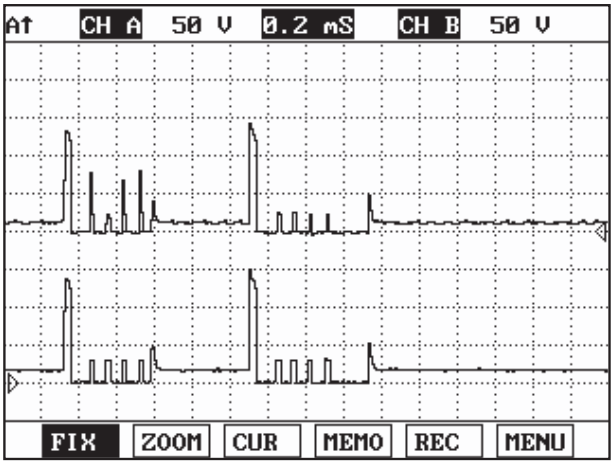


Fig. 3 Injector power waveform combined with High/Low side

SUDFL8101L

NOTE

Waveforms of Fig.1) and Fig.2) are displayed by turns in the course of checking injector waveform in LOW side. The reason that the waveform like a Fig.2) is displayed is used in LOW side in common the power of HIGH side of injector #1, #4 or injector #2, #3 which is not activated.

MONITOR SCAN TOOL DATA EF1D794F

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Fuel injection amount" parameter on the scan tool.

NOTE

The scan tool data indicate engine rpm information related to "Fuel injection amount" parameter depending on DTC detecting conditions. Be sure to check that "Fuel amount" is limited to below 40㎣/st in case of fail safe.

■ Specification: Fuel amount - Approx. 9.0~10.5 ㎣/st at idle

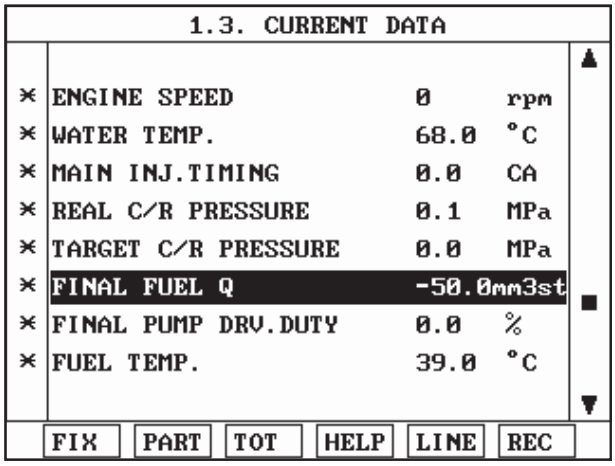


Fig. 1 Fuel injection amount data at ignition ON

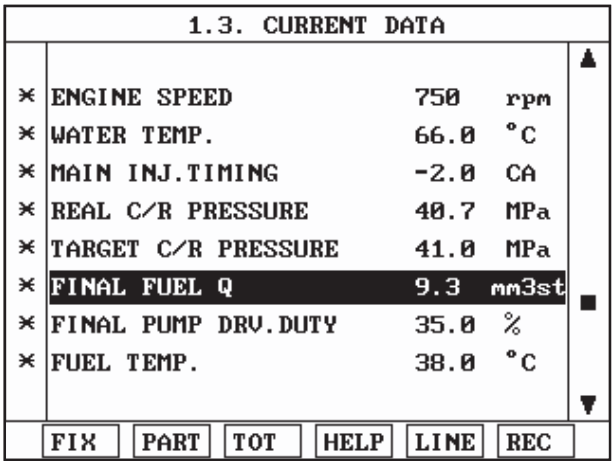


Fig. 2 Fuel injection amount data at idle

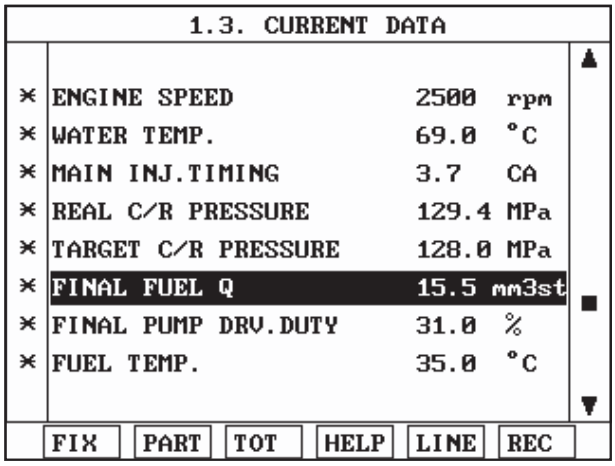


Fig. 3 Fuel injection amount data at 2,500rpm

SUDFL8102L

TERMINAL & CONNECTOR INSPECTION EF080893

Refer to DTC P0112.

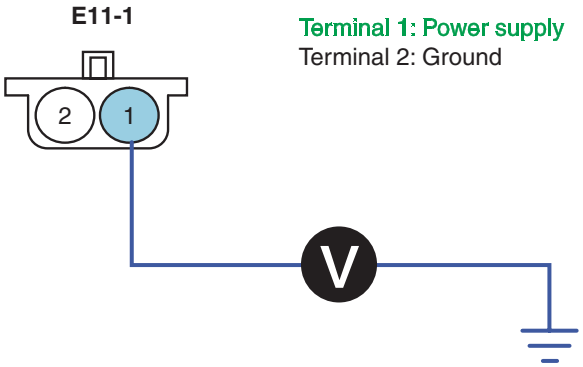
POWER SUPPLY INSPECTION E355AB64

1. Power Supply Voltage Inspection

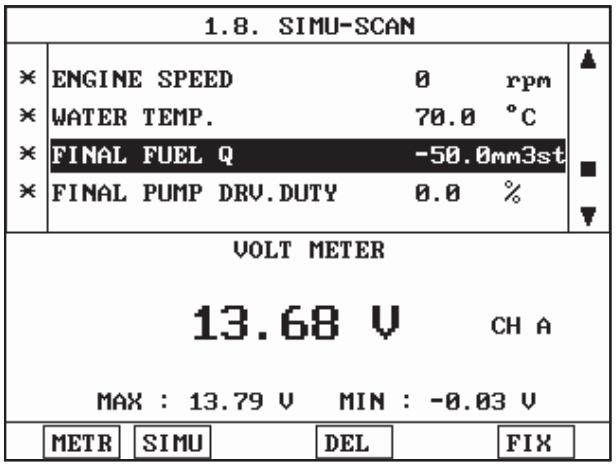
   1) Leave injector #1 connector(E11-1) installed.

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 1 of the injector #1 and chassis ground.



Terminal 1: Power supply
Terminal 2: Ground



▶ With injector #1 connector disconnected/connected (At IG ON)

SUDFL8103L

■ Specification: Injector #1 signal power approx. 13.57 V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

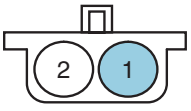
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn ignition OFF.

2) Disconnect injector #1 connector(E11-1) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of injector #1 harness connector(E11-1) and terminal 2 of ECM connector(F39-2).



Terminal 1:

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

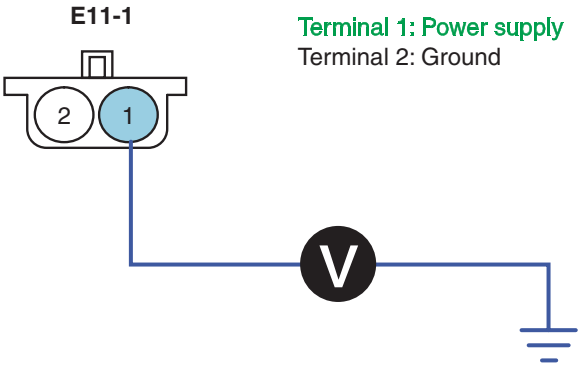
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. Power Supply Short to Power Inspection

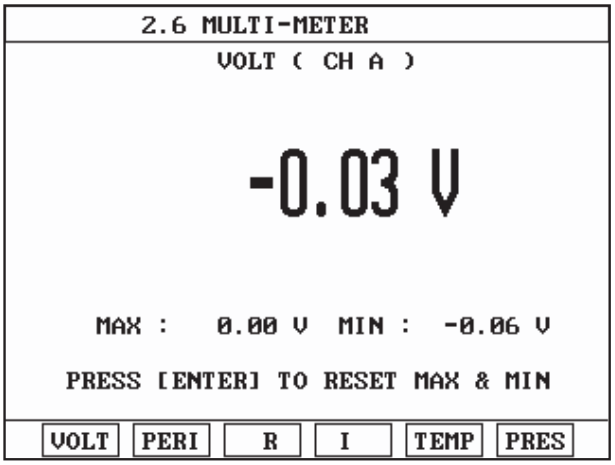
1) Disconnect injector #1 connector(E11-1) and ECM connector(F39-2).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of injector #1 harness connector(E11-1) and chassis ground.



Terminal 1: Power supply
Terminal 2: Ground



SUDFL8105L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

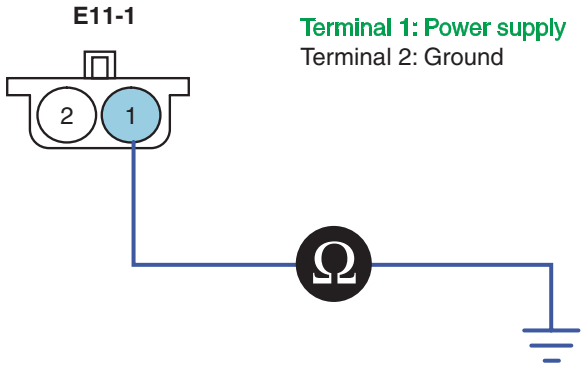
▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

4. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect injector #1 connector(E11-1) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of injector #1 harness connector(E11-1) and chassis ground.



SUDFL8106L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

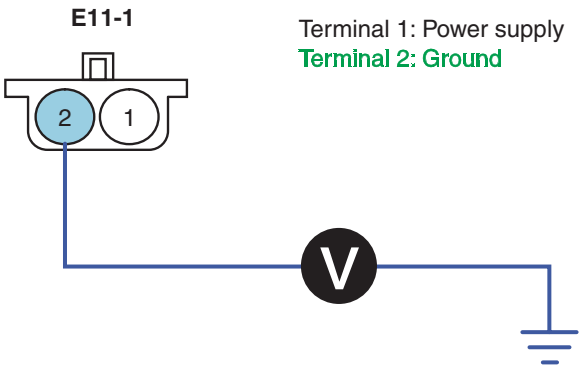
GROUND CIRCUIT INSPECTION E980DAF1

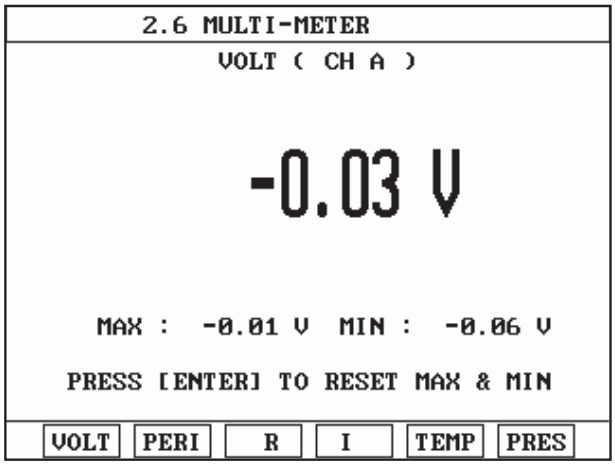
1. Ground Voltage Drop Inspection

1) Disconnect injector #1 connector(E11-1).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 2 of injector #1 harness connector(E11-1) and chassis ground.





SUDFL8107L

■ Specification: Ground voltage drop - Within 200mV

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

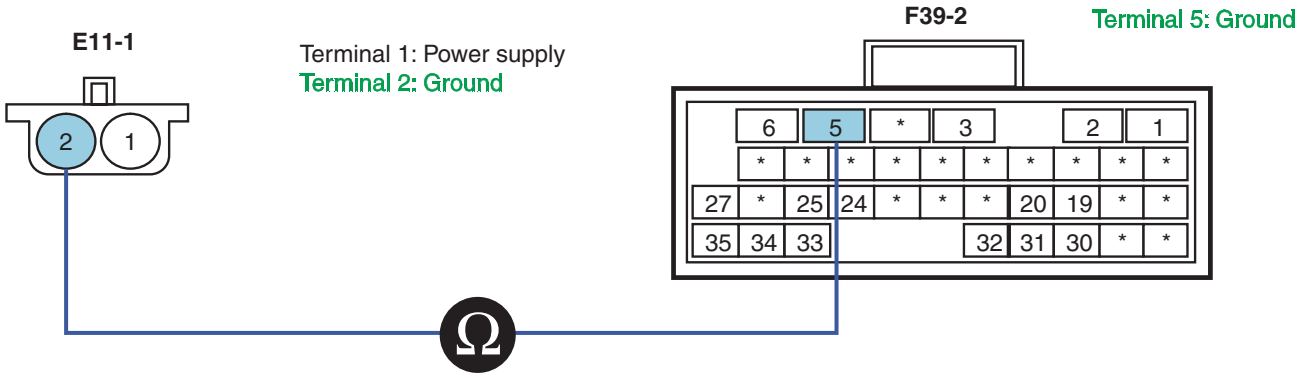
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect injector #1 connector(E11-1) and ECM connector(F39-2).

3) Measure resistance between terminal 2 of injector #1 harness connector(E11-1) and terminal 5 of ECM connector(F39-2).



SNBFL8047L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

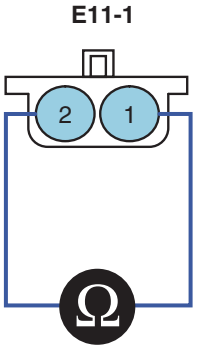
COMPONENT INSPECTION E9C533D4

1. Injector Component Inspection

1) Turn ignition OFF.

2) Disconnect injector#1 connector(E11-1).

3) Measure resistance between terminal 1 and 2 of injector#1 connector.



Terminal 1: Power supply
Terminal 2: Ground

■ Specification

Item	Specification
Resistance	0.45 Ω(20˚C)

SUDFL8109L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the injector and then go to "Verification of Vehicle Repair" procedure.

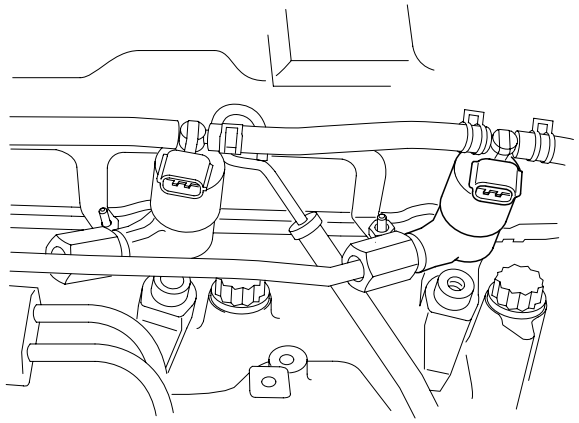
VERIFICATION OF VEHICLE REPAIR E8D578EA

Refer to DTC P0112.

DTC P0202 INJECTOR #2 COIL OPEN

COMPONENT LOCATION EE65BC32

Injector



SUDFL8098L

DESCRIPTION EA2ABE7F

1. GENERAL DESCRIPTION
   Injector carries out function to inject fuel amount calculated by ECM by making diesel spread with small particles to combustion chamber compressed with high pressure. Fuel injected generates power through combustion process.
   Purpose to increase fuel pressure of common rail diesel engine up to Max. 1,600 bar is to make fuel into small particles, small particles of fuel are related to smoke reduction, high power of engine, fuel consumption improvement etc.
   Also, hydraulic servo type is used to control fuel pressure of 1,600 bar with solenoid, injector solenoid is driven by current after increasing solenoid driving voltage up to 135V.
   Multi injection is possible by applying fuel injection which is not mechanic injector but electric control injector.
   ECM injects fuel after dividing into two stages of pilot injection and main injection andit is possible to control Injection time and injection amount independently to each cylinder. Power, torque, exhaust gas, fuel consumption improvement etc. can be optimized by controlling engine to optimum fuel injection amount.

2. DTC DESCRIPTION
   If crank rotating angle is 4499.0 degree or more due to the open in harness of injector #2, ECM judges this as a fault and DTC is set. The possible causes are open circuit #2 of ECM connector(F39-1), open in injector coil, excessive resistance in injector pin, poor connection of wiring etc.
   Lack of engine power will occur since fuel amount is limited to below 40mm^3/st in case of fail safe. There may cause damage to engine if the vehicle is driven for a long time with faulty injector.

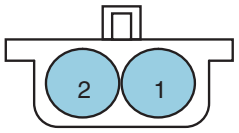
DTC DETECTING CONDITION E42C9430

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Open in harness of terminal 2 of ECM connector(F39-1) • Open in injector coil • Injector pin resistance • Wiring problem
Enable Conditions	• Ignition ON/ Running			
Threshold Value	• Open in harness of injector #2			
Diagnosis Time	• 4499.0 CA(Crank angle) or more			
Fail Safe	Fuel Cut	No	• Fuel amount is limited to below 40mm³/st . • Lack of engine power	
	Fuel Limit	Yes		
	MIL	ON		

SPECIFICATION E102001A

Item	Specification
Resistance	0.45Ω (At 20˚C)
Injector driving voltage	135V
Injector driving current	20A
Injector control type	Current control

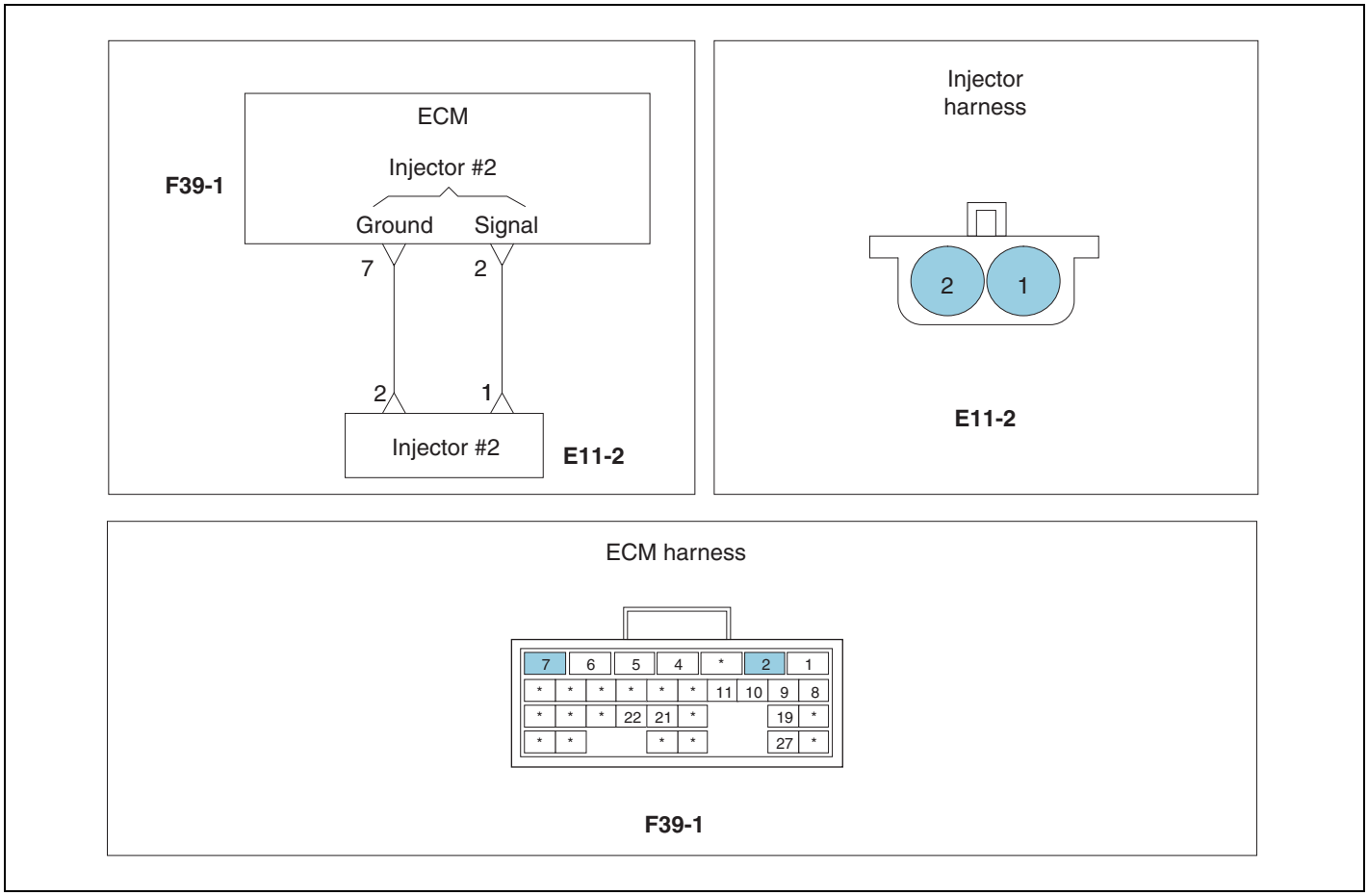
Terminal 1: Signal
Terminal 2: Ground



Sensor connector

SUDFL8099L

SCHEMATIC DIAGRAM E5767F89



SNBFL8048L

SIGNAL WAVEFORM EDD205FA

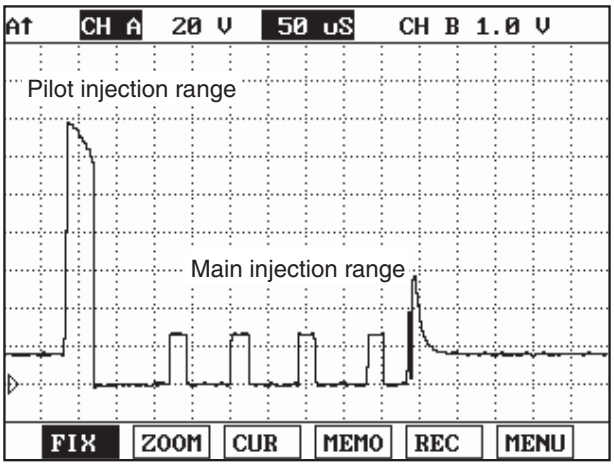


Fig. 1 Low side waveform when activating injector(Ground side)

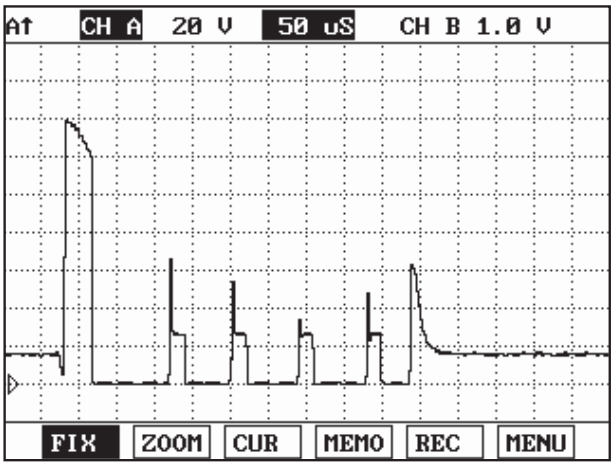


Fig. 2 High side injector power waveform(Signal side)

Fig.1) is divided into pilot injection range and main injection range as low side waveform when activating injector.
Fig.2) is high side injector power waveform.

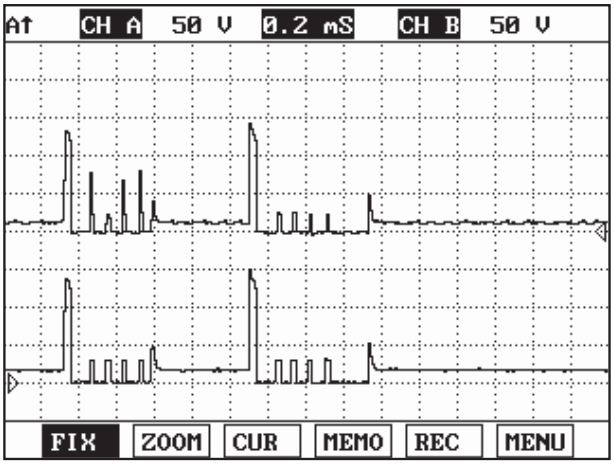


Fig. 3 Injector power waveform combined with High/Low side

SUDFL8101L

NOTE

Waveforms of Fig.1) and Fig.2) are displayed by turns in the course of checking injector waveform in LOW side. The reason that the waveform like a Fig.2) is displayed is used in LOW side in common the power of HIGH side of injector #1, #4 or injector #2, #3 which is not activated.

MONITOR SCAN TOOL DATA E3B71911

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Fuel injection amount" parameter on the scan tool.

NOTE

The scan tool data indicate engine rpm information related to "Fuel injection amount" parameter depending on DTC detecting conditions. Be sure to check that "Fuel amount" is limited to below 40㎣/st in case of fail safe.

■ Specification: Fuel amount - Approx. 9.0~10.5 ㎣/st at idle

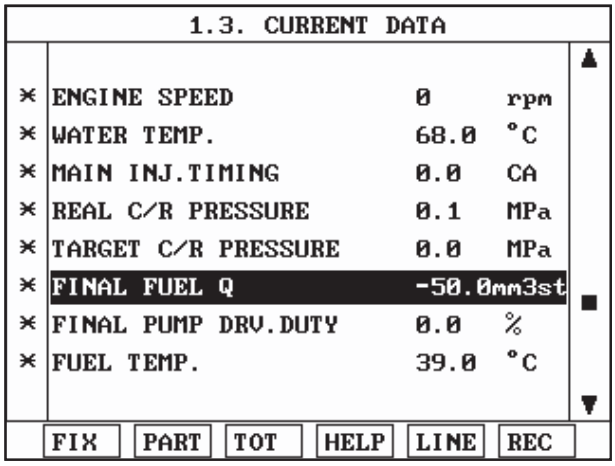


Fig. 1 Fuel injection amount data at ignition ON

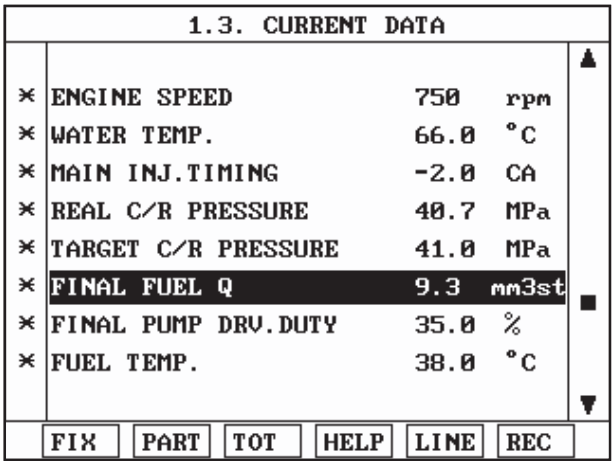


Fig. 2 Fuel injection amount data at idle

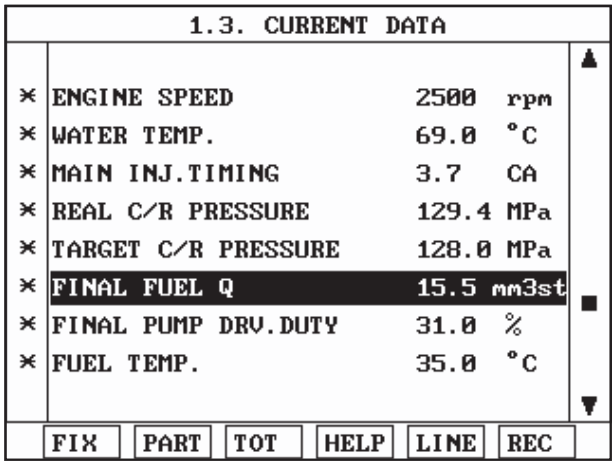


Fig. 3 Fuel injection amount data at 2,500rpm

SUDFL8102L

TERMINAL & CONNECTOR INSPECTION EE0B4BFB

Refer to DTC P0112.

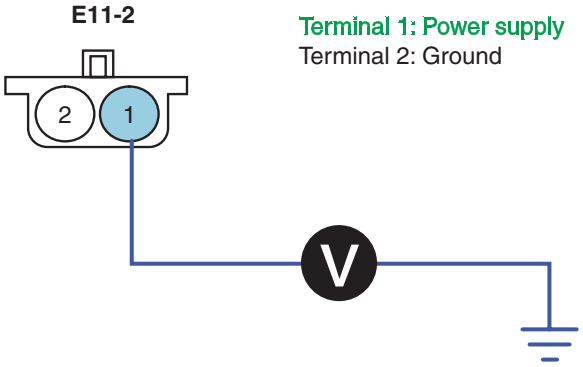
POWER SUPPLY INSPECTION E1844F23

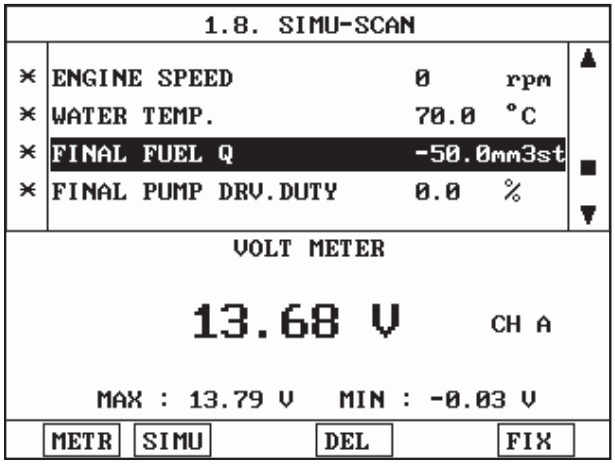
1. Power Supply Voltage Inspection

   1) Leave injector #2 connector(E11-2) installed.

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 1 of the injector #2 and chassis ground.





▶ With injector #2 connector disconnected/connected (At IG ON)

SUDFL8111L

■ Specification: Injector #2 signal power approx. 13.57 V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

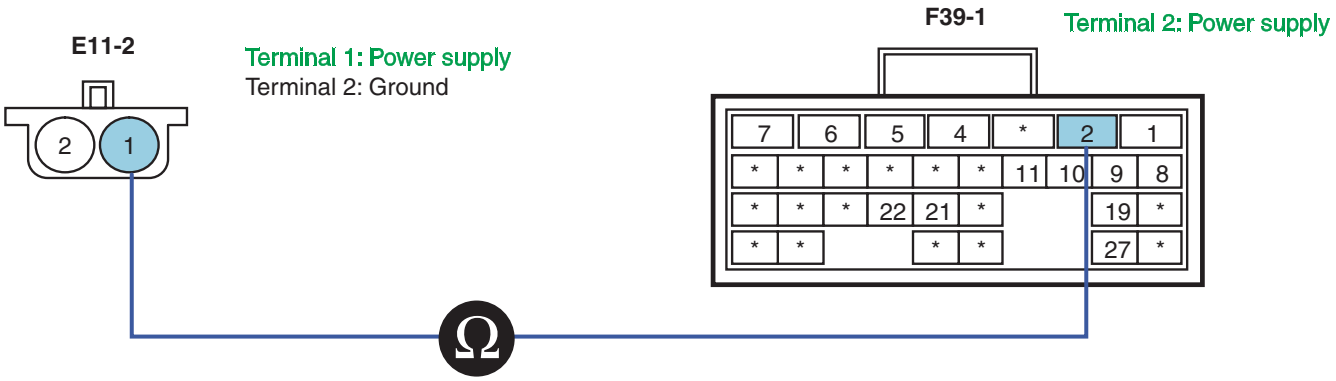
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn ignition OFF.

2) Disconnect injector #2 connector(E11-2) and ECM connector(F39-1).

3) Measure resistance between terminal 1 of injector #2 harness connector(E11-2) and terminal 2 of ECM connector(F39-1).



SNBFL8049L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

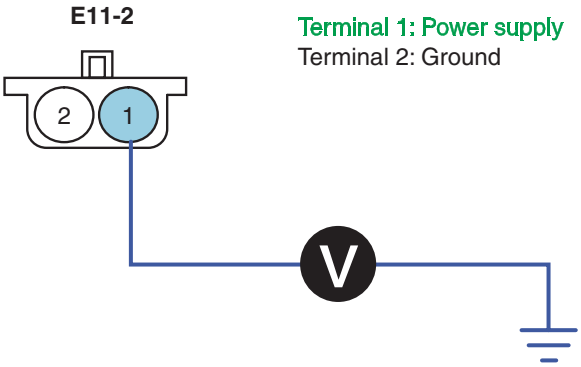
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. Power Supply Short to Power Inspection

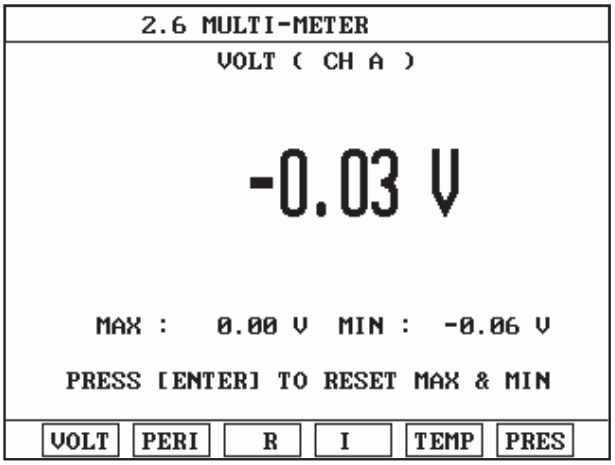
1) Disconnect injector #2 connector(E11-2) and ECM connector(F39-1).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of injector #2 harness connector(E11-2) and chassis ground.



Terminal 1: Power supply
Terminal 2: Ground



SUDFL8113L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

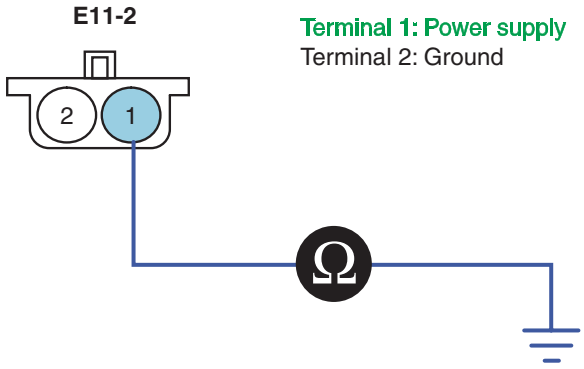
▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

4. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect injector #2 connector(E11-2) and ECM connector(F39-1).

3) Measure resistance between terminal 1 of injector #2 harness connector(E11-2) and chassis ground.



SUDFL8114L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

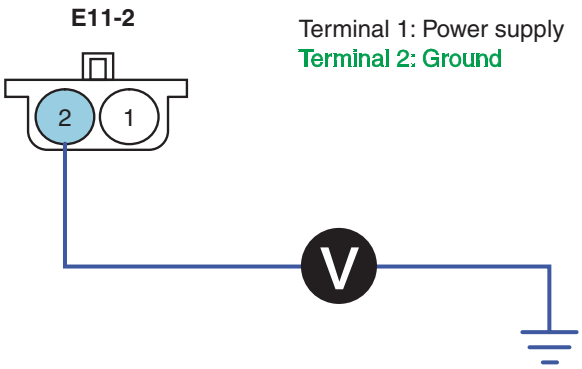
GROUND CIRCUIT INSPECTION E3A29052

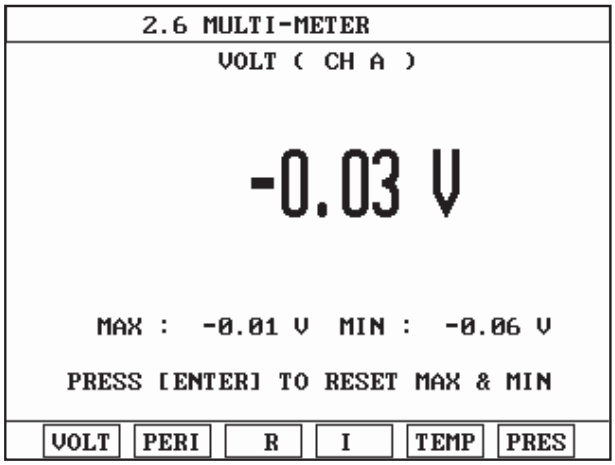
1. Ground Voltage Drop Inspection

1) Disconnect injector #2 connector(E11-2).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 2 of injector #2 harness connector(E11-2) and chassis ground.





SUDFL8115L

■ Specification: Ground voltage drop - Within 200mV

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

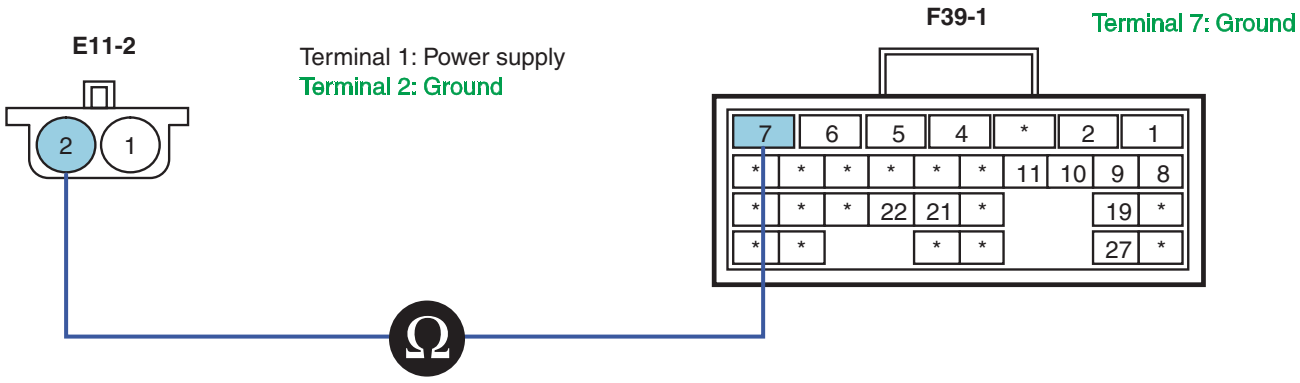
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect injector #2 connector(E11-2) and ECM connector(F39-1).

3) Measure resistance between terminal 2 of injector #2 harness connector(E11-2) and terminal 7 of ECM connector(F39-1).



SNBFL8050L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E4AA12E8

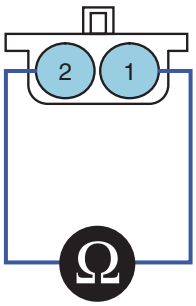
1. Injector Component Inspection

1) Turn ignition OFF.

2) Disconnect injector#2 connector(E11-2).

3) Measure resistance between terminal 1 and 2 of injector#2 connector.

E11-2



Terminal 1: Power supply
Terminal 2: Ground

■ Specification

Item	Specification
Resistance	0.45 Ω(20˚C)

SUDFL8117L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the injector and then go to "Verification of Vehicle Repair" procedure.

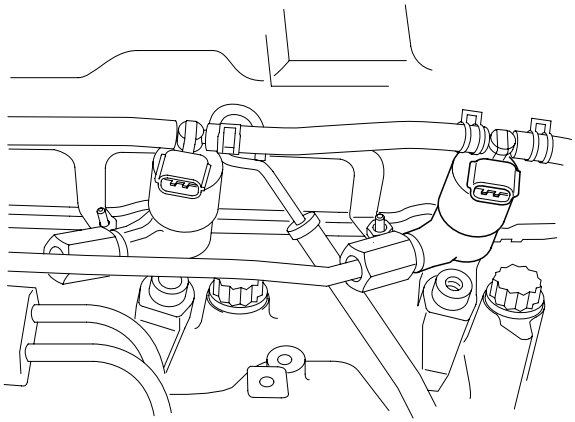
VERIFICATION OF VEHICLE REPAIR E96AC508

Refer to DTC P0112.

DTC P0203 INJECTOR #3 COIL OPEN

COMPONENT LOCATION E1FD49FA

Injector



SUDFL8098L

DESCRIPTION EAF07417

1. GENERAL DESCRIPTION
   Injector carries out function to inject fuel amount calculated by ECM by making diesel spread with small particles to combustion chamber compressed with high pressure. Fuel injected generates power through combustion process.
   Purpose to increase fuel pressure of common rail diesel engine up to Max. 1,600 bar is to make fuel into small particles, small particles of fuel are related to smoke reduction, high power of engine, fuel consumption improvement etc.
   Also, hydraulic servo type is used to control fuel pressure of 1,600 bar with solenoid, injector solenoid is driven by current after increasing solenoid driving voltage up to 135V.
   Multi injection is possible by applying fuel injection which is not mechanic injector but electric control injector.
   ECM injects fuel after dividing into two stages of pilot injection and main injection and it is possible to control Injection time and injection amount independently to each cylinder. Power, torque, exhaust gas, fuel consumption improvement etc. can be optimized by controlling engine to optimum fuel injection amount.

2. DTC DESCRIPTION
   If crank rotating angle is 4499.0 degree or more due to the open in harness of injector #3, ECM judges this as a fault and DTC is set. The possible causes are open circuit #1 of ECM connector(F39-1), open in injector coil, excessive resistance in injector pin, poor connection of wiring etc.
   Lack of engine power will occur since fuel amount is limited to below 40mm^3/st in case of fail safe. There may cause damage to engine if the vehicle is driven for a long time with faulty injector.

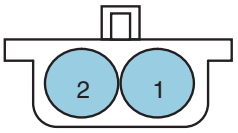
DTC DETECTING CONDITION E6D9404B

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Open in harness of terminal 1 of ECM connector(F39-1) • Open in injector coil • Injector pin resistance • Wiring problem
Enable Conditions	• Ignition ON/ Running			
Threshold Value	• Open in harness of injector #3			
Diagnosis Time	• 4499.0 CA(Crank angle) or more			
Fail Safe	Fuel Cut	No	• Fuel amount is limited to below 40mm³/st. • Lack of engine power	
	Fuel Limit	Yes		
	MIL	ON		

SPECIFICATION E4AA6C0C

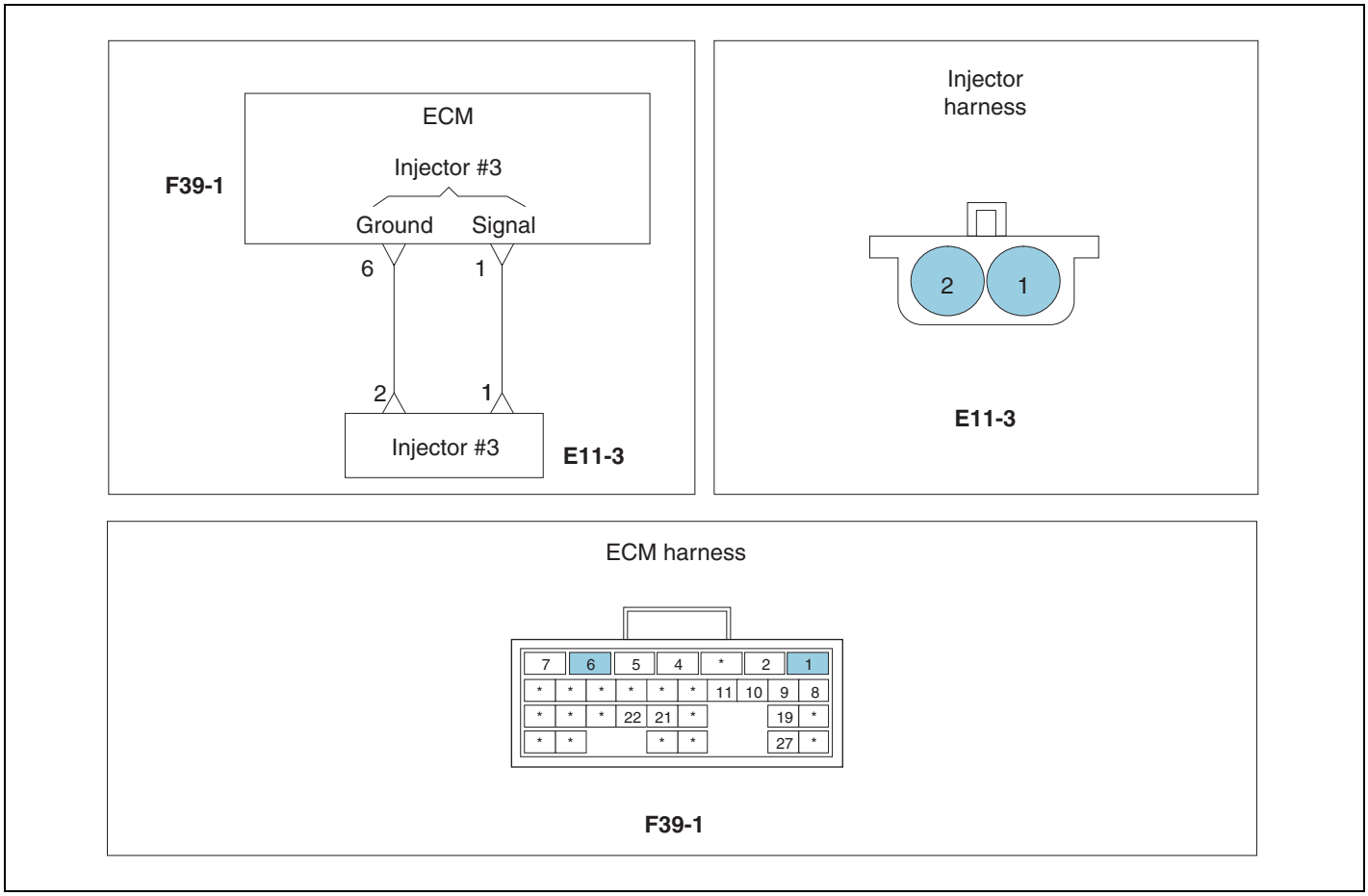
Item	Specification
Resistance	0.45Ω (At 20˚C)
Injector driving voltage	135V
Injector driving current	20A
Injector control type	Current control

Ter



Sensor connector

SCHEMATIC DIAGRAM EC93BAA7



SNBFL8051L

SIGNAL WAVEFORM E3253642

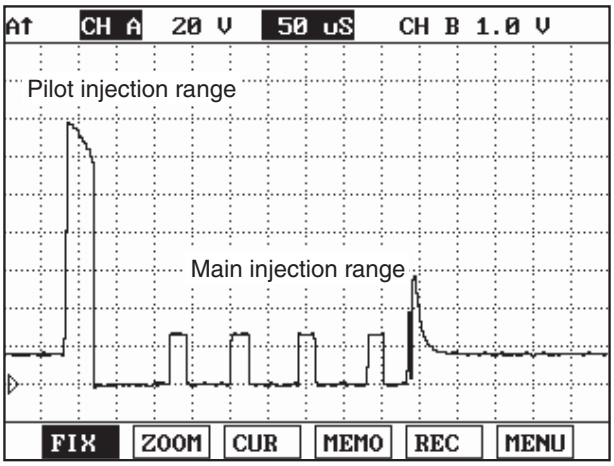


Fig. 1 Low side waveform when activating injector(Ground side)

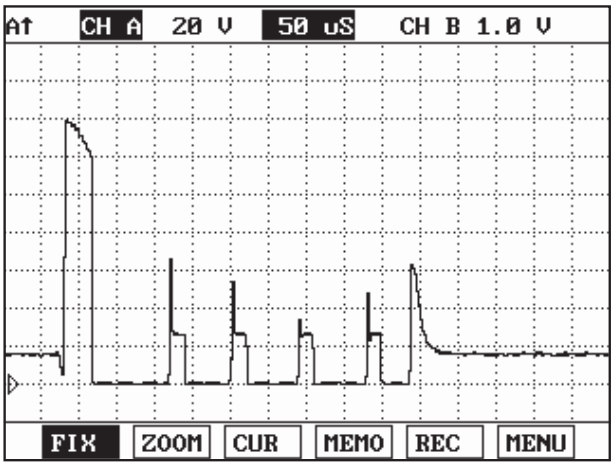


Fig. 2 High side injector power waveform(Signal side)

Fig.1) is divided into pilot injection range and main injection range as low side waveform when activating injector.
Fig.2) is high side injector power waveform.

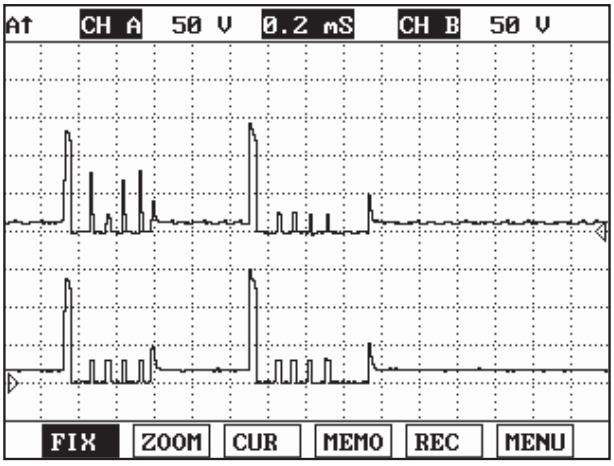


Fig. 3 Injector power waveform combined with High/Low side

SUDFL8101L

NOTE

Waveforms of Fig.1) and Fig.2) are displayed by turns in the course of checking injector waveform in LOW side. The reason that the waveform like a Fig.2) is displayed is used in LOW side in common the power of HIGH side of injector #1, #4 or injector #2, #3 which is not activated.

MONITOR SCAN TOOL DATA EE6E35CF

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Fuel injection amount" parameter on the scan tool.

NOTE

The scan tool data indicate engine rpm information related to "Fuel injection amount" parameter depending on DTC detecting conditions. Be sure to check that "Fuel amount" is limited to below 40㎣/st in case of fail safe.

■ Specification: Fuel amount - Approx. 9.0~10.5 ㎣/st at idle

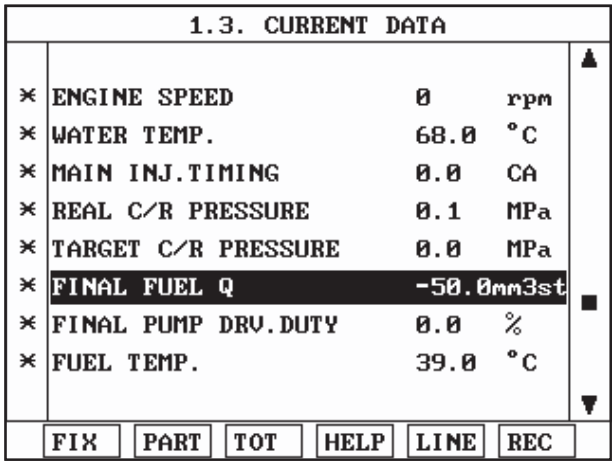


Fig. 1 Fuel injection amount data at ignition ON

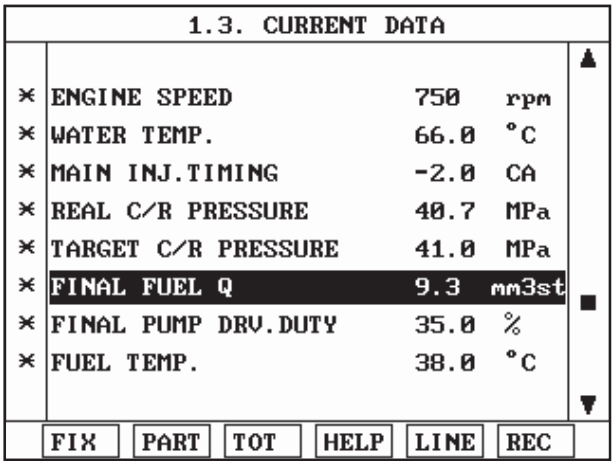


Fig. 2 Fuel injection amount data at idle

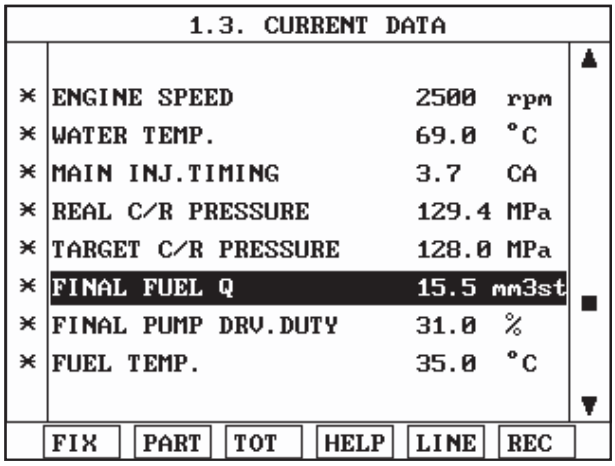


Fig. 3 Fuel injection amount data at 2,500rpm

SUDFL8102L

TERMINAL & CONNECTOR INSPECTION E1F78CE7

Refer to DTC P0112.

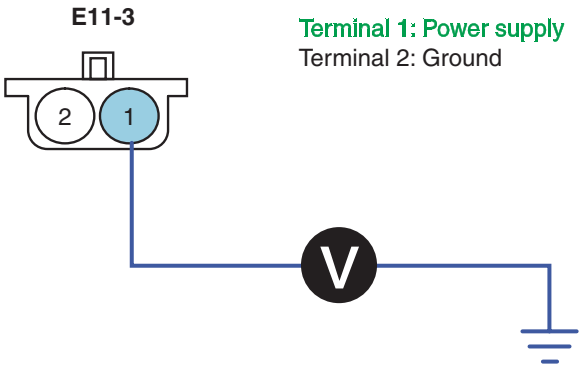
POWER SUPPLY INSPECTION EA11DC1C

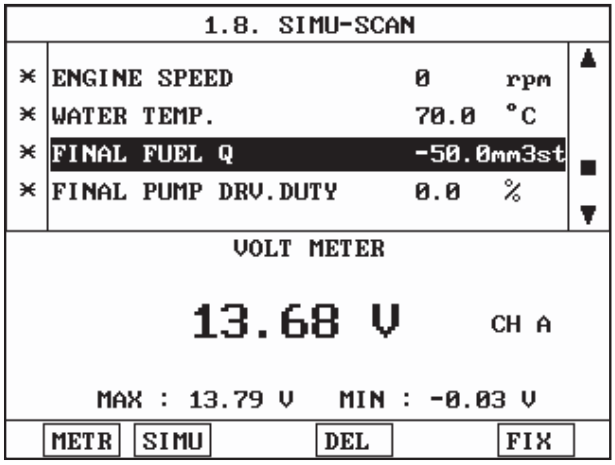
1. Power Supply Voltage Inspection

   1) Leave injector #3 connector(E11-3) installed.

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 1 of the injector #3 and chassis ground.





▶ With injector #3 connector disconnected/connected (At IG ON)

SUDFL8119L

■ Specification: Injector #3 signal power approx. 13.57 V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

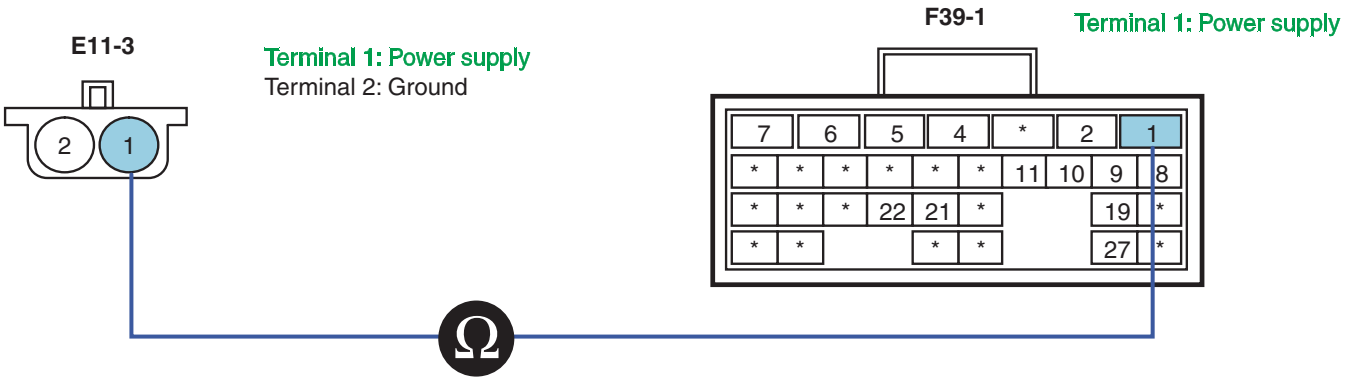
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn ignition OFF.

2) Disconnect injector #3 connector(E11-3) and ECM connector(F39-1).

3) Measure resistance between terminal 1 of injector #3 harness connector(E11-3) and terminal 1 of ECM connector(F39-1).



SNBFL8052L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

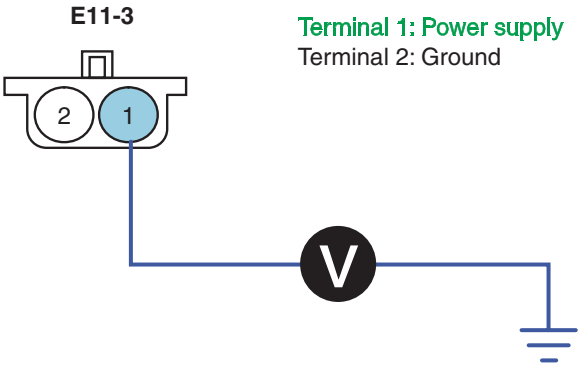
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. Power Supply Short to Power Inspection

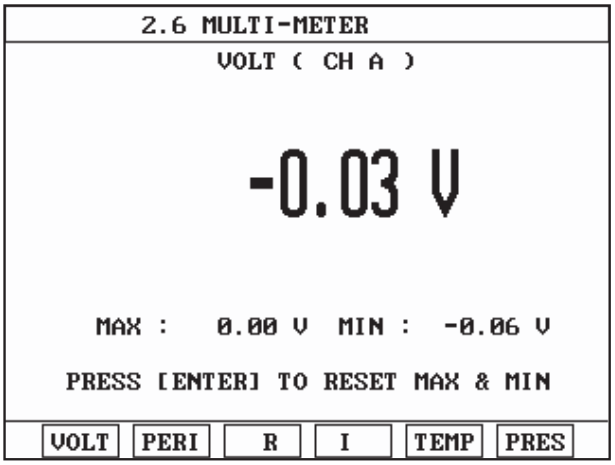
1) Disconnect injector #3 connector(E11-3) and ECM connector(F39-1).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of injector #3 harness connector(E11-3) and chassis ground.



Terminal 1: Power supply
Terminal 2: Ground



SUDFL8121L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

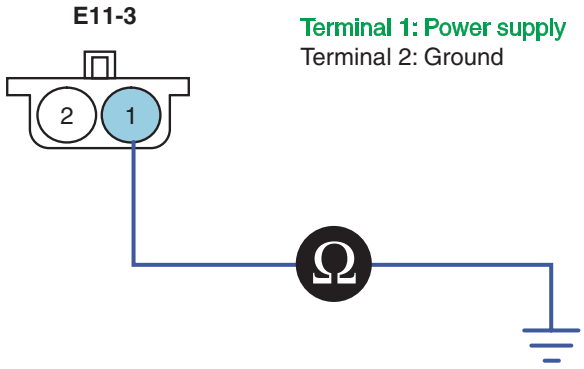
▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

4. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect injector #3 connector(E11-3) and ECM connector(F39-1).

3) Measure resistance between terminal 1 of injector #3 harness connector(E11-3) and chassis ground.



SUDFL8122L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

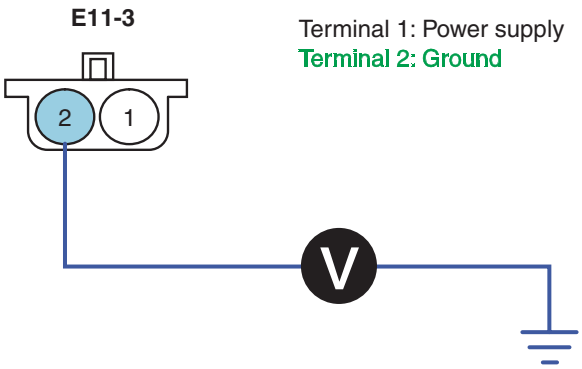
GROUND CIRCUIT INSPECTION EC4EA82E

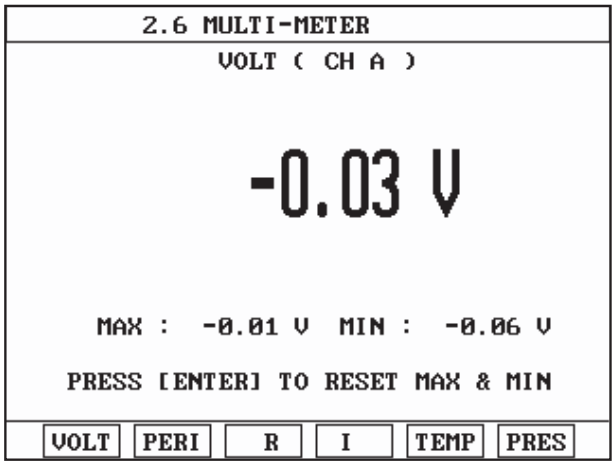
1. Ground Voltage Drop Inspection

1) Disconnect injector #3 connector(E11-3).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 2 of injector #3 harness connector(E11-3) and chassis ground.





SUDFL8123L

■ Specification: Ground voltage drop - Within 200mV

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

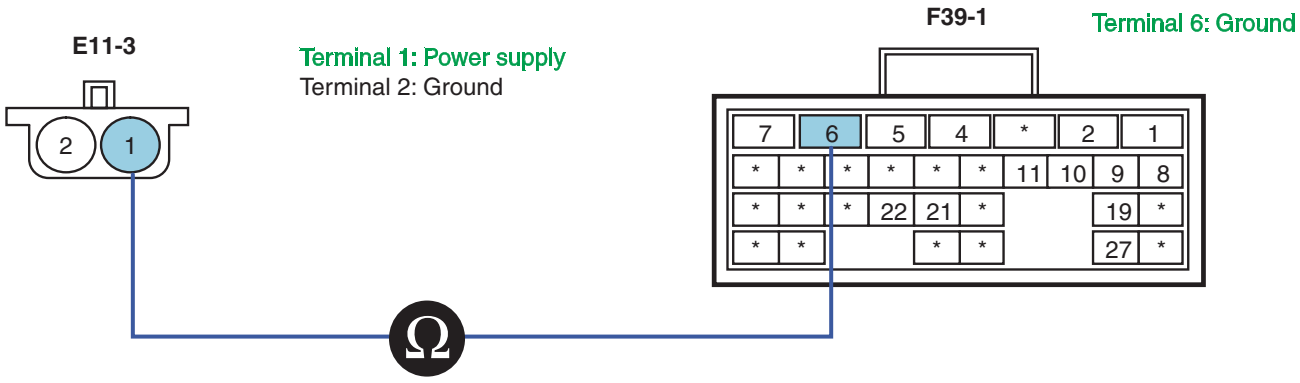
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect injector #3 connector(E11-3) and ECM connector(F39-1).

3) Measure resistance between terminal 1 of injector #3 harness connector(E11-3) and terminal 6 of ECM connector(F39-1).



SNBFL8053L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

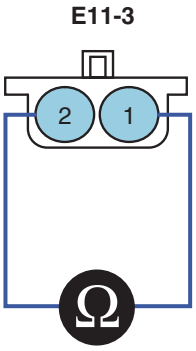
COMPONENT INSPECTION E8EE5E78

1. Injector Component Inspection

1) Turn ignition OFF.

2) Disconnect injector#3 connector(E11-3).

3) Measure resistance between terminal 1 and 2 of injector#3 connector.



■ Specification

Item	Specification
Resistance	0.45 Ω(20˚C)

SUDFL8125L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the injector and then go to "Verification of Vehicle Repair" procedure.

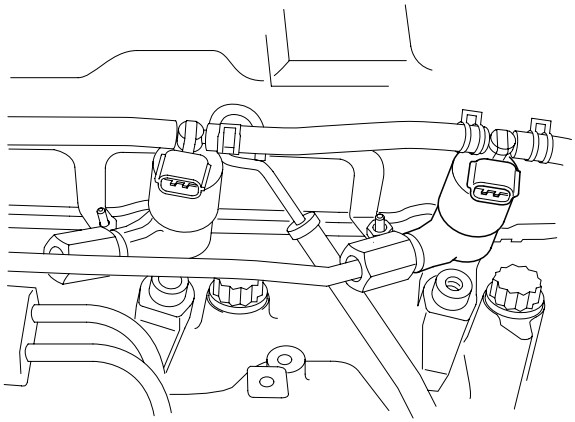
VERIFICATION OF VEHICLE REPAIR E2544E7B

Refer to DTC P0112.

DTC P0204 INJECTOR #4 COIL OPEN

COMPONENT LOCATION EE8FB041

Injector



SUDFL8098L

DESCRIPTION E4BC1053

1. GENERAL DESCRIPTION
   Injector carries out function to inject fuel amount calculated by ECM by making diesel spread with small particles to combustion chamber compressed with high pressure. Fuel injected generates power through combustion process.
   Purpose to increase fuel pressure of common rail diesel engine up to Max. 1,600 bar is to make fuel into small particles, small particles of fuel are related to smoke reduction, high power of engine, fuel consumption improvement etc.
   Also, hydraulic servo type is used to control fuel pressure of 1,600 bar with solenoid, injector solenoid is driven by current after increasing solenoid driving voltage up to 135V.
   Multi injection is possible by applying fuel injection which is not mechanic injector but electric control injector.
   ECM injects fuel after dividing into two stages of pilot injection and main injection and it is possible to control Injection time and injection amount independently to each cylinder. Power, torque, exhaust gas, fuel consumption improvement etc. can be optimized by controlling engine to optimum fuel injection amount.

2. DTC DESCRIPTION
   If crank rotating angle is 4499.0 degree or more due to the open in harness of injector #4, ECM judges this as a fault and DTC is set. The possible causes are open in terminal 3 of ECM connector(F39-2), open in injector coil, excessive resistance in injector pin, poor connection of wiring etc.
   Lack of engine power will occur since fuel amount is limited to below 40mm^3/st in case of fail safe. There may cause damage to engine if the vehicle is driven for a long time with faulty injector.

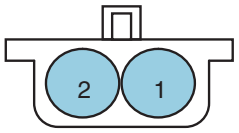
DTC DETECTING CONDITION E96034C4

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Open in harness of terminal 3 of ECM connector(F39-2) • Open in injector coil • Injector pin resistance • Wiring problem
Enable Conditions	• Ignition ON/ Running			
Threshold Value	• Open in harness of injector #4			
Diagnosis Time	• 4499.0 CA(Crank angle) or more			
Fail Safe	Fuel Cut	No	• Fuel amount is limited to below 40mm³/st . • Lack of engine power	
	Fuel Limit	Yes		
	MIL	ON		

SPECIFICATION EC01459F

Item	Specification
Resistance	0.45Ω (At 20˚C)
Injector driving voltage	135V
Injector driving current	20A
Injector control type	Current control

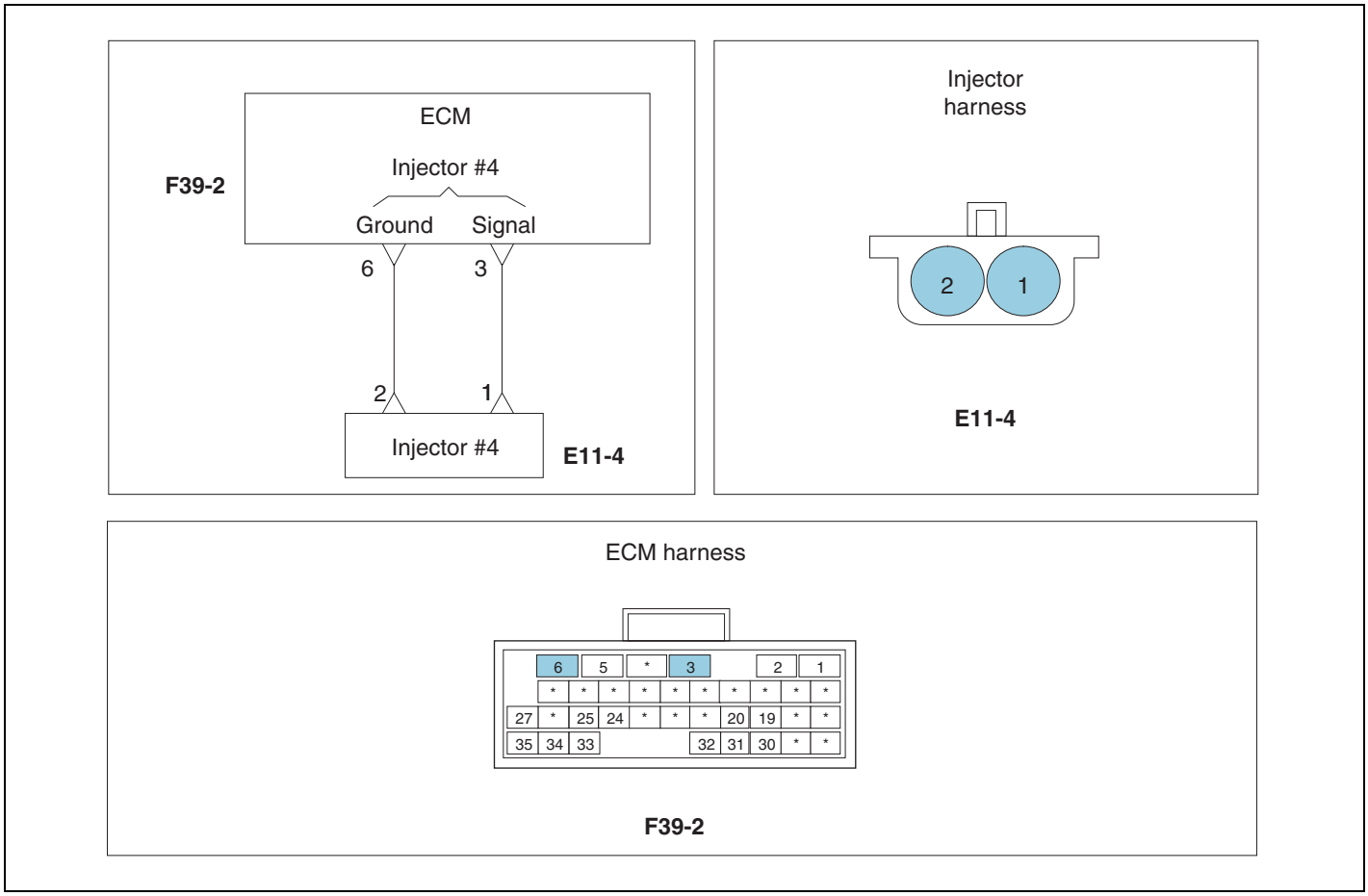
Terminal 1: Signal
Terminal 2: Ground



Sensor connector

SUDFL8099L

SCHEMATIC DIAGRAM EAD29441



SNBFL8054L

SIGNAL WAVEFORM E540A8E2

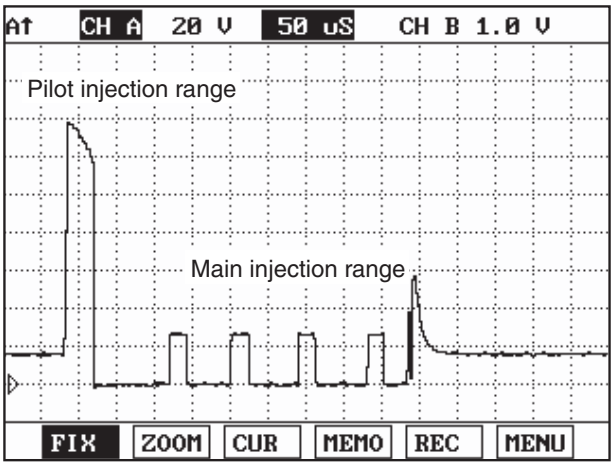


Fig. 1 Low side waveform when activating injector(Ground side)

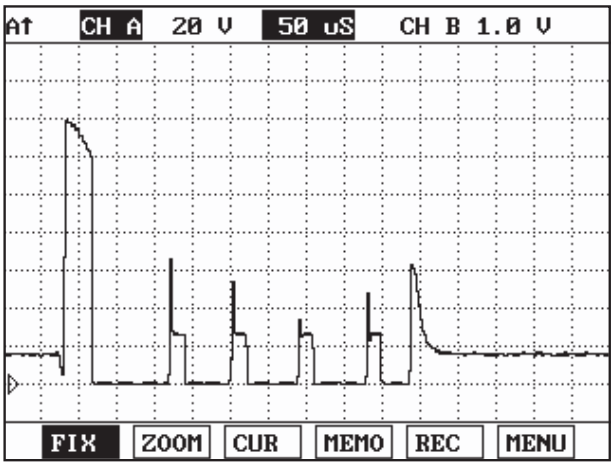


Fig. 2 High side injector power waveform(Signal side)

Fig.1) is divided into pilot injection range and main injection range as low side waveform when activating injector.
Fig.2) is high side injector power waveform.

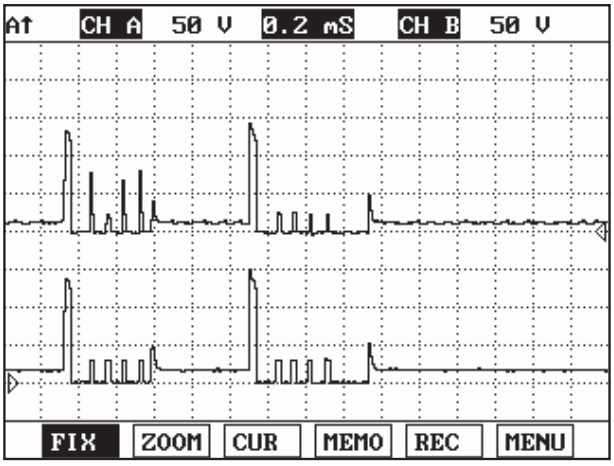


Fig. 3 Injector power waveform combined with High/Low side

SUDFL8101L

NOTE

Waveforms of Fig.1) and Fig.2) are displayed by turns in the course of checking injector waveform in LOW side. The reason that the waveform like a Fig.2) is displayed is used in LOW side in common the power of HIGH side of injector #1, #4 or injector #2, #3 which is not activated.

MONITOR SCAN TOOL DATA E201285F

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Fuel injection amount" parameter on the scan tool.

NOTE

The scan tool data indicate engine rpm information related to "Fuel injection amount" parameter depending on DTC detecting conditions. Be sure to check that "Fuel amount" is limited to below 40㎣/st in case of fail safe.

■ Specification: Fuel amount - Approx. 9.0~10.5 ㎣/st at idle

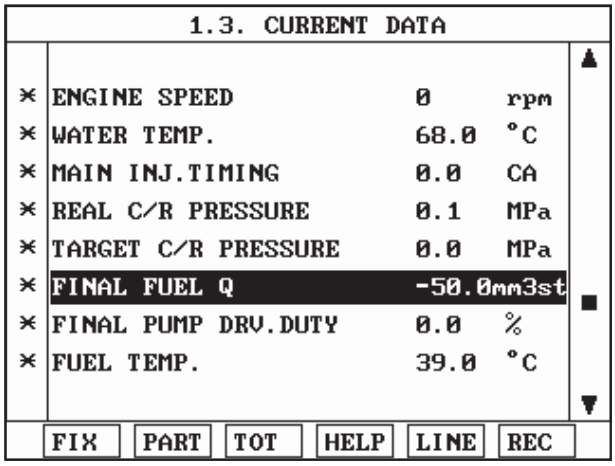


Fig. 1 Fuel injection amount data at ignition ON

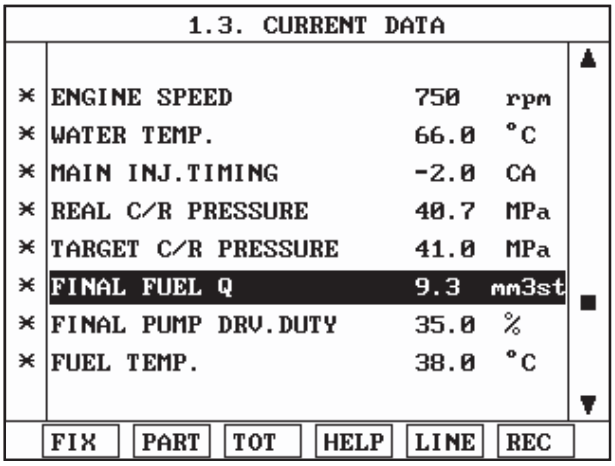


Fig. 2 Fuel injection amount data at idle

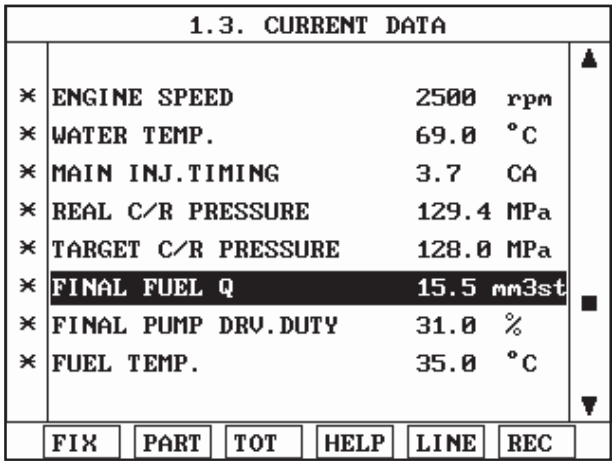


Fig. 3 Fuel injection amount data at 2,500rpm

SUDFL8102L

TERMINAL & CONNECTOR INSPECTION EC8EE143

Refer to DTC P0112.

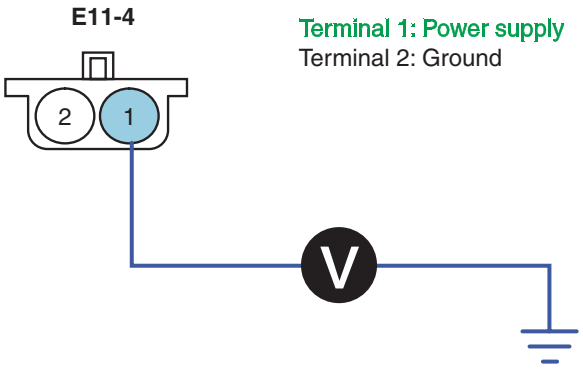
POWER SUPPLY INSPECTION EBC3B45C

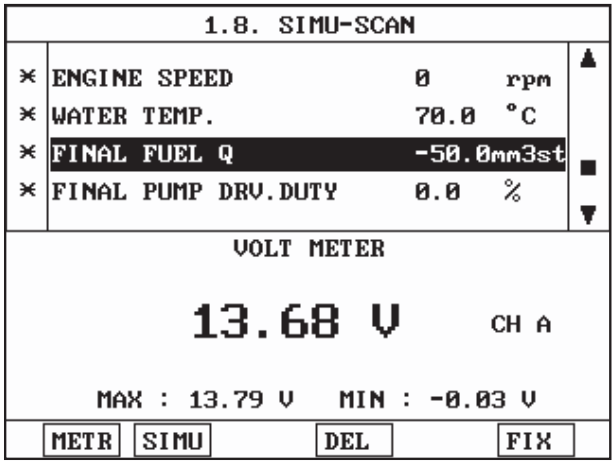
1. Power Supply Voltage Inspection

   1) Leave injector #4 connector(E11-4) installed.

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 1 of the injector #4 and chassis ground.





▶ With injector #4 connector disconnected/connected (At IG ON)

SUDFL8127L

■ Specification: Injector #4 signal power approx. 13.57 V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

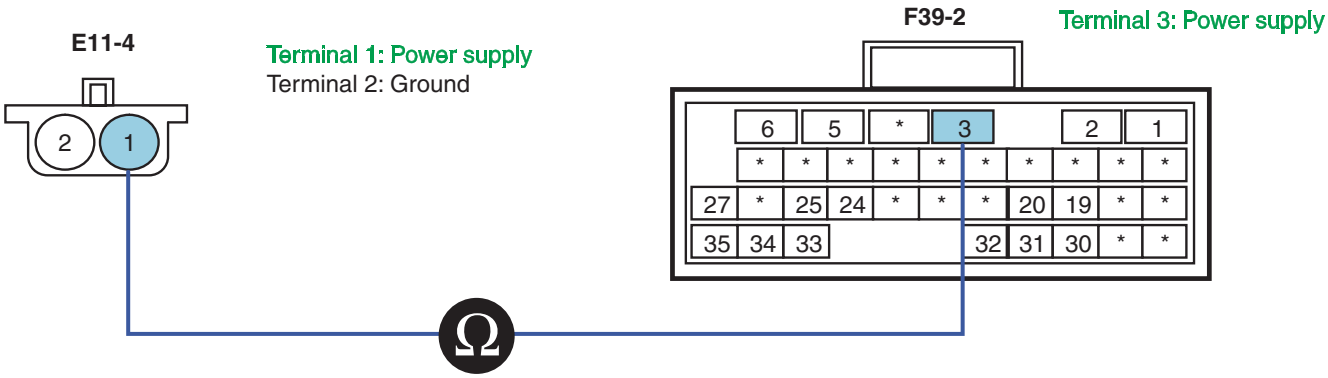
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn ignition OFF.

2) Disconnect injector #4 connector(E11-4) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of injector #4 harness connector(E11-4) and terminal 3 of ECM connector(F39-2).



SNBFL8055L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

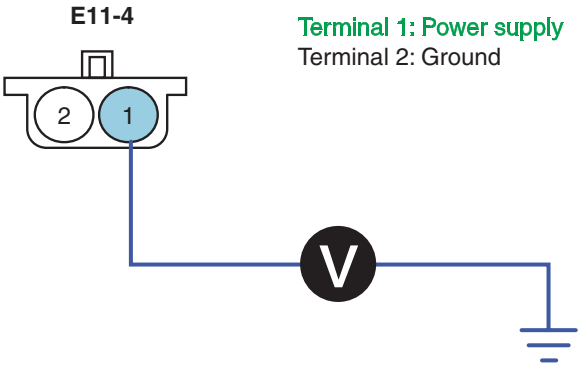
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. Power Supply Short to Power Inspection

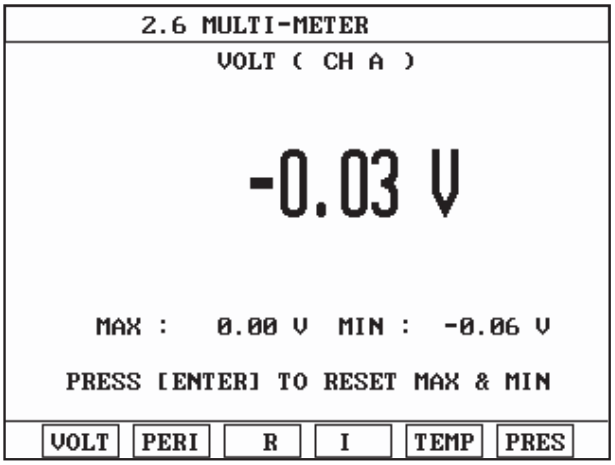
1) Disconnect injector #4 connector(E11-4) and ECM connector(F39-2).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of injector #4 harness connector(E11-4) and chassis ground.



Terminal 1: Power supply
Terminal 2: Ground



SUDFL8129L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

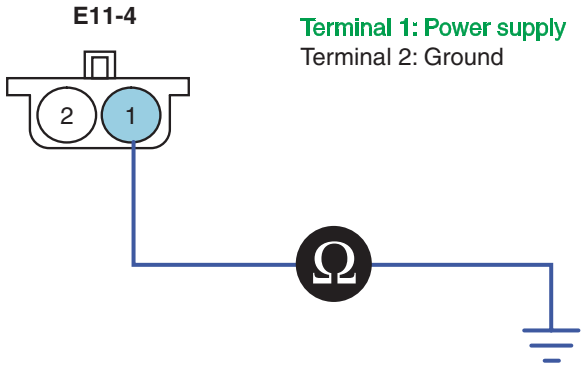
▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

4. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect injector #4 connector(E11-4) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of injector #4 harness connector(E11-4) and chassis ground.



SUDFL8130L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

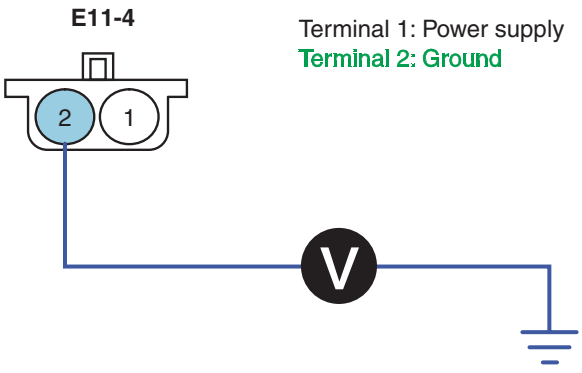
GROUND CIRCUIT INSPECTION EA7E8BB9

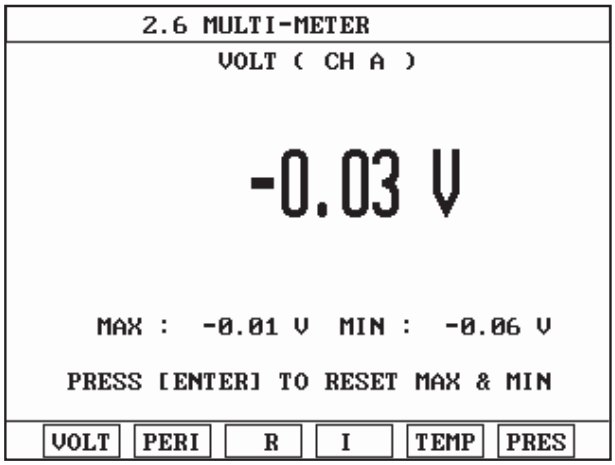
1. Ground Voltage Drop Inspection

1) Disconnect injector #4 connector(E11-4).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 2 of injector #4 harness connector(E11-4) and chassis ground.





SUDFL8131L

■ Specification: Ground voltage drop - Within 200mV

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

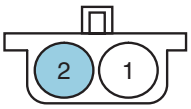
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

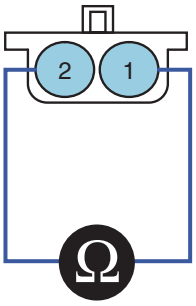
2) Disconnect injector #4 connector(E11-4) and ECM connector(F39-2).

3) Measure resistance between terminal 2 of injector #4 harness connector(E11-2) and terminal 6 of ECM connector(F39-2).



Terminal 1: Power supply
Terminal 2:

E11-4



Terminal 1: Power supply
Terminal 2: Ground

■ Specification

Item	Specification
Resistance	0.45 Ω(20˚C)

SUDFL8133L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the injector and then go to "Verification of Vehicle Repair" procedure.

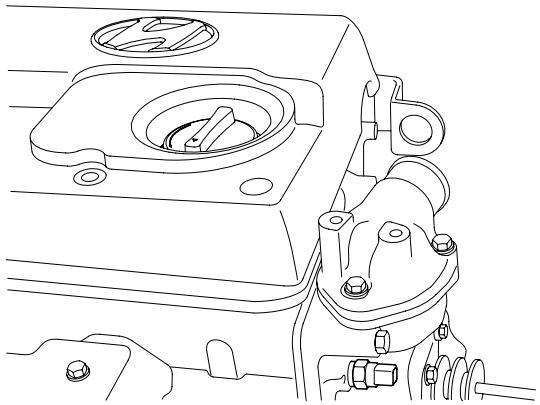
VERIFICATION OF VEHICLE REPAIR E5D97224

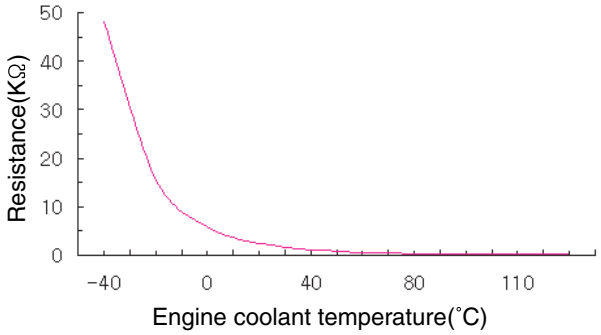
Refer to DTC P0112.

DTC P0217 ENGINE COOLANT OVER TEMPERATURE

COMPONENT LOCATION EF70561F

Coolant temperature sensor





SUDFL8134L

DESCRIPTION E2BE635C

1. GENERAL DESCRIPTION
   ECTS(Engine Coolant Temperature Sensor) is located on coolant passage of cylinder head. The ECTS uses a thermistor whose resistance changes with the temperature. The electric resistance of the ECTS decreases as the temperature increases, and increases as the temperature decreases, that is negative characteristics.
   The ECTS receives 5 voltage via resistor from ECM and resistor and thermistor are linked in series. ECM received signal from ECTS is used to control injection timing, fuel amount correction and automatic cooling fan.
   Specially the defective engine coolant temperature sensor has a great influence on the cold starting and is one of the factors to cause white smoke at starting.

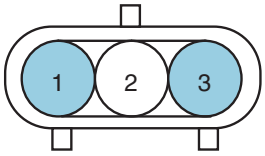
2. DTC DESCRIPTION
   If the output voltage of the engine coolant temperature sensor is over 115°C for 2,995.9ms or more, the ECM judges this as a fault and DTC is set.
   Fuel amount correction will not be controlled by ECM depending on engine coolant temperature but vehicle is possible to drive. Maximum engine power is limited and warning lamp comes on.

DTC DETECTING CONDITION EC8CE914

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Check cooling system.
Enable Conditions	• Ignition ON/ At running			
Threshold Value	• 115°C or more			
Diagnosis Time	• 2,995.9ms or more			
Fail Safe	Fuel Cut	No	• Fuel amount is limited to below 40mm³/st. • Fuel correction and engine power is not changed according to engine coolant temperature.	
	Fuel Limit	Yes		
	MIL	ON		

SPECIFICATION E5BC0051

Temperature		Resistance between terminals 1 and 3(kΩ)
℃	°F	
-20	-4	15.48
0	32	5.79
20	68	2.45
40	104	1.148
80	176	0.322

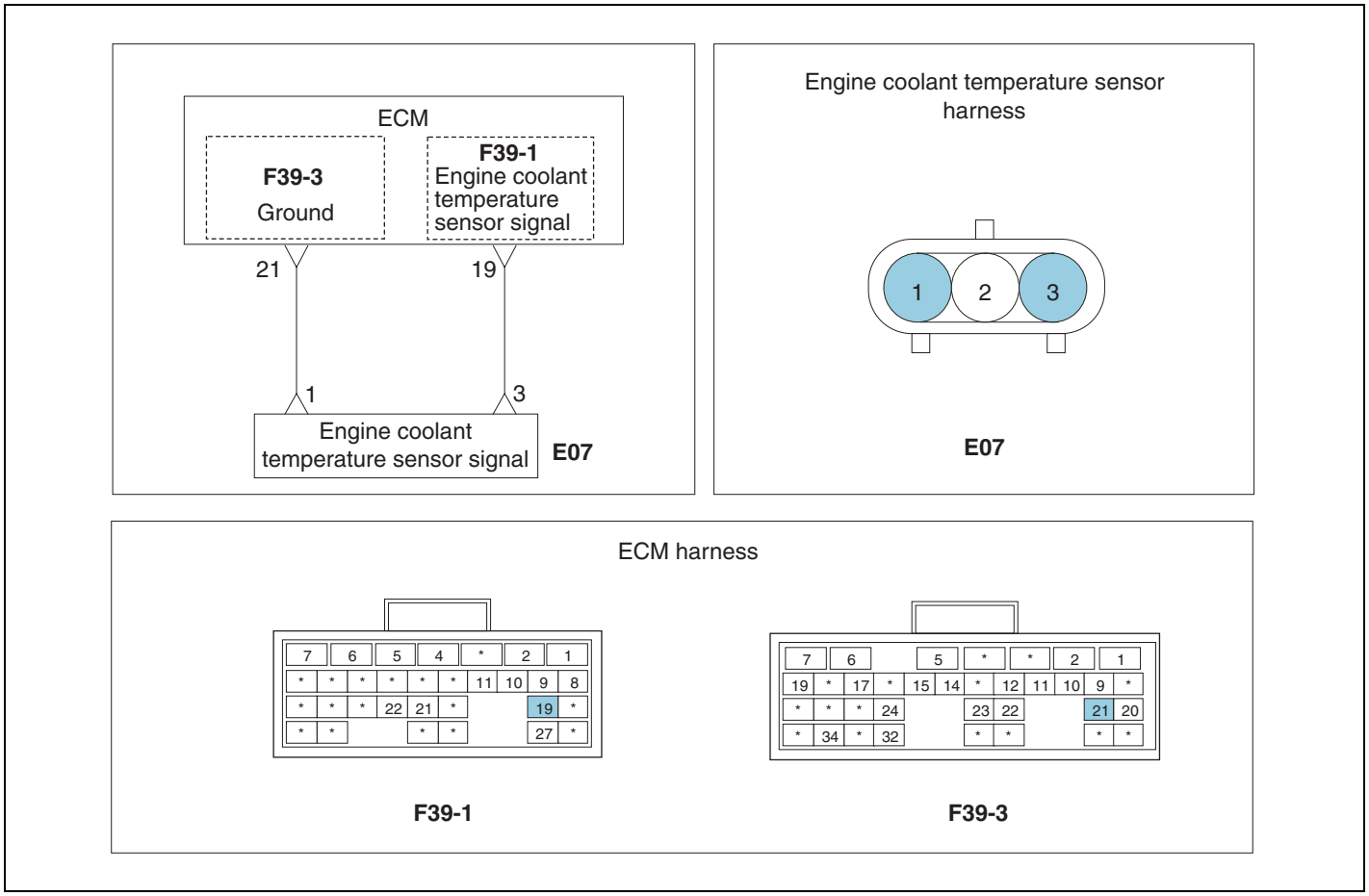


Sensor connector

Terminal 1: Ground
Terminal 3: Sensor output

SUDFL8036L

SCHEMATIC DIAGRAM EF541848



SNBFL8057L

MONITOR SCAN TOOL DATA EF925BE6

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Engine Coolant Temperature Sensor" parameter on the scan tool.

NOTE

Engine coolant temperature sensor data is displayed on the scan tool depending on DTC detecting condition. In case of fail safe. be sure to check that fuel amount is limited to below 40㎣/st if engine coolant temperature is over 115°C.

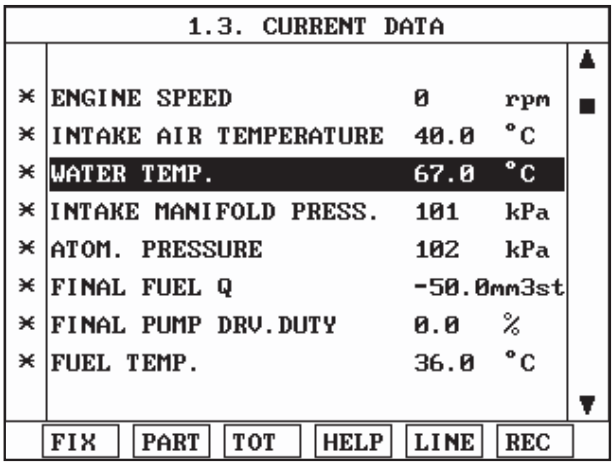


Fig. 1 Engine coolant temperature sensor data at ignition ON

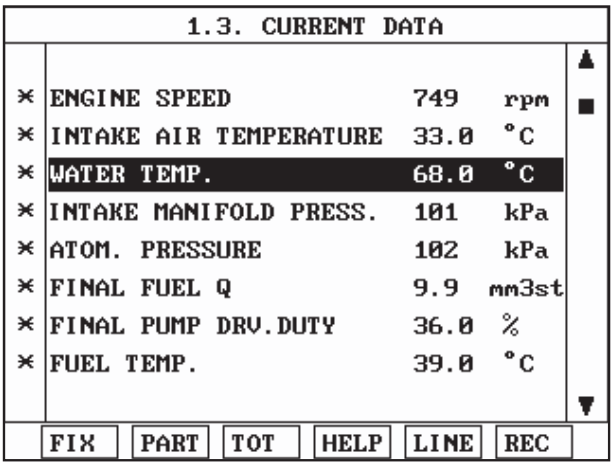


Fig. 2 Engine coolant temperature sensor data at idle

SUDFL8038L

TERMINAL & CONNECTOR INSPECTION E656B285

Refer to DTC P0112.

SYSTEM INSPECTION ED53A3FE

1. Cooling system inspection
   - Check the fan belt tension.
   - Check the engine coolant for level and leaks.
   - Check the radiator grille.
   - Check the engine coolant for contamination or corrosion.
   - Check the thermostat for normal operation.
   - Check the water pump for operation.
   - In case of automatic cooling fan, check it for oil leaks.
   - Check all possible causes for overheat.
   - Is the system normal for the above checks?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the faulty cooling system and then go to "Verification of Vehicle Repair" procedure.
Repeat the cooling system checks one or two times.

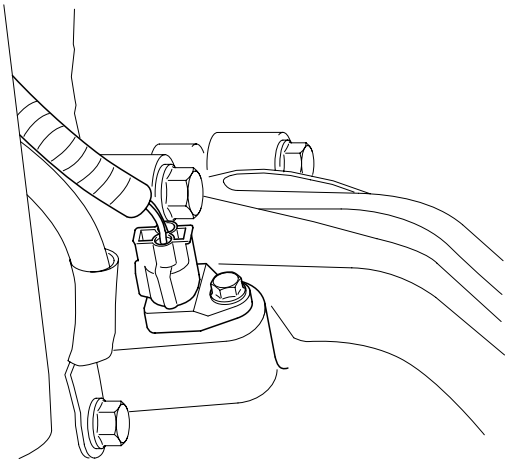
VERIFICATION OF VEHICLE REPAIR EF9A5EFD

Refer to DTC P0112.

DTC P0219 ENGINE OVERSPEED CONDITION

COMPONENT LOCATION ED3E2EFF

Crankshaft position sensor



SUDFL8136L

DESCRIPTION E8D911E4

1. GENERAL DESCRIPTION
   The engine piston position is used for determining fuel injection timing, all pistons are connected to crankshaft via connecting rod. After the crankshaft position sensor detects piston position, it sends signal to the ECM to determine fuel injection timing and engine speed. The camshaft position sensor is used to detect the top dead center of compression stroke of each cylinder. Based on these signals, the ECM determines fuel injection timing and injection order of each cylinder.

2. DTC DESCRIPTION
   If the engine rpm is over 4,000rpm for 97.6 ms or more, the ECM judges this as a fault and DTC is set.
   In case engine rpm is over 4,000 rpm to prevent damage due to engine over speed, the fuel injection is injected partially to reduce engine rpm. If engine rpm is lower than 3,500rpm, the injection will return to normal condition. The engine system will be protected like this.

DTC DETECTING CONDITION E949A8C5

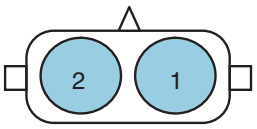
<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="5">• Check crankshaft position sensor.</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• More than 4,000rpm</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 97.6ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• In case engine rpm is more than 4,000rpm, partial injection will be applied. If 3,500 rpm or less, it will return to normal injection.</td></tr>
<tr><td>Fuel Limit</td><td>Yes</td></tr>
<tr><td>MIL</td><td>ON</td></tr>
</table>

SPECIFICATION EB133C5C

Injector resistance(terminal-to-terminal)

Temperature(℃)	Resistance between terminals 1 and 2(Ω)
20	125 ± 17

Air gap	1.50 ± 0.5 mm

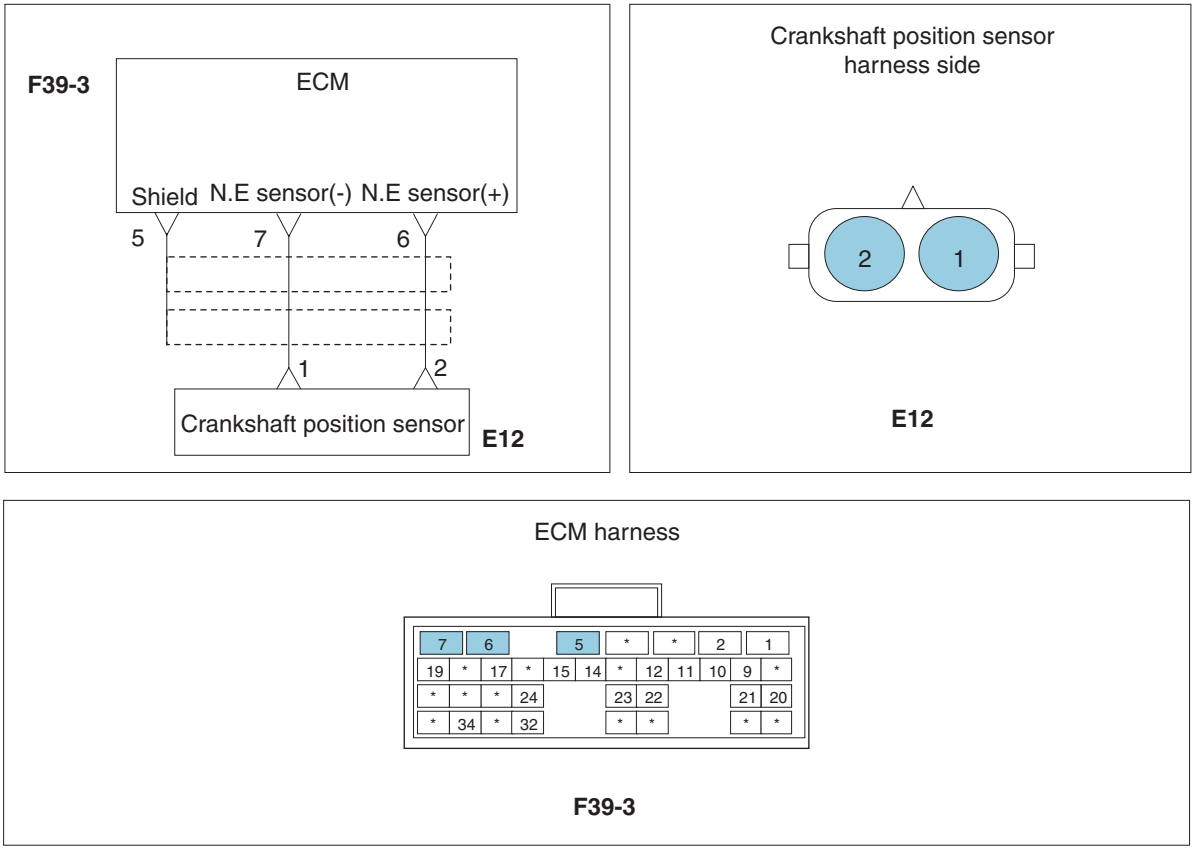


Terminal 1: N.E sensor(-)
Terminal 2: N.E sensor(+)

Sensor side connector

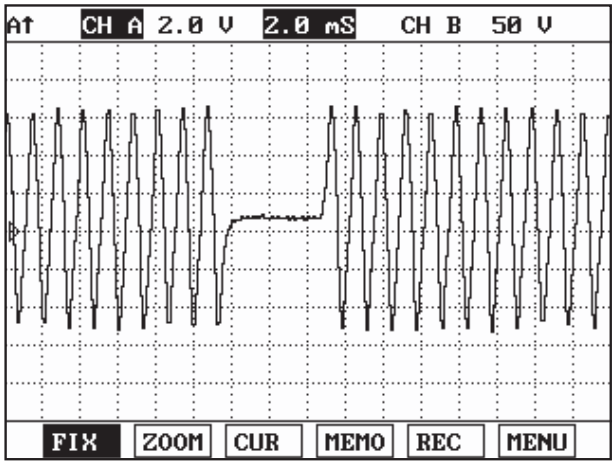
SUDFL8137L

SCHEMATIC DIAGRAM EB0E4042



SNBFL8058L

SIGNAL WAVEFORM EA55C77B



SUDFL8139L

MONITOR SCAN TOOL DATA E41435BE

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Fuel injection amount" parameter on the scan tool.

NOTE

The value of "Engine revolution" depending on engine operation conditions will change. Compare "Fuel injection amount" between 4,000rpm or more and 3,500rpm or less of engine rpm in case of fail safe.

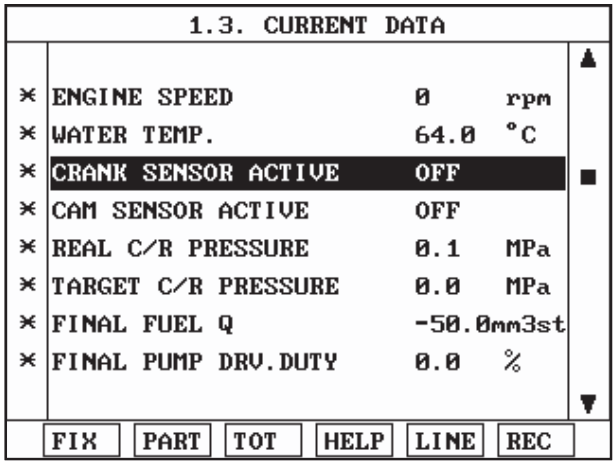


Fig. 1 Engine rpm data at ignition ON

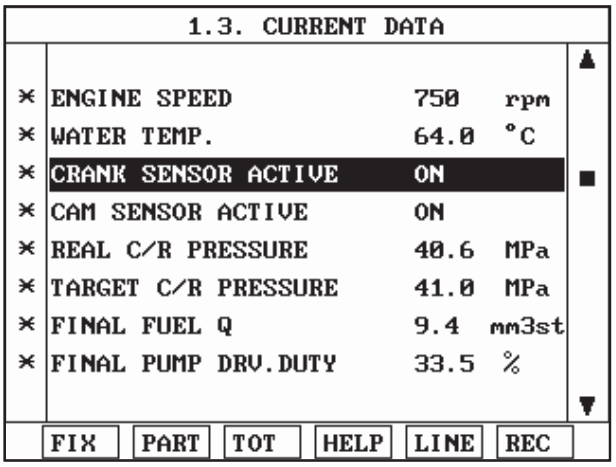


Fig. 2 Engine rpm data at idle

SUDFL8140L

TERMINAL & CONNECTOR INSPECTION E0D5C020

Refer to DTC P0112.

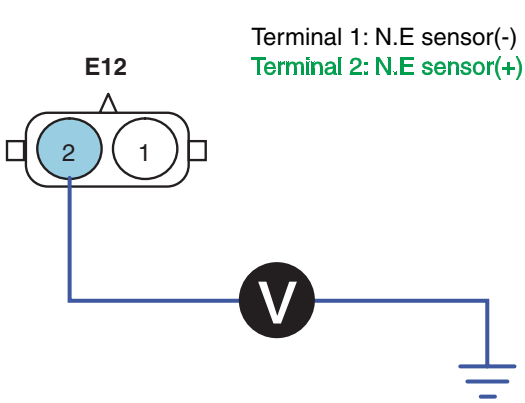
POWER SUPPLY INSPECTION E8260767

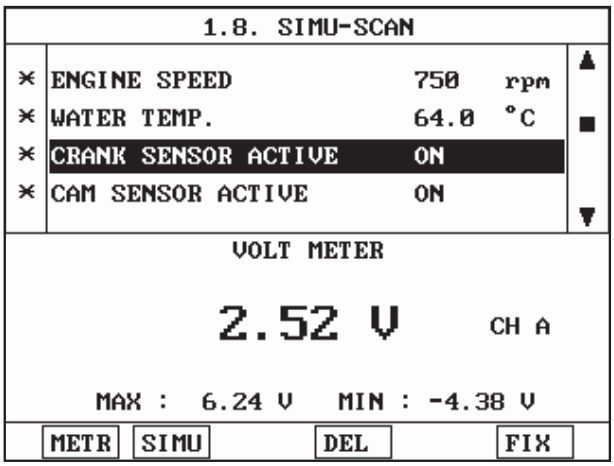
1. N.E sensor(+) Voltage Inspection

   1) Leave the crankshaft position sensor connector(E12) installed.

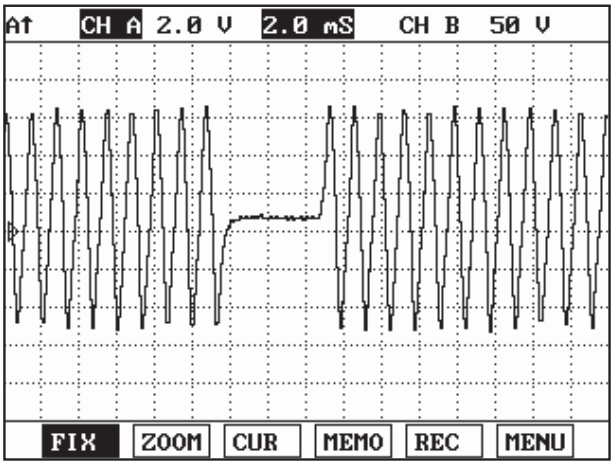
   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 2 of the crankshaft position sensor harness connector and chassis ground.





▶ With crankshaft position sensor connector connected (Power at idle)



▶ With crankshaft position sensor connector connected (Waveform at idle)

SUDFL8141L

■ Specification: ETC control module output power approx. 5.97 V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

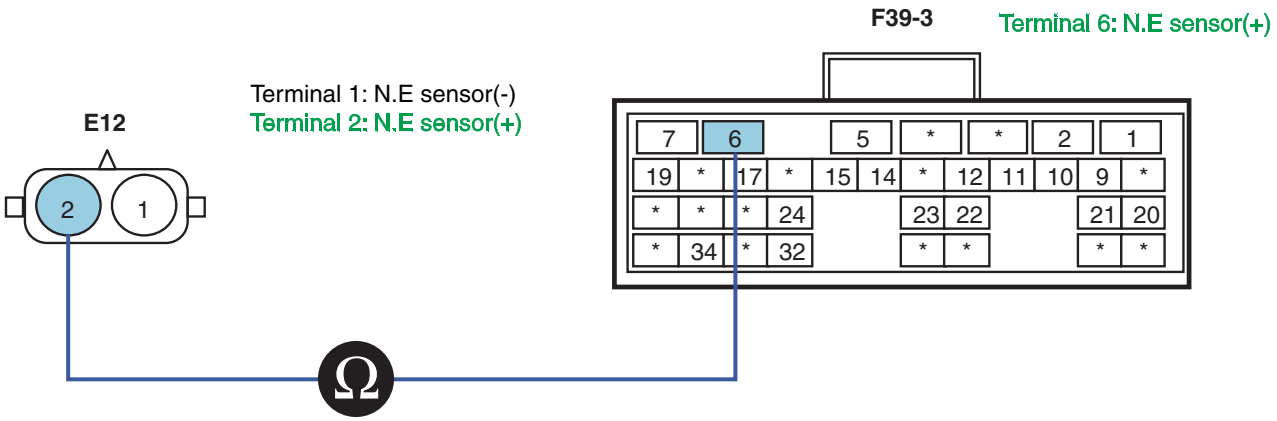
▶ Go to "N.E Sensor(+) Open Inspection" procedure.

2. N.E Sensor(+) Open Inspection

1) Turn ignition OFF.

2) Disconnect crankshaft position sensor connector(E12) and ECM connector(F39-3).

3) Measure resistance between terminal 2 of crankshaft position sensor harness connector and terminal 6 of ECM connector(F39-3).



SNBFL8059L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "N.E Sensor(+) Short to Power Inspection" procedure.

NO

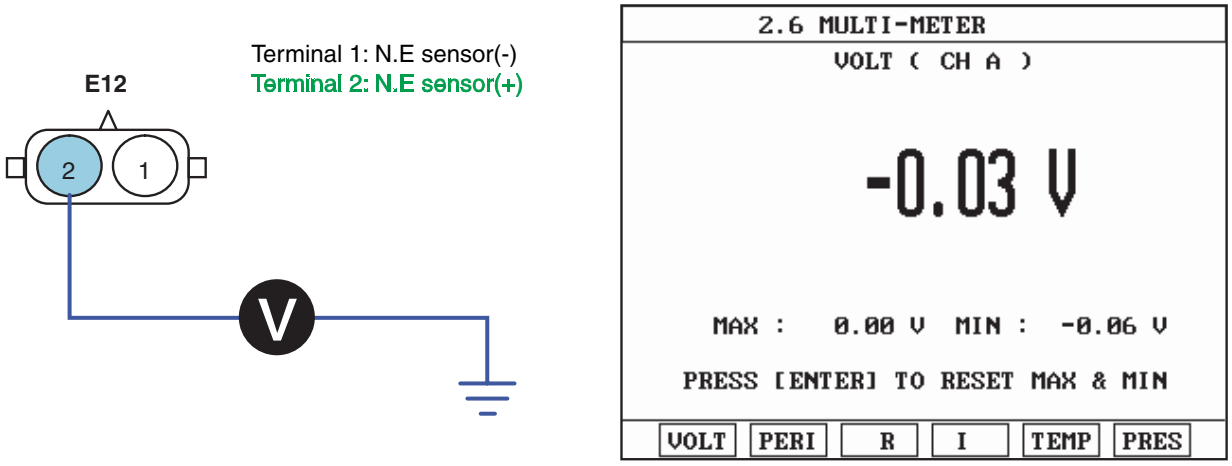
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. N.E Sensor(+) Short to Power Inspection

1) Disconnect crankshaft position sensor connector(E12) and ECM connector(F39-3).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 2 of crankshaft position sensor harness connector and chassis ground.



SUDFL8143L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

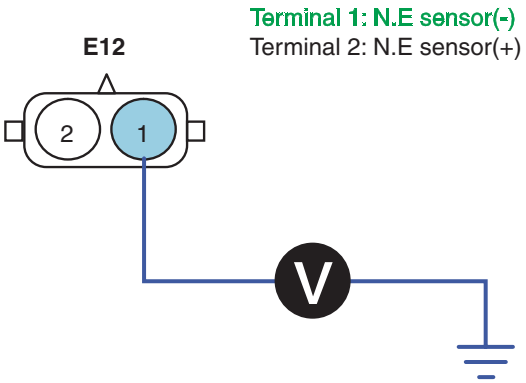
GROUND CIRCUIT INSPECTION EF3CE0C1

1. N.E Sensor(+) Voltage Inspection

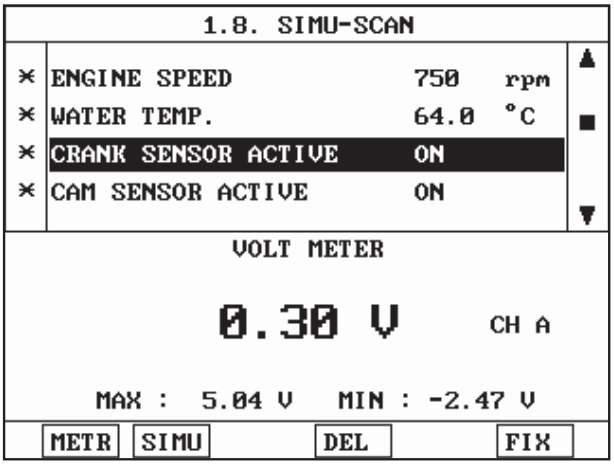
1) Leave crankshaft position sensor connector(E12) connected.

2) Turn the ignition ON. Start the engine.

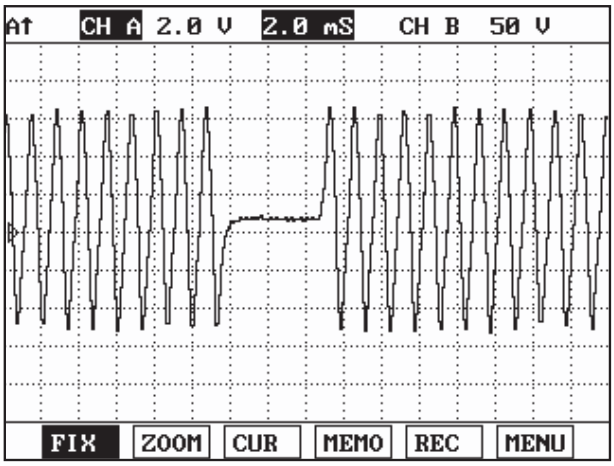
3) Measure voltage between terminal 1 of crankshaft position sensor harness connector and chassis ground.



Terminal 1: N.E sensor(-)
Terminal 2: N.E sensor(+)



▶ With crankshaft position sensor connector connected at idle



▶ With crankshaft position sensor connector connected (Waveform at idle)

SUDFL8144L

■ Specification: ETC control module output power approx. 5.97 V

4) Is the voltage measured within specification?

YES

▶ Go to "Shield Circuit Inspection" procedure.

NO

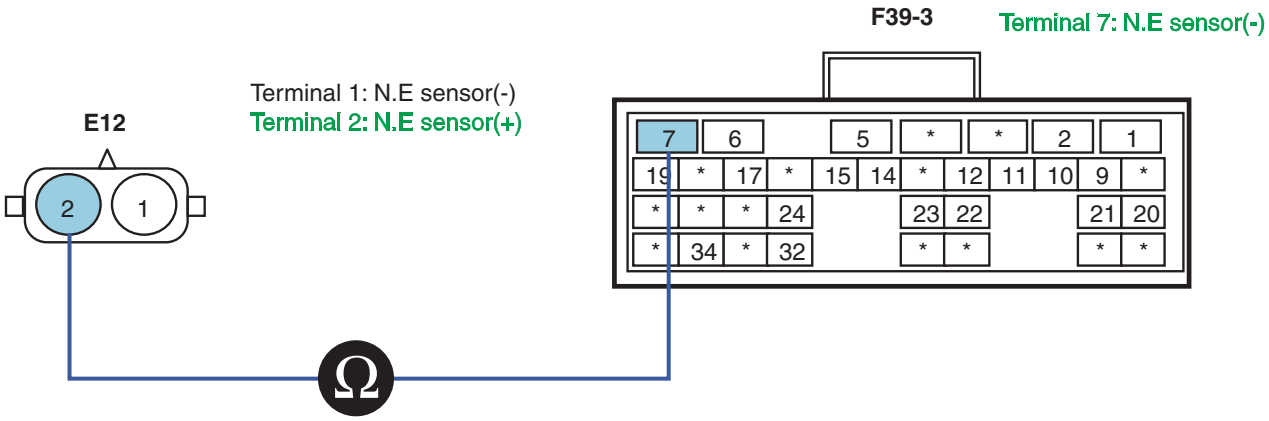
▶ Go to "N.E Sensor(-) Open Inspection" procedure.

2. N.E Sensor(-) Open Inspection

1) Turn the ignition OFF.

2) Disconnect crankshaft position sensor connector(E12) and ECM connector(F39-3).

3) Measure resistance between terminal 2 of crankshaft position sensor harness connector and terminal 7 of ECM connector(F39-3).



SNBFL8060L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "N.E Sensor(-) Short to Power Inspection" procedure.

NO

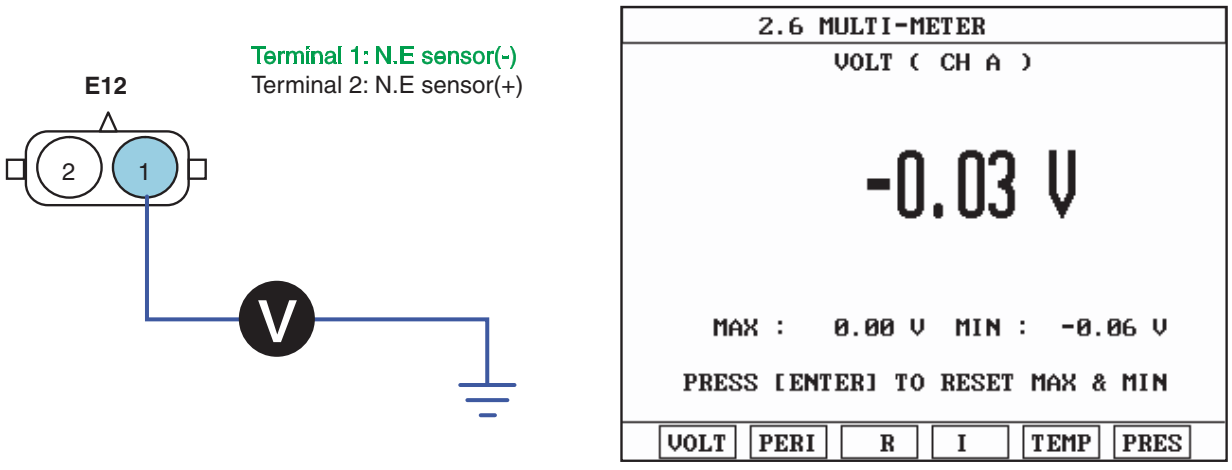
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. N.E Sensor(-) Short to Power Inspection

1) Disconnect crankshaft position sensor connector(E12) and ECM connector(F39-3).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of crankshaft position sensor harness connector and chassis ground.



SUDFL8146L

■ Specification: Below 0~0.1V

4) Is the resistance measured within specification?

YES

▶ Go to "Shield Circuit Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

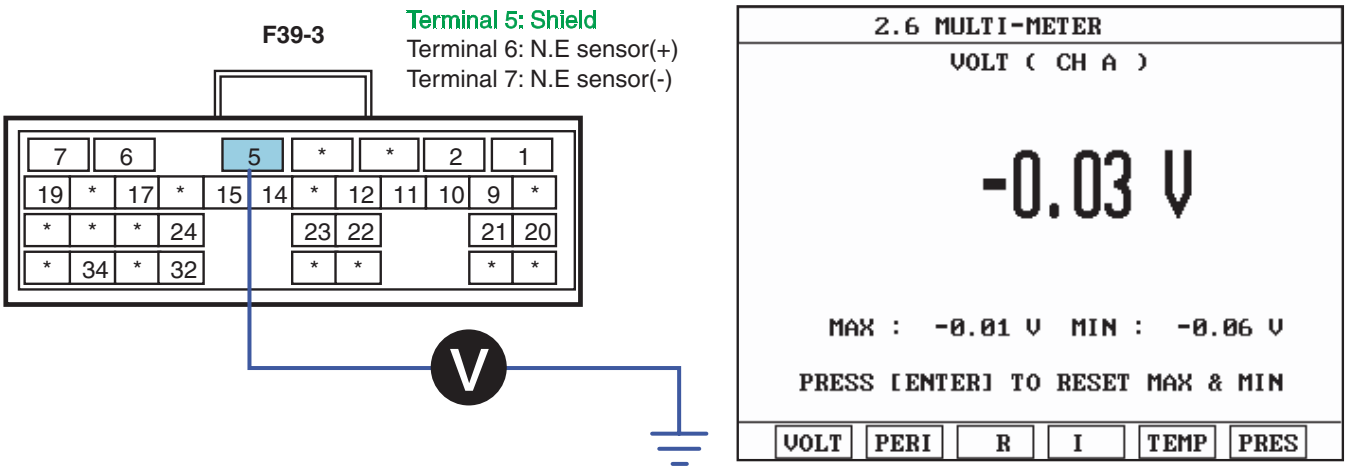
SHIELD CIRCUIT INSPECTION EF69DF00

1. Shield Short to Power Inspection

   1) Disconnect ECM connector(F39-3).

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 5 of ECM harness connector and chassis ground.



SNBFL8061L

■ Specification: Shield ground power approx. 0V

   4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

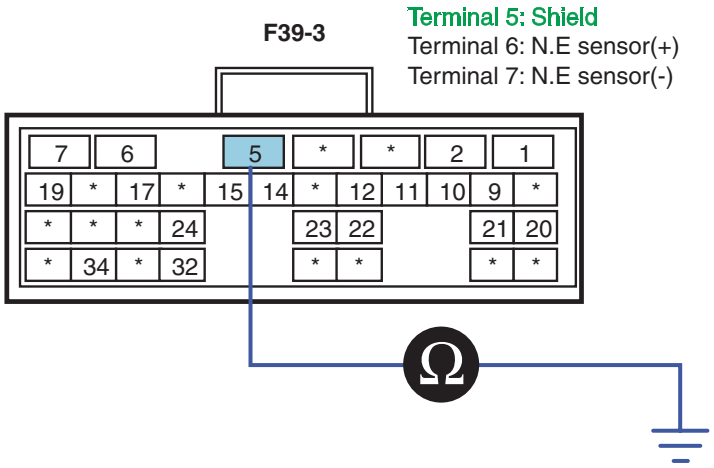
▶ Go to "Shield Short to Ground Inspection" procedure.

2. Shield Short to Ground Inspection

   1) Turn the ignition OFF.

   2) Disconnect ECM connector(F39-3).

   3) Measure resistance between terminal 5 of ECM harness connector(F39-3) and chassis ground.



SNBFL8062L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

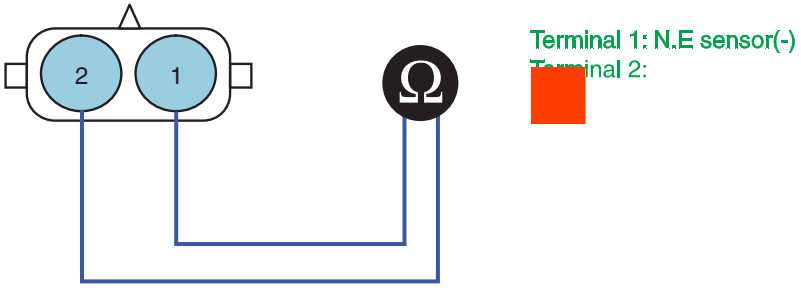
COMPONENT INSPECTION E7223402

1. Crankshaft position Sensor Resistance Inspection

1) Turn ignition OFF.

2) Disconnect crankshaft position sensor connector(E12).

3) Measure resistance between terminals 1 and 2 of crankshaft position sensor connector.



4) Is the resistance measured within specification?

YES

▶ Go to "Crankshaft position Sensor Waveform Inspection" procedure.

NO

▶ Replace the crankshaft position sensor and then go to "Verification of Vehicle Repair" procedure.

2. Crankshaft position Sensor Waveform Inspection

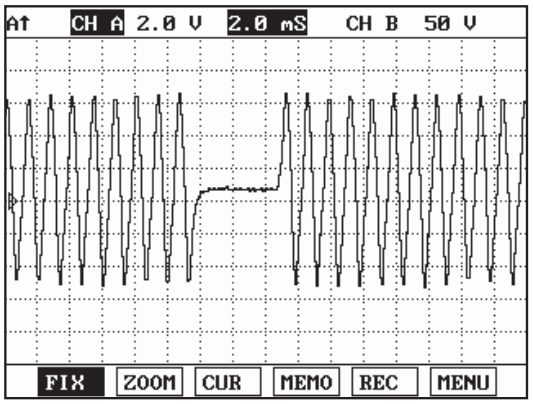
1) Turn ignition OFF.

2) Connect crankshaft position sensor connector(E12).

3) Connect oscilloscope to terminal 2 of crankshaft position sensor.

4) Check crankshaft position waveform for normal operation at idle state.

Crankshaft position sensor waveform
(at idle)



SUDFL8150L

5) Is the crankshaft position sensor waveform normal?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the crankshaft position sensor and then go to "Verification of Vehicle Repair" procedure.

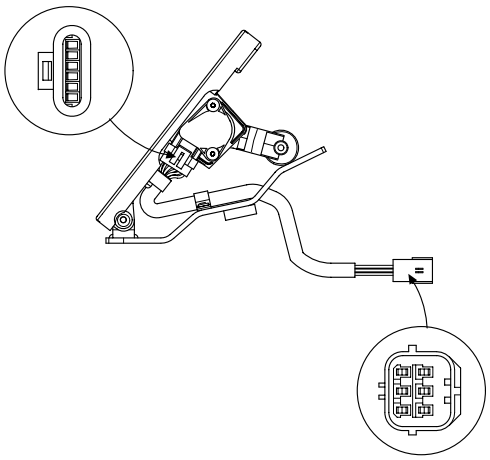
VERIFICATION OF VEHICLE REPAIR E99FBB60

Refer to DTC P0112.

DTC P0220 PEDAL SENSOR NO.2 NOT OPEN

COMPONENT LOCATION E004D821

Accelerator pedal position sensor



SUDFL8046L

DESCRIPTION E7DCB692

1. GENERAL DESCRIPTION
   The accelerator pedal position sensor detects pedal position and sends signal to ECM. It is composed of two potentiometers(dual variable resistor type). Power supply is provided separately to detect acceleration condition exactly. The voltage of accelerator pedal position sensor is generated by potentiometer and the position of accelerator pedal is calculated by using characteristic curve programmed beforehand.

2. DTC DESCRIPTION
   The accelerator pedal sensor indicates idle state in spite of idle switch OFF when the vehicle is being driven. When the accelerator pedal sensor "2" outputs 0~5V and the accelerator pedal sensor "1" outputs 5.1V or more for more than 1048.6ms, the ECM judges this as a fault and DTC is set. The possible causes are defective sensor, wiring problem etc.

DTC DETECTING CONDITION ECDCCA56

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Wiring problem • Defective sensor
Enable Conditions	• IG ON/ Running			
Threshold Value	• Idle switch OFF, 0V≤ accelerator pedal position sensor "2" output voltage≤ 5.0V, Accelerator pedal position sensor "1" output voltage≥ 5.1V			
Diagnosis Time	• 1,048.6ms or more			
Fail Safe	Fuel Cut	No		
	Fuel Limit	No		
	MIL	OFF		

SPECIFICATION EF2B3A9F

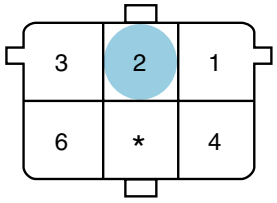
Resistance between terminals of accelerator pedal position sensor

Terminals 1-2(Not operating)	Terminals 1-2(Operating)	Terminals 1-3(Not operating)	Terminals 1-3(Operating)
Approx. 2.67kΩ	Approx. 1.06kΩ	Approx. 2.64kΩ	Approx. 2.64kΩ

Terminals 2-3(Not operating)	Terminals 2-3(Operating)
Approx. 0.732kΩ	Approx. 2.59kΩ

Accelerator pedal position sensor track "1", "2"	Specification	
	Idle state((0%)	Wide open(100%)
Output voltage	0.65V	3.85V

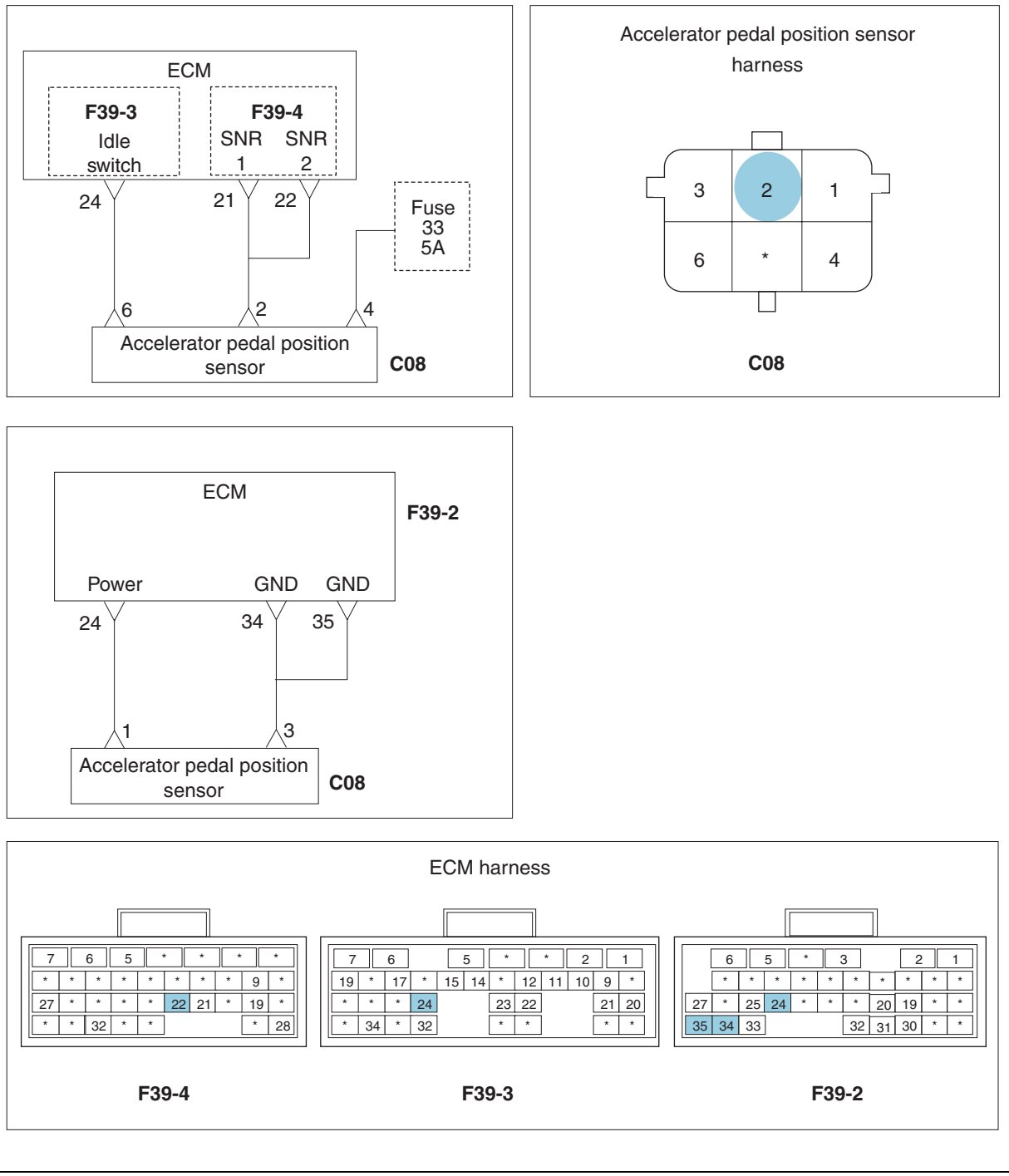
Terminal 2: Sensor "1", "2"



Sensor connector

SUDFL8065L

SCHEMATIC DIAGRAM EECFD728



SNBFL8063L

MONITOR SCAN TOOL DATA E013B80E

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Accelerator Pedal Position" parameter on the scan tool.

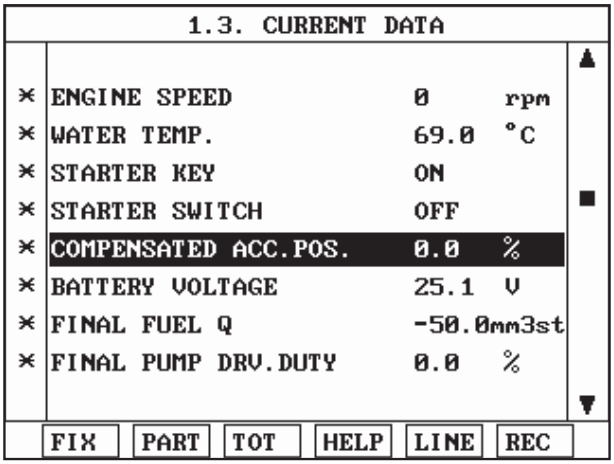


Fig. 1 Accelerator pedal position sensor data at ignition ON

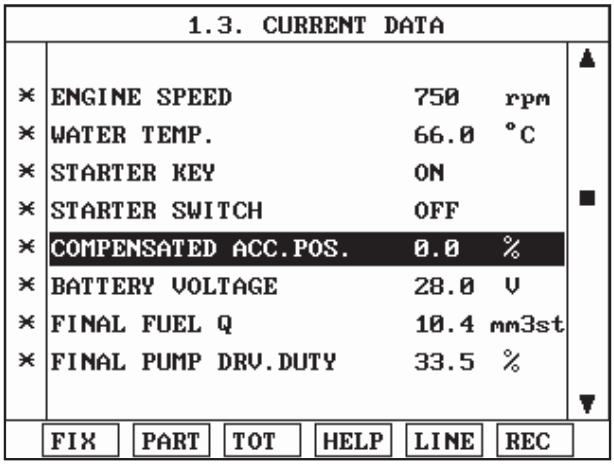


Fig. 2 Accelerator pedal position sensor data at idle

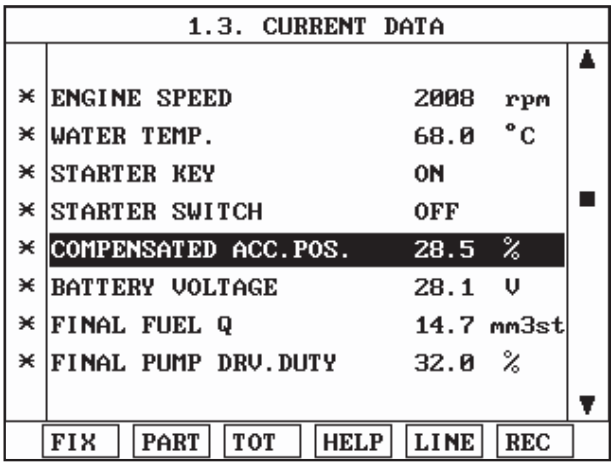


Fig. 3 Accelerator pedal position sensor data at 2,000rpm

SUDFL8049L

TERMINAL & CONNECTOR INSPECTION EE83881F

Refer to DTC P0112.

SIGNAL INSPECTION E388DBF4

1. Signal Voltage Inspection

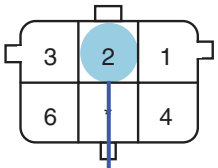
   1) Leave the accelerator pedal sensor connector(C08) and ECM(F39-4) installed.

   2) Turn the ignition ON. The engine stops.

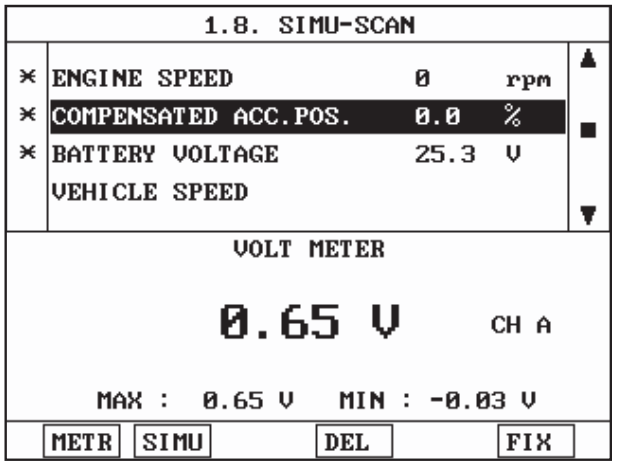
   3) Measure voltage between terminal 2 of accelerator pedal position sensor harness connector and chassis ground.

[Sensor side]

C08



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W



▶ With accelerator pedal position sensor connector installed (At IG ON)

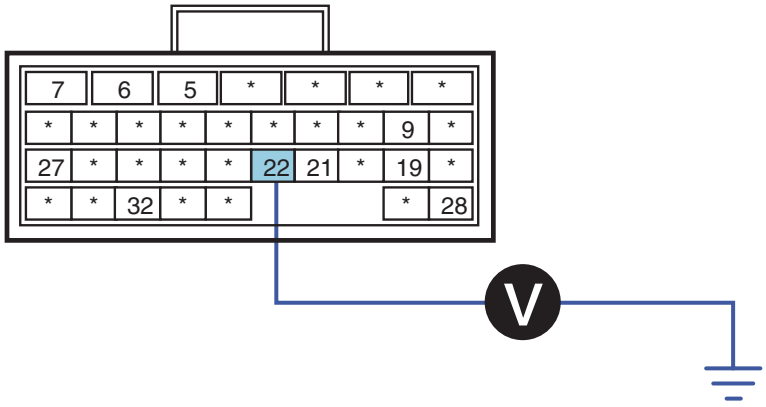
SNBFL8021L

4) Measure voltage between terminal 22 of ECM connector and chassis ground.

[ECM]

F39-4

Terminal 22: SNR2



SNBFL8064L

■ Specification: Accelerator pedal position signal power approx.0.13V(At not operating)

5) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

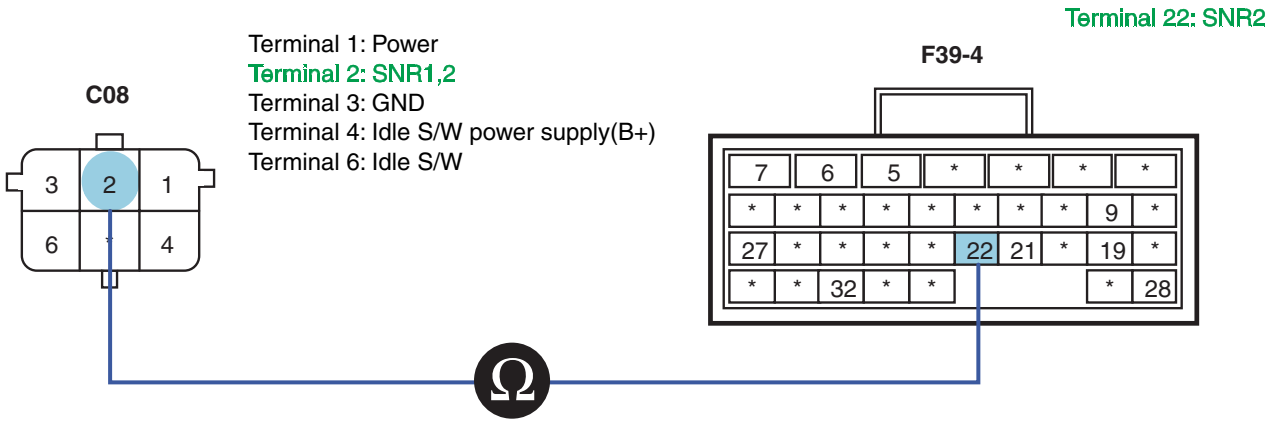
▶ Go to "Signal Open Inspection" procedure.

2. Signal Open Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 2 of accelerator pedal position sensor harness connector(C08) and terminal 22 of ECM connector(F39-4).



SNBFL8065L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Power Inspection" procedure.

NO

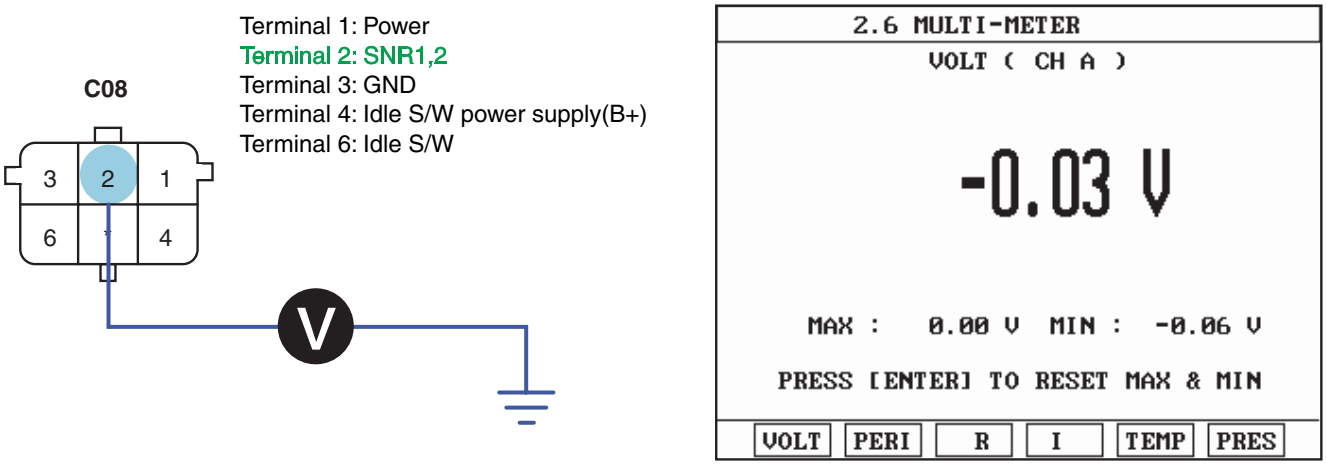
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Signal Short to Power Inspection

1) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

2) Turn the ignition ON. The engine stops.

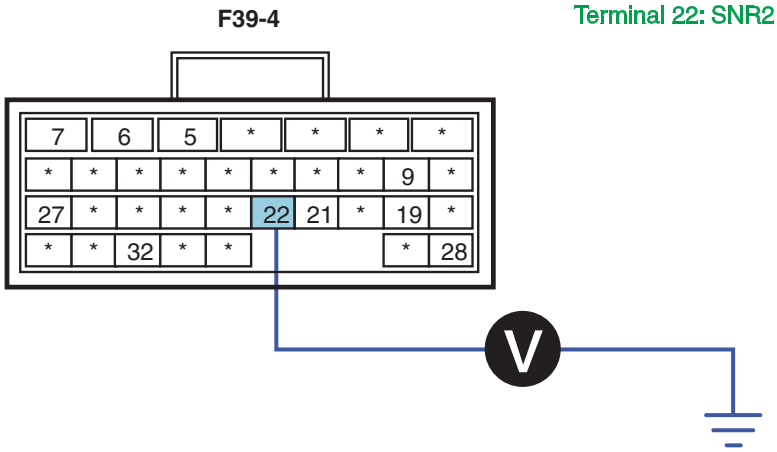
3) Measure voltage between terminal 2 of accelerator pedal position sensor harness connector(C08) and chassis ground.



SNBFL8024L

4) Measure voltage between terminal 22 of ECM connector and chassis ground.

[ECM]



SNBFL8064L

■ Specification: Below 0~0.1V

5) Is the voltage measured within specification?

YES

▶ Go to "Signal Short to Ground Inspection" procedure.

NO

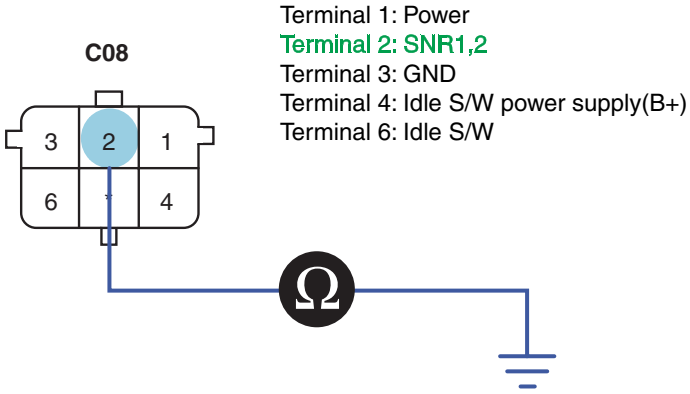
▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

4. Signal Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

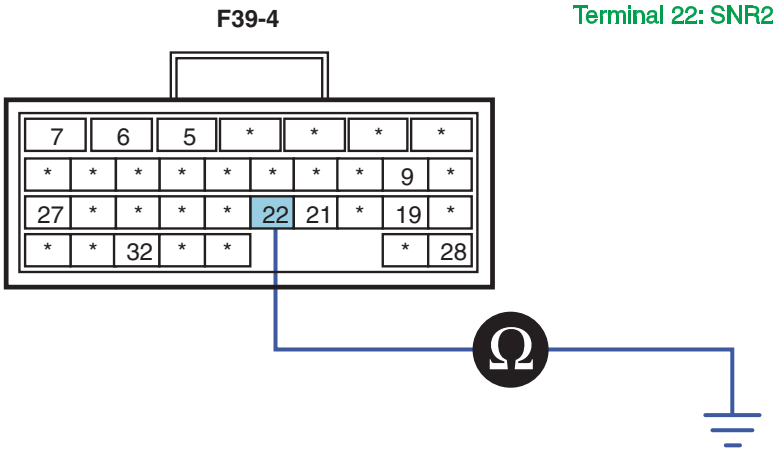
3) Measure resistance between terminal 2 of accelerator pedal position sensor harness connector(C08) and chassis ground.



SNBFL8025L

4) Measure resistance between terminal 22 of ECM connector and chassis ground.

[ECM]



SNBFL8066L

■ Specification: Infinite

5) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

POWER SUPPLY INSPECTION EF2D9DA7

1. Power Supply Voltage Inspection

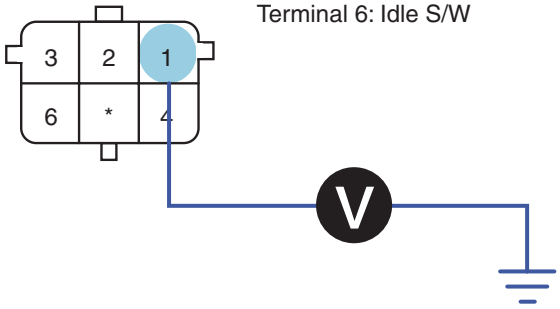
   1) Leave accelerator pedal position sensor connector(C08) and ECM connector(F39-2) connected.

   2) Turn the ignition ON. The engine stops.

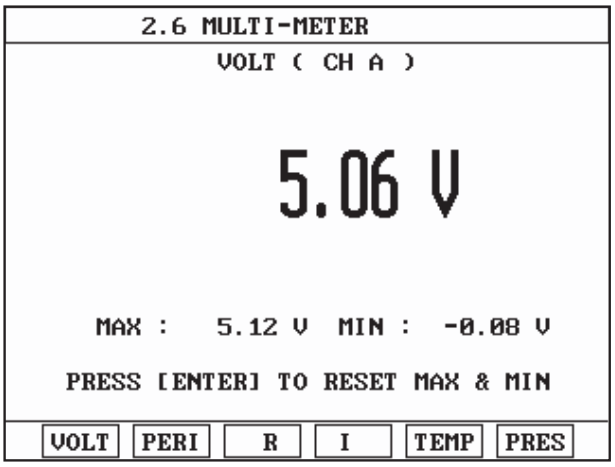
   3) Measure voltage between terminal 1 of accelerator pedal position sensor harness connector(C08) and chassis ground.

[Sensor side]

C08



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W



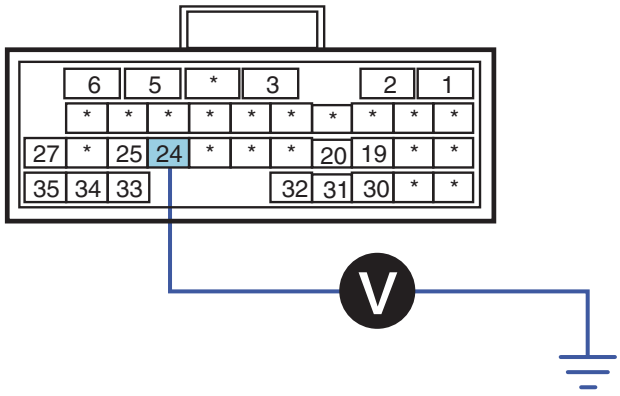
▶ With accelerator pedal position sensor connector disconnected/connected(At IG ON)

SNBFL8027L

4) Measure voltage between terminals 24 of ECM connector and chassis ground.

[ECM]

F39-2



Terminal 24: Power

SNBFL8028L

■ Specification: Accelerator pedal position sensor signal power approx. 5.21V

5) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

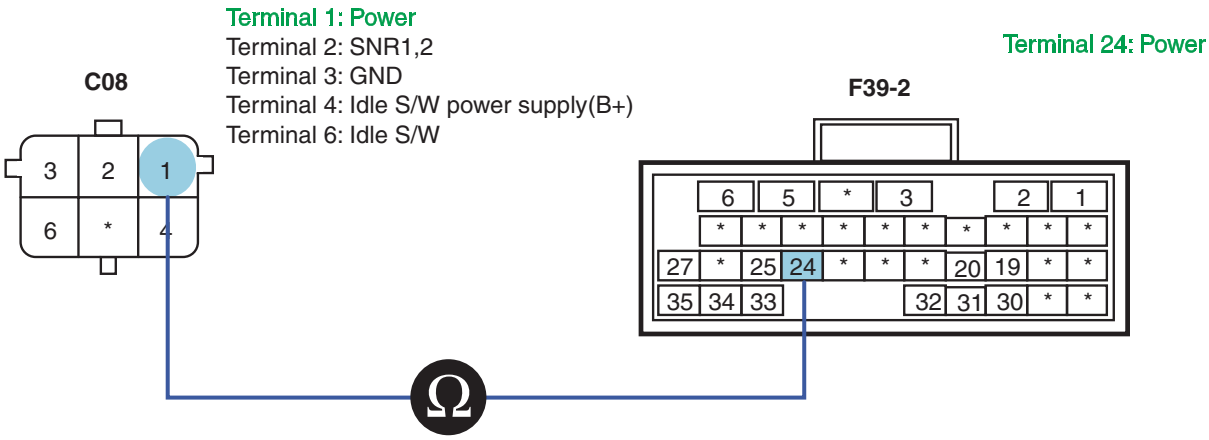
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 1 of accelerator pedal position sensor harness connector(C08) and terminals 24 of ECM connector(F39-2).



SNBFL8029L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

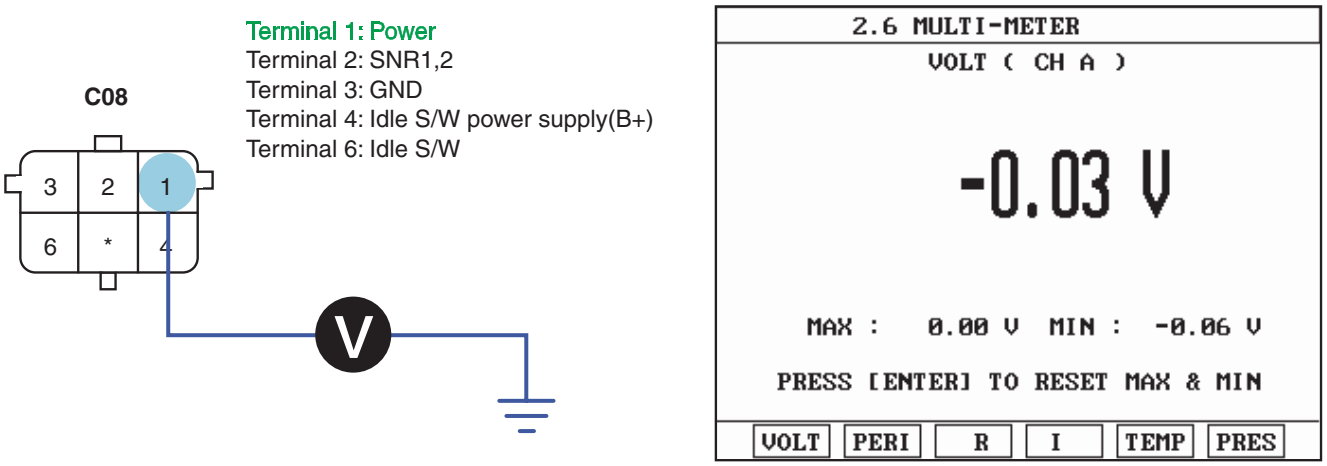
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Power Supply Short to Power Inspection

1) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

2) Turn the ignition ON. The engine stops.

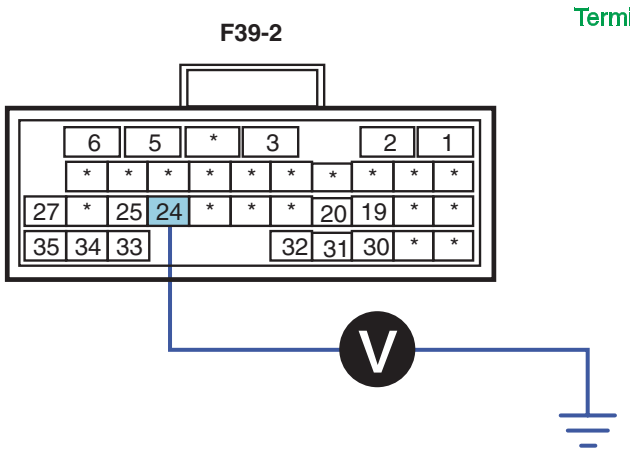
3) Measure voltage between terminal 1 of accelerator pedal position sensor harness connector and chassis ground.



SNBFL8030L

4) Measure voltage between terminals 24 of ECM connector and chassis ground.

[ECM]



SNBFL8028L

■ Specification: Below 0~0.1V

5) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

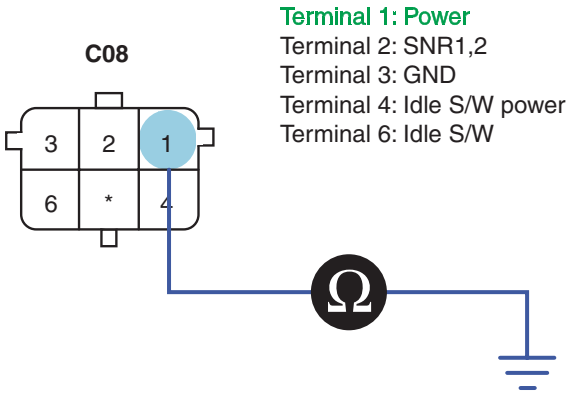
▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

4. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

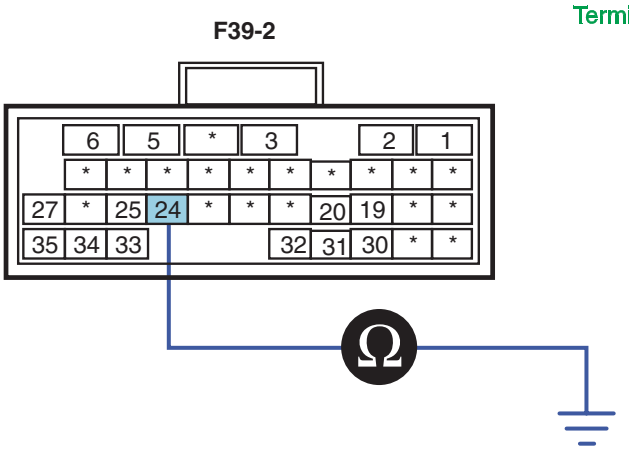
3) Measure resistance between terminal 1 of accelerator pedal position sensor harness connector and chassis ground.



SNBFL8031L

4) Measure resistance between terminals 24 of ECM connector and chassis ground.

[ECM]



SNBFL8032L

■ Specification: Infinite

5) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

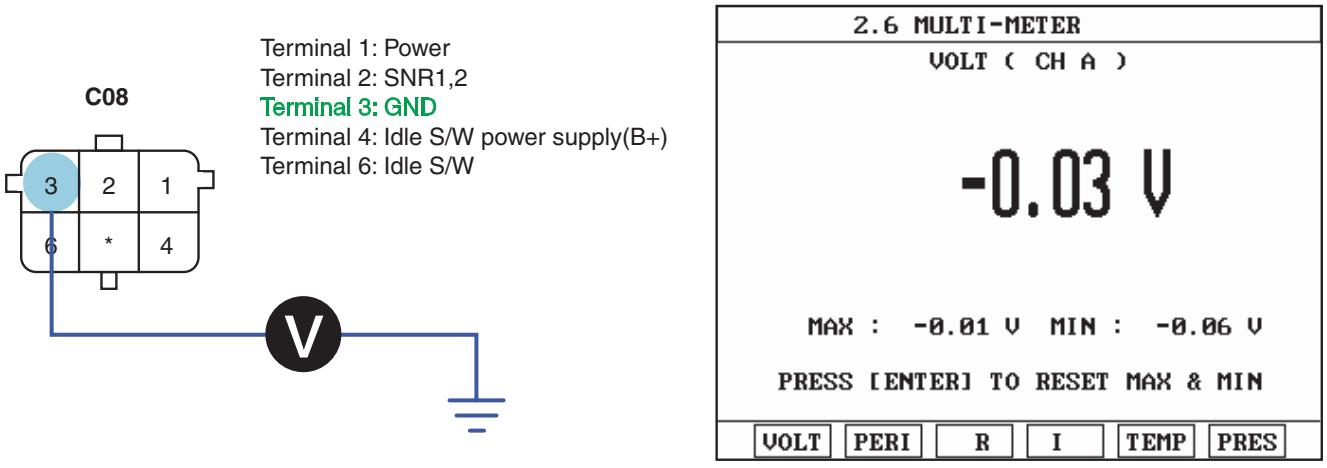
GROUND CIRCUIT INSPECTION E8963CF0

1. Ground Voltage Drop Inspection

   1) Disconnect accelerator pedal position sensor connector(C08).

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage drop between terminal 3 of accelerator pedal position sensor harness connector and chassis ground.



SNBFL8033L

■ Specification: Ground Voltage Drop - Within 200mV

4) Is the ground voltage drop measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

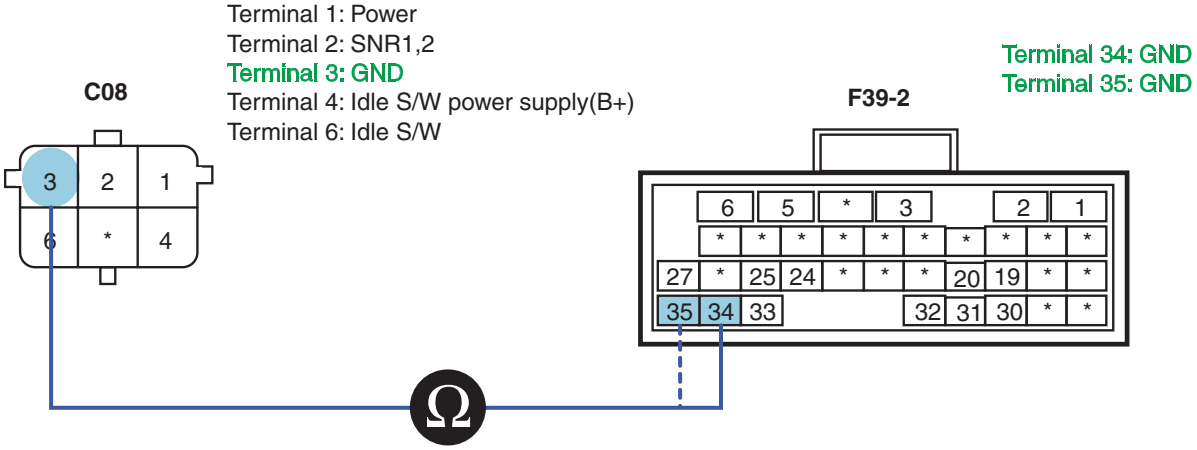
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 3 of accelerator pedal position sensor harness connector and terminals 34,35 of ECM connector(F39-2).



SNBFL8034L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

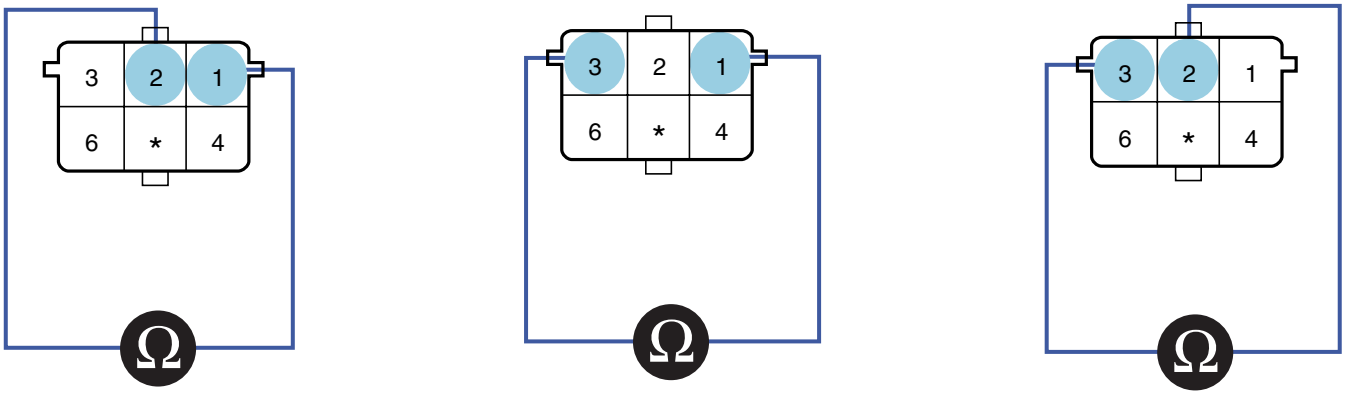
COMPONENT INSPECTION E837A590

1. Accelerator Pedal Position Sensor Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08).

3) Measure resistance between terminals 1-2, 2-3, 1-3 of accelerator pedal position sensor connector.



Resistance between terminals of accelerator pedal position sensor

Terminals 1-2(Not operating)	Terminals 1-2(Operating)	Terminals 1-3(Not operating)	Terminals 1-3(Operating)
Approx. 2.67kΩ	Approx. 1.06kΩ	Approx. 2.64kΩ	Approx. 2.64kΩ

Terminals 2-3(Not operating)	Terminals 2-3(Operating)
Approx. 0.732kΩ	Approx. 2.59kΩ

SUDFL8064L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace accelerator pedal position sensor and then go to "Verification of Vehicle Repair" procedure.

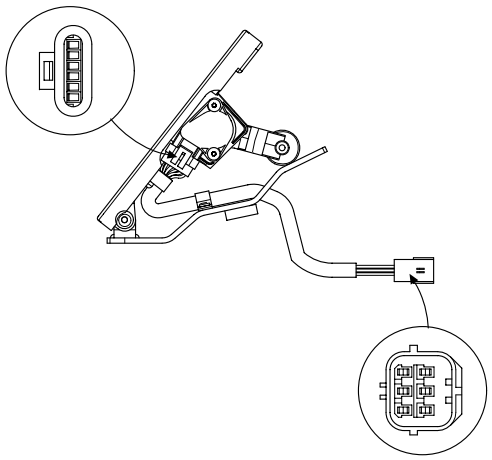
VERIFICATION OF VEHICLE REPAIR E1B5C8EC

Refer to DTC P0112.

DTC P0221 PEDAL SENSOR NO.2 NOT CLOSE

COMPONENT LOCATION E7840B15

Accelerator pedal position sensor



SUDFL8046L

DESCRIPTION E1C1BFDD

1. GENERAL DESCRIPTION
   The accelerator pedal position sensor detects pedal position and sends signal to ECM. It is composed of two potentiometers(dual variable resistor type). Power supply is provided separately to detect acceleration condition exactly. The voltage of accelerator pedal position sensor is generated by potentiometer and the position of accelerator pedal is calculated by using characteristic curve programmed beforehand.

2. DTC DESCRIPTION
   The accelerator pedal sensor does not indicate idle state in spite of idle switch ON when the vehicle is not accelerated. When the accelerator pedal sensor "2" outputs above 5.1V and the accelerator pedal sensor "1" outputs 0~5.0V or more for more than 1048.6ms, the ECM judges this as a fault and DTC is set. The possible causes are defective sensor, wiring problem etc.

DTC DETECTING CONDITION E8B4E67D

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Wiring problem • Defective sensor
Enable Conditions	• IG ON/ Running			
Threshold Value	• Idle switch ON, Accelerator pedal position sensor "2" output voltage≥ 5.1V, 0V≤ accelerator pedal position sensor "1" output voltage≤ 5.0V,			
Diagnosis Time	• 1,048.6ms or more			
Fail Safe	Fuel Cut	No		
	Fuel Limit	No		
	MIL	OFF		

SPECIFICATION ED2DE91A

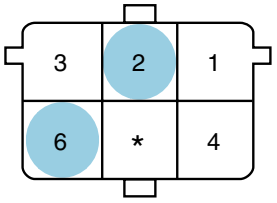
Resistance between terminals of accelerator pedal position sensor

Terminals 1-2(Not operating)	Terminals 1-2(Operating)	Terminals 1-3(Not operating)	Terminals 1-3(Operating)
Approx. 2.67kΩ	Approx. 1.06kΩ	Approx. 2.64kΩ	Approx. 2.64kΩ

Terminals 2-3(Not operating)	Terminals 2-3(Operating)
Approx. 0.732kΩ	Approx. 2.59kΩ

Accelerator pedal position sensor track "1", "2"	Specification	
	Idle state((0%)	Wide open(100%)
Output voltage	0.65V	3.85V

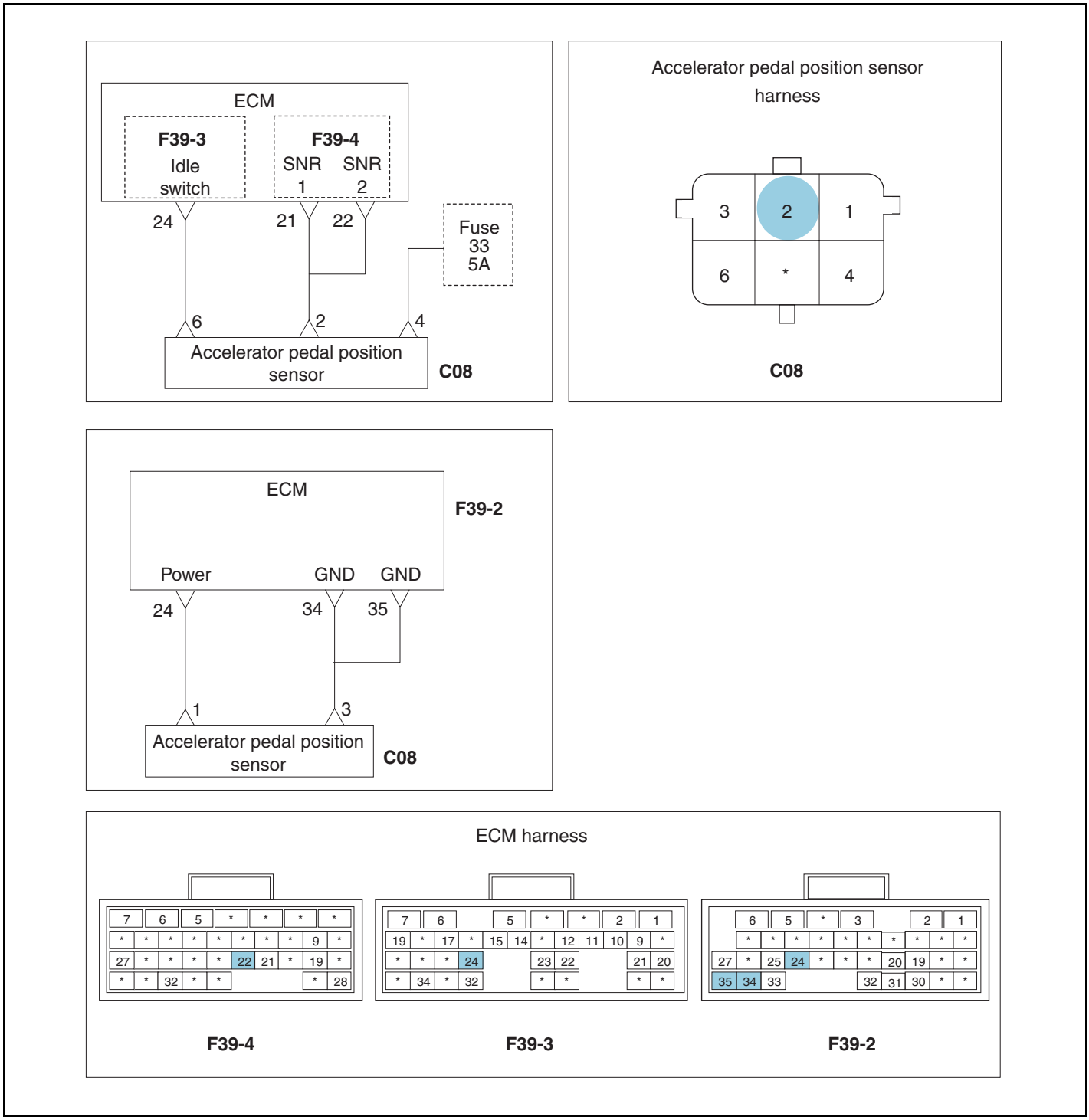
Terminal 2: Sensor "1", "2"



Sensor connector

SUDFL8155L

SCHEMATIC DIAGRAM EFB808D9



SNBFL8063L

MONITOR SCAN TOOL DATA E39133ED

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Accelerator Pedal Position" parameter on the scan tool.

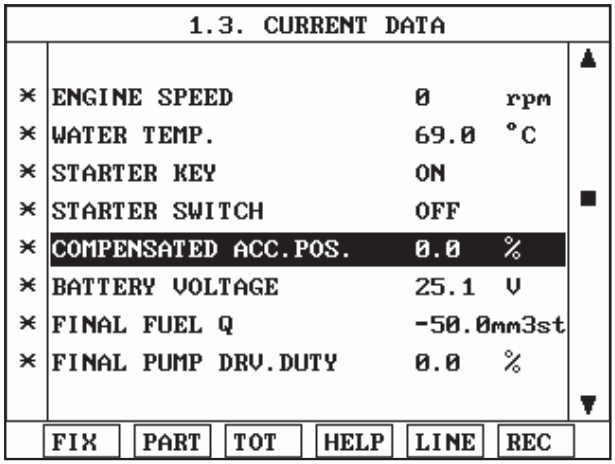


Fig. 1 Accelerator pedal position sensor data at ignition ON

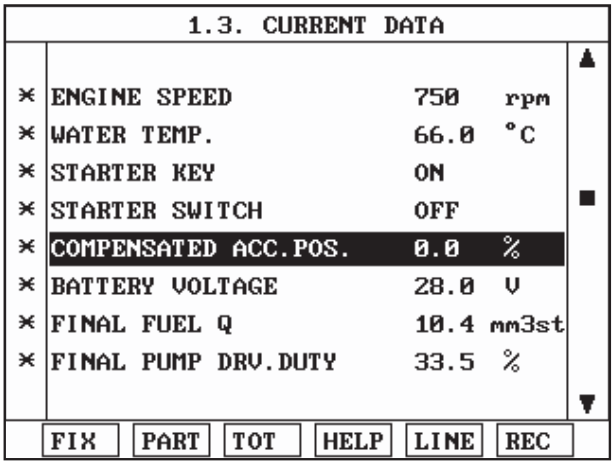


Fig. 2 Accelerator pedal position sensor data at idle

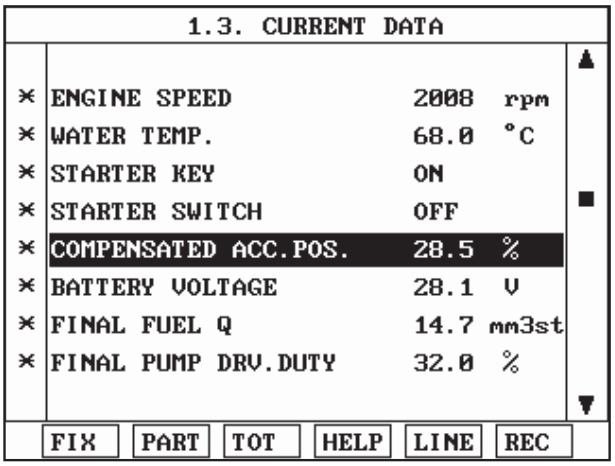


Fig. 3 Accelerator pedal position sensor data at 2,000rpm

SUDFL8049L

TERMINAL & CONNECTOR INSPECTION EAE0B67D

Refer to DTC P0112.

SIGNAL INSPECTION E5F0CC5A

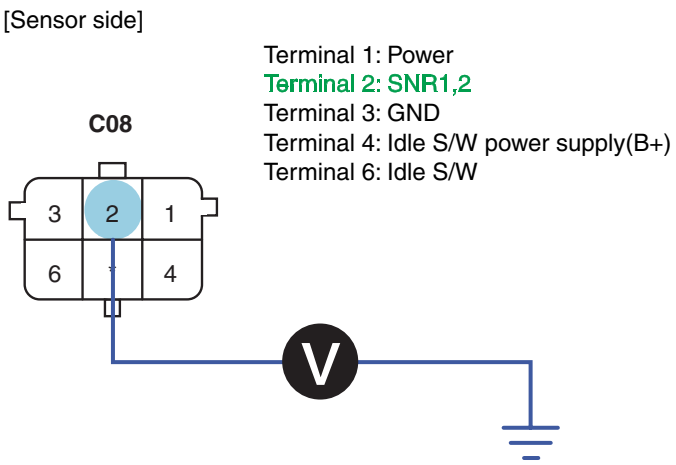
1. Signal Voltage Inspection

   1) Leave the accelerator pedal sensor connector(C08) and ECM(F39-4) installed.

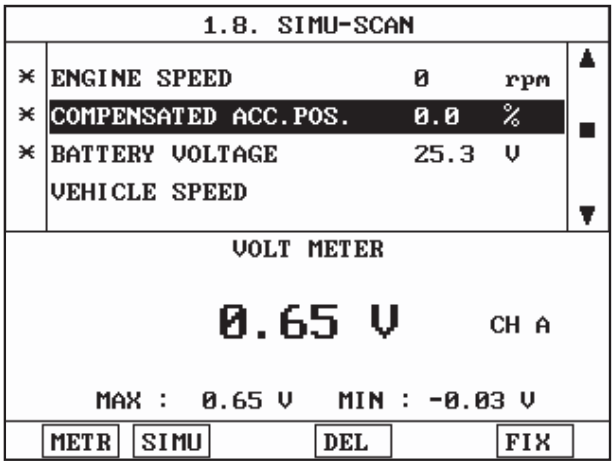
   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 2 of accelerator pedal position sensor harness connector and chassis ground.

[Sensor side]



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W

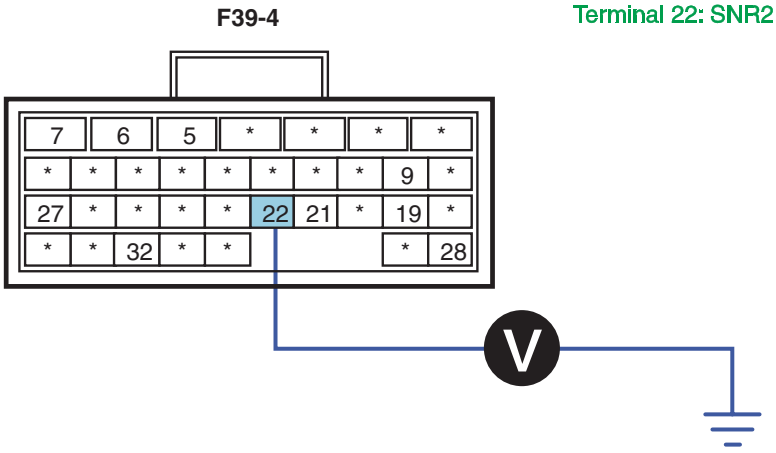


▶ With accelerator pedal position sensor connector installed (At IG ON)

SNBFL8021L

4) Measure voltage between terminal 22 of ECM connector and chassis ground.

[ECM]



Terminal 22: SNR2

SNBFL8064L

■ Specification: Accelerator pedal position signal power approx.0.13V(At not operating)

5) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

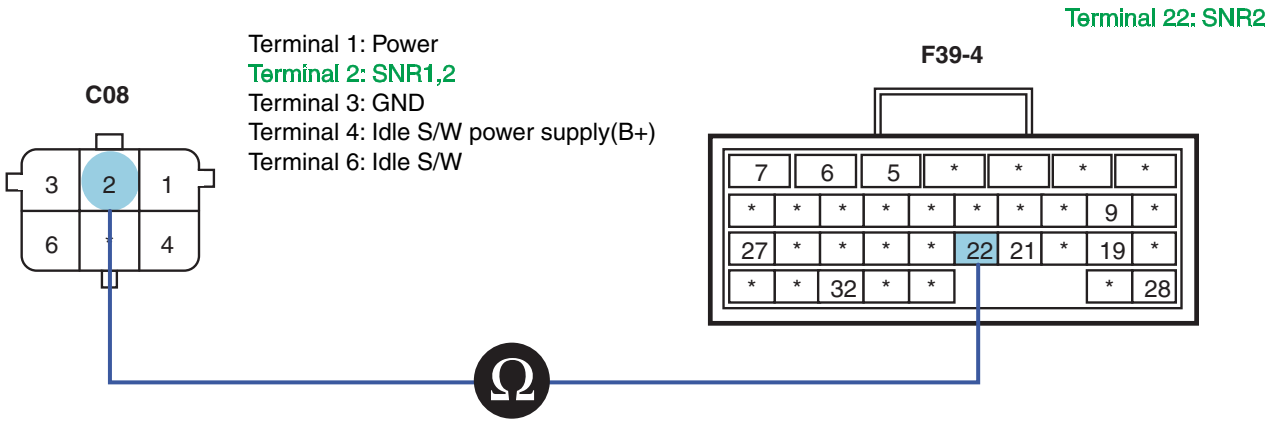
▶ Go to "Signal Open Inspection" procedure.

2. Signal Open Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 2 of accelerator pedal position sensor harness connector(C08) and terminal 22 of ECM connector(F39-4).



SNBFL8065L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Power Inspection" procedure.

NO

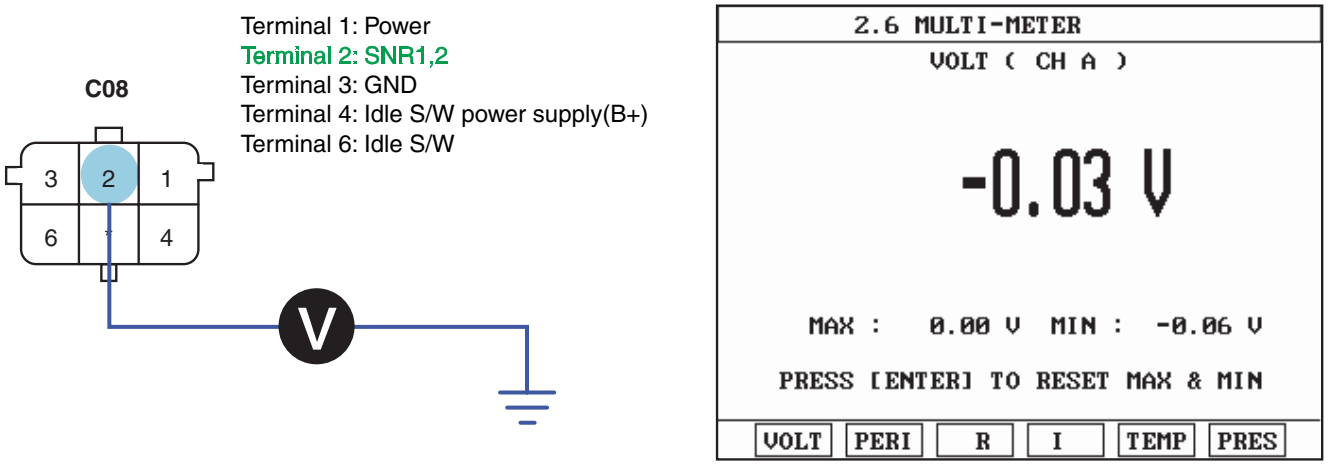
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Signal Short to Power Inspection

1) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

2) Turn the ignition ON. The engine stops.

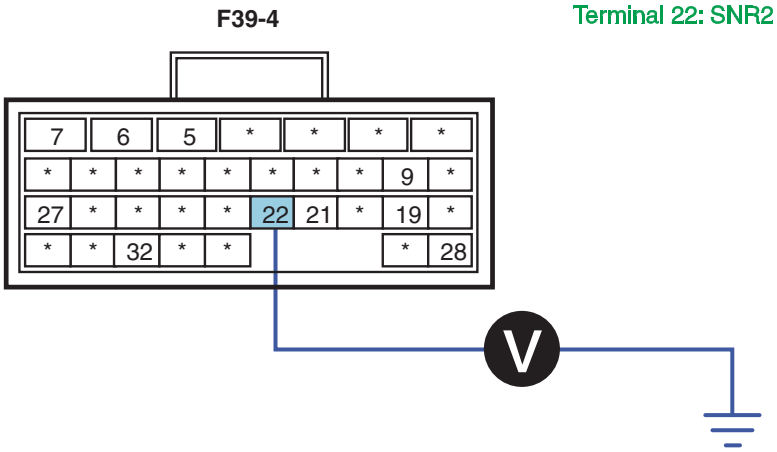
3) Measure voltage between terminal 2 of accelerator pedal position sensor harness connector(C08) and chassis ground.



SNBFL8024L

4) Measure voltage between terminal 22 of ECM connector and chassis ground.

[ECM]



SNBFL8064L

■ Specification: Below 0~0.1V

5) Is the voltage measured within specification?

YES

▶ Go to "Signal Short to Ground Inspection" procedure.

NO

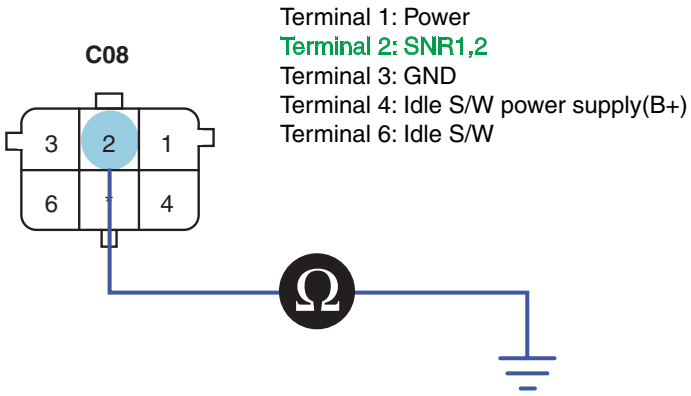
▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

4. Signal Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

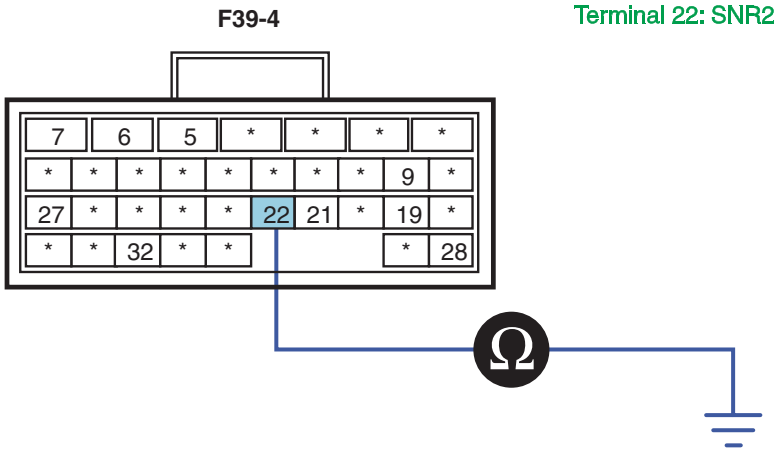
3) Measure resistance between terminal 2 of accelerator pedal position sensor harness connector(C08) and chassis ground.



SNBFL8025L

4) Measure resistance between terminal 22 of ECM connector and chassis ground.

[ECM]



SNBFL8066L

■ Specification: Infinite

5) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

POWER SUPPLY INSPECTION EA7B9A02

1. Power Supply Voltage Inspection

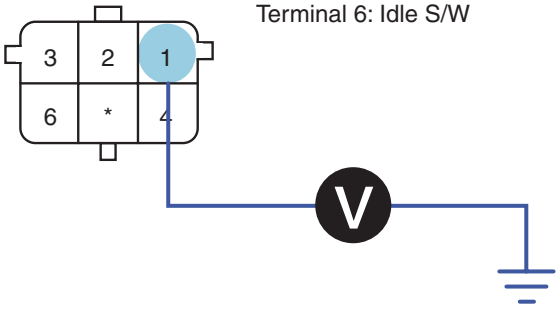
1) Leave accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2) installed.

2) Turn the ignition ON. The engine stops.

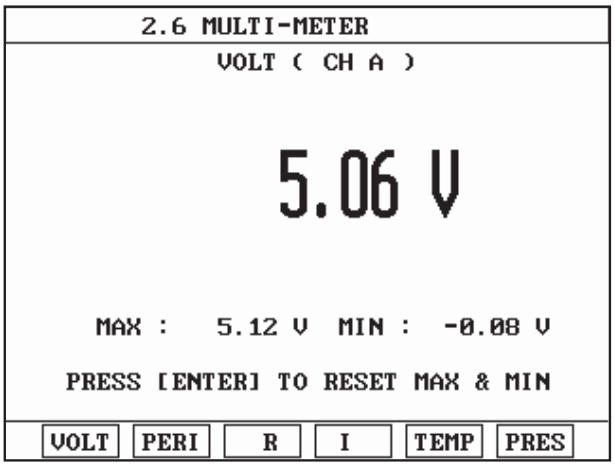
3) Measure voltage between terminal 1 of accelerator pedal position sensor harness connector(C08) and chassis ground.

[Sensor side]

C08



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W



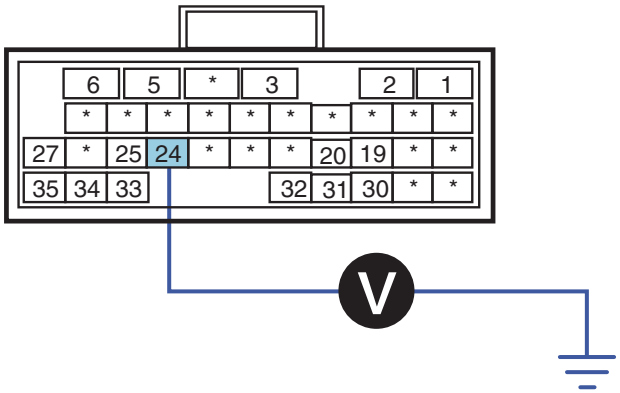
▶ With accelerator pedal position sensor connector disconnected/connected(At IG ON)

SNBFL8027L

4) Measure voltage between terminals 24 of ECM connector and chassis ground.

[ECM]

F39-2



Terminal 24: Power

SNBFL8028L

■ Specification: Accelerator pedal position sensor signal power approx. 5.21V

5) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

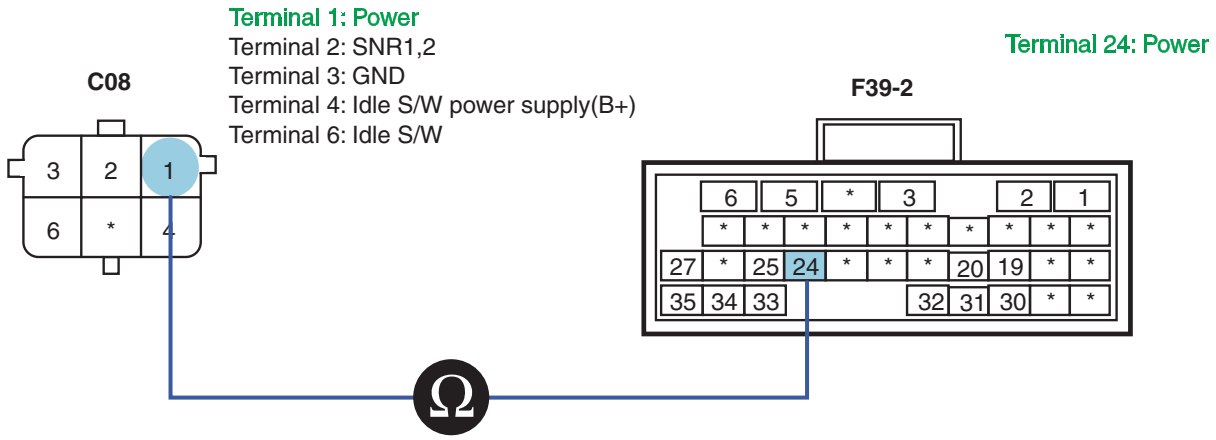
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 1 of accelerator pedal position sensor harness connector(C08) and terminals 24 of ECM connector(F39-2).



SNBFL8029L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

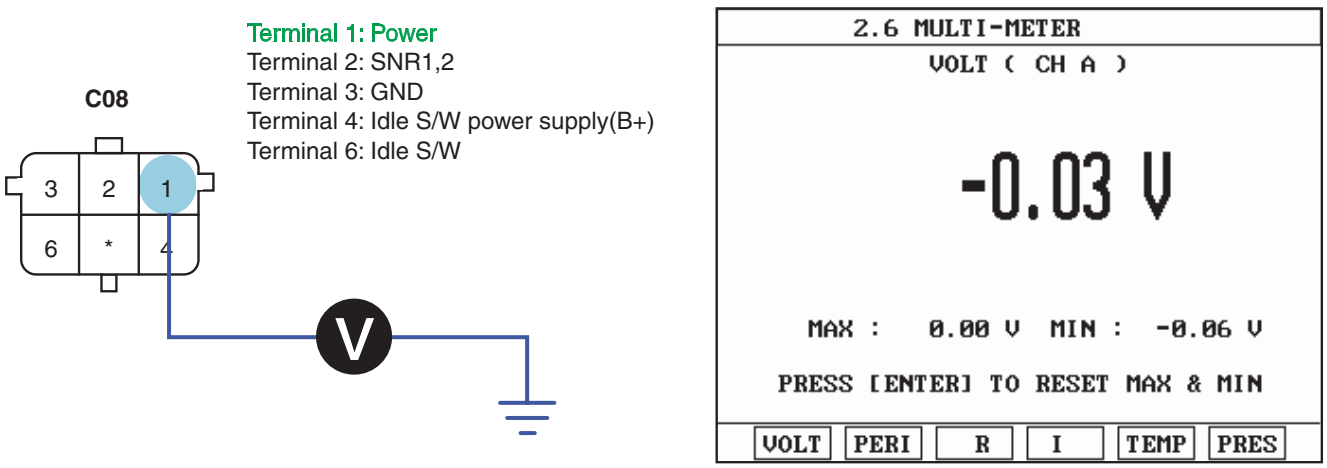
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Power Supply Short to Power Inspection

1) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

2) Turn the ignition ON. The engine stops.

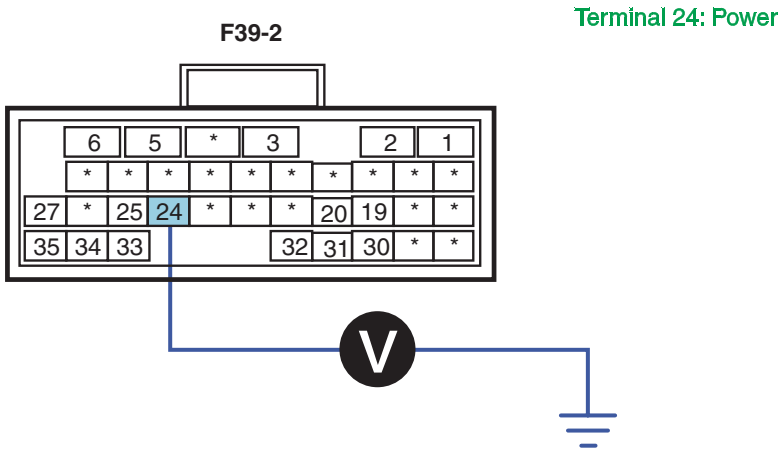
3) Measure voltage between terminal 1 of accelerator pedal position sensor harness connector and chassis ground.



SNBFL8030L

4) Measure voltage between terminals 24 of ECM connector and chassis ground.

[ECM]



SNBFL8028L

■ Specification: Below 0~0.1V

5) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

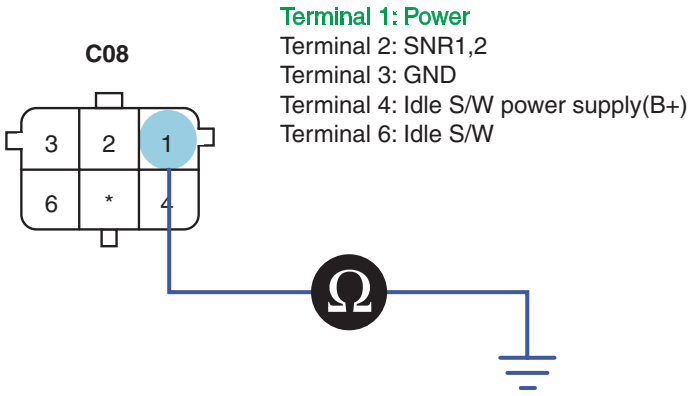
▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

4. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

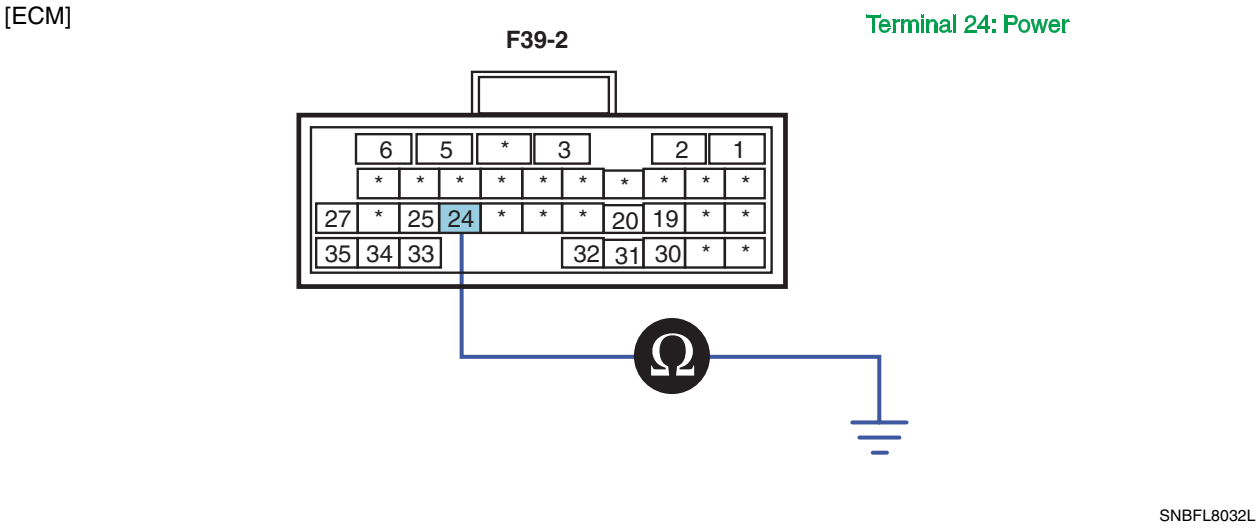
2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 1 of accelerator pedal position sensor harness connector and chassis ground.



SNBFL8031L

4) Measure resistance between terminals 24 of ECM connector and chassis ground.



■ Specification: Infinite

5) Is the resistance measured within specification?

YES

▶ Go to "Ground Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

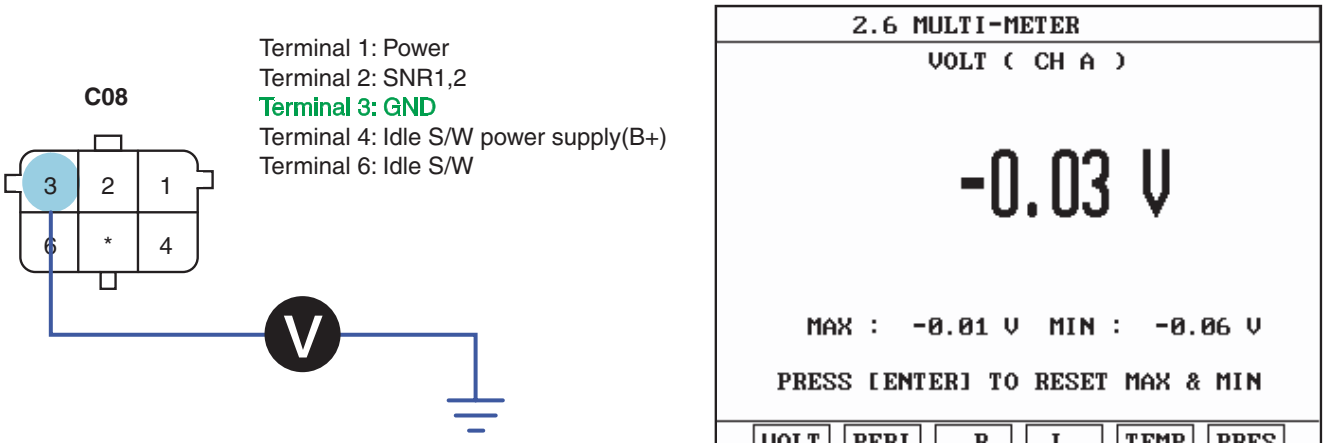
GROUND CIRCUIT INSPECTION EF48886B

1. Ground Voltage Drop Inspection

   1) Disconnect accelerator pedal position sensor connector(C08).

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage drop between terminal 3 of accelerator pedal position sensor harness connector and chassis ground.



SNBFL8033L

■ Specification: Ground Voltage Drop - Within 200mV

4) Is the ground voltage drop measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

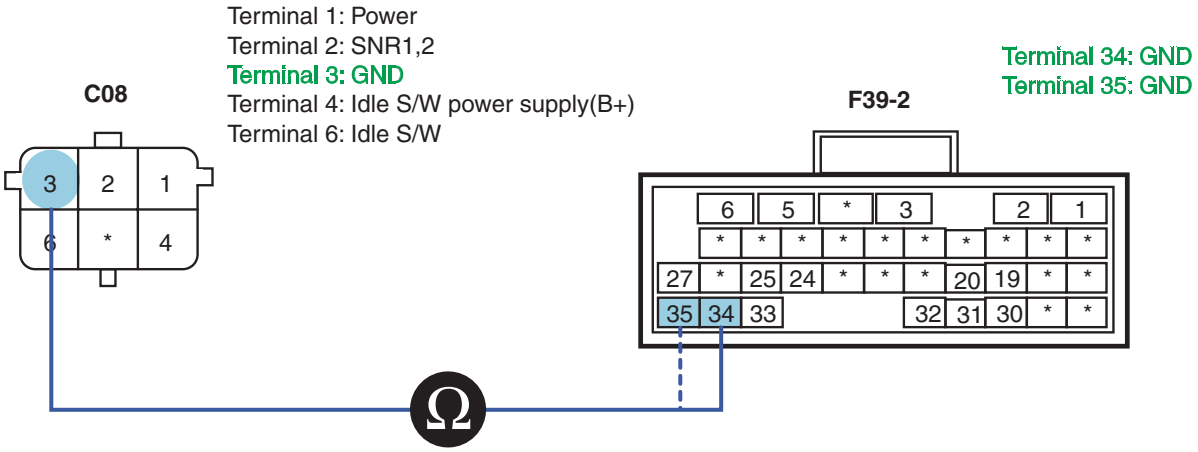
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 3 of accelerator pedal position sensor harness connector and terminals 34,35 of ECM connector(F39-2).



SNBFL8034L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

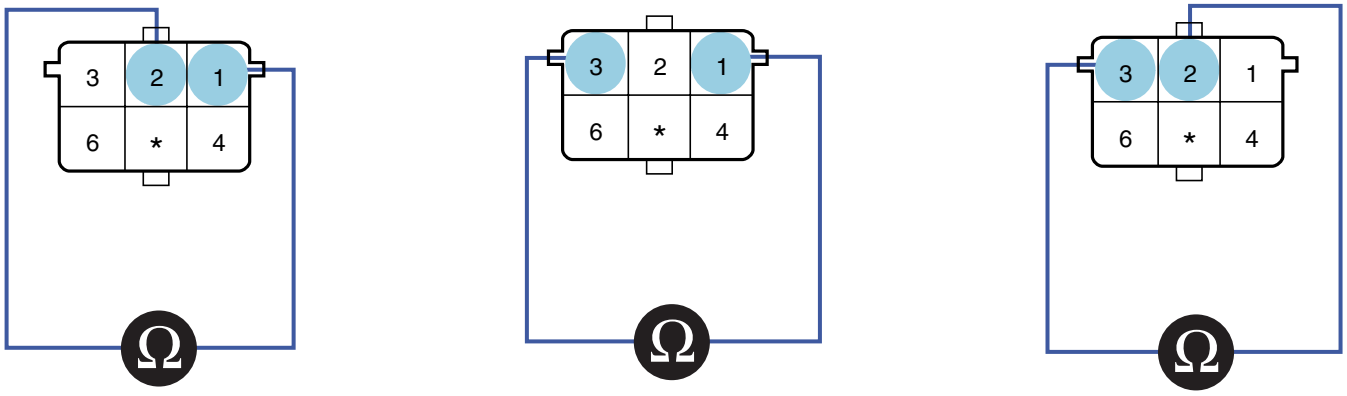
COMPONENT INSPECTION E05FC8BE

1. Accelerator Pedal Position Sensor Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08).

3) Measure resistance between terminals 1-2, 2-3, 1-3 of accelerator pedal position sensor connector.



Resistance between terminals of accelerator pedal position sensor

Terminals 1-2(Not operating)	Terminals 1-2(Operating)	Terminals 1-3(Not operating)	Terminals 1-3(Operating)
Approx. 2.67kΩ	Approx. 1.06kΩ	Approx. 2.64kΩ	Approx. 2.64kΩ

Terminals 2-3(Not operating)	Terminals 2-3(Operating)
Approx. 0.732kΩ	Approx. 2.59kΩ

SUDFL8064L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace accelerator pedal position sensor and then go to "Verification of Vehicle Repair" procedure.

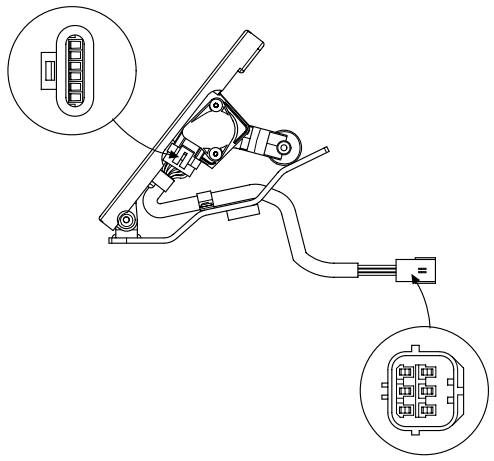
VERIFICATION OF VEHICLE REPAIR E915B38C

Refer to DTC P0112.

DTC P0222 PEDAL SENSOR NO.2 SIGNAL LOW

COMPONENT LOCATION EC28F5C9

Accelerator pedal position sensor



SUDFL8046L

DESCRIPTION E10A9E10

1. GENERAL DESCRIPTION
   The accelerator pedal position sensor detects pedal position and sends signal to ECM. It is composed of two potentiometers(dual variable resistor type). Power supply is provided separately to detect acceleration condition exactly. The voltage of accelerator pedal position sensor is generated by potentiometer and the position of accelerator pedal is calculated by using characteristic curve programmed beforehand.

2. DTC DESCRIPTION
   When the accelerator pedal sensor "2" outputs below 0.5V for more than 1048.6ms, the ECM judges this as a fault and DTC is set. The possible causes are defective sensor, wiring problem etc. When the accelerator pedal sensor " 2" is defective, ECM is controlled by using data of the accelerator pedal sensor "1" and the vehicle is possible to be driven in normal condition.

DTC DETECTING CONDITION E5A32C21

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="5">• Wiring problem
• Defective sensor
• Open circuit of terminal 22 of ECM connector(F39-4)</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG ON/ Running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• Below 0.5V</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 1,048.6ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• When sensor "2" is defective, ECM uses data of sensor "1". Normal driving is possible.</td></tr>
<tr><td>Fuel Limit</td><td>No</td></tr>
<tr><td>MIL</td><td>OFF</td></tr>
</table>

SPECIFICATION EBFD4BBF

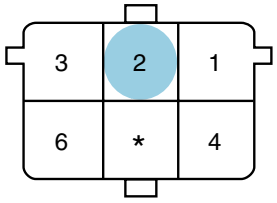
Resistance between terminals of accelerator pedal position sensor

Terminals 1-2(Not operating)	Terminals 1-2(Operating)	Terminals 1-3(Not operating)	Terminals 1-3(Operating)
Approx. 2.67kΩ	Approx. 1.06kΩ	Approx. 2.64kΩ	Approx. 2.64kΩ

Terminals 2-3(Not operating)	Terminals 2-3(Operating)
Approx. 0.732kΩ	Approx. 2.59kΩ

Accelerator pedal position sensor track "1", "2"	Specification	
	Idle state((0%)	Wide open(100%)
Output voltage	0.65V	3.85V

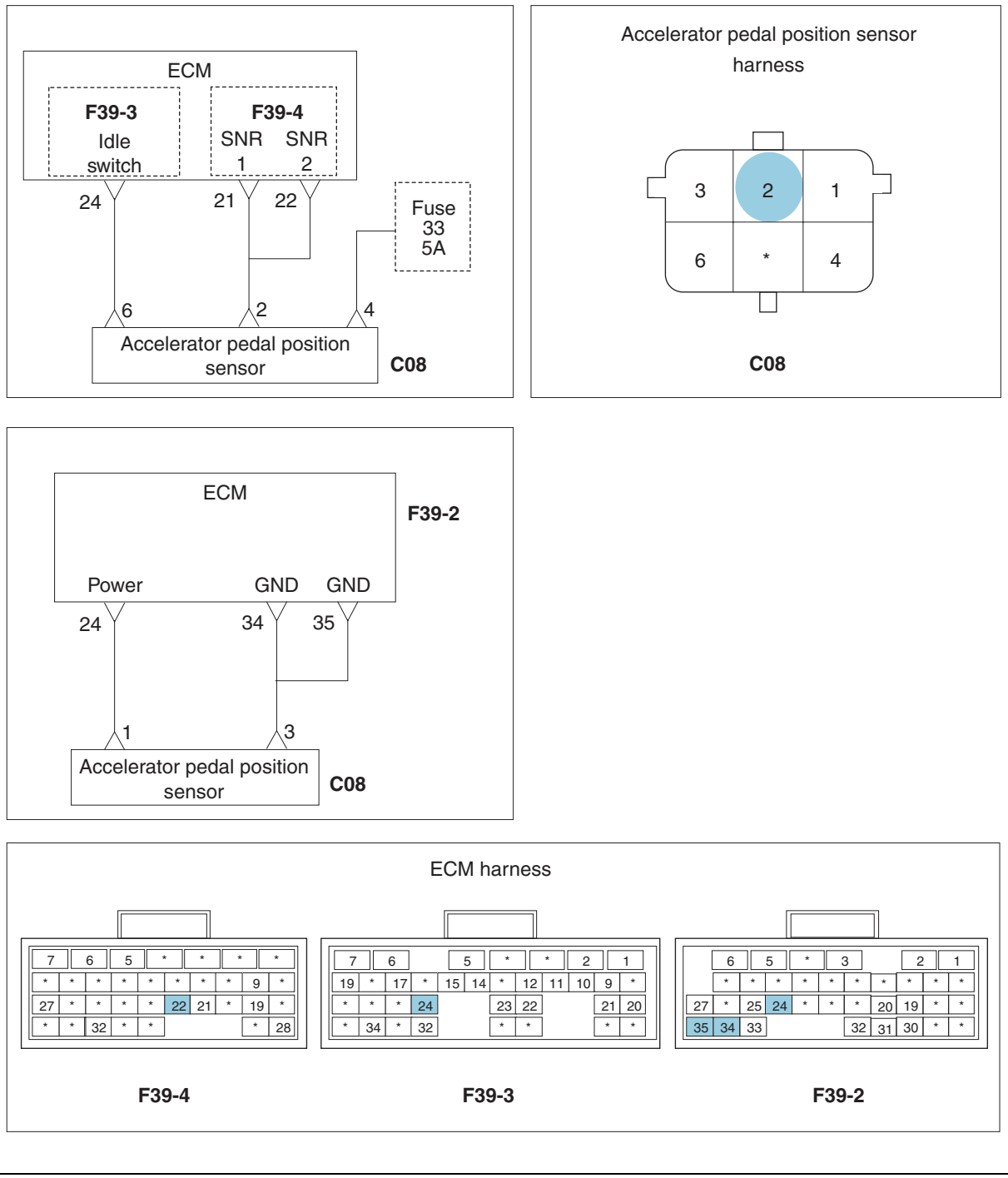
Terminal 2: Sensor "1", "2"



Sensor connector

SUDFL8065L

SCHEMATIC DIAGRAM EBA602BD



SNBFL8063L

MONITOR SCAN TOOL DATA E7D7E170

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Accelerator Pedal Position" parameter on the scan tool.

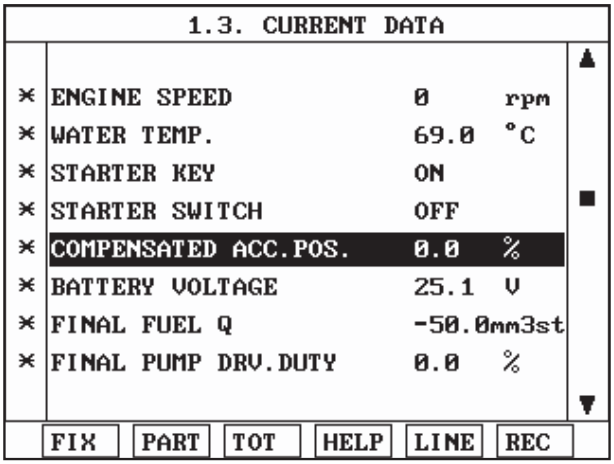


Fig. 1 Accelerator pedal position sensor data at ignition ON

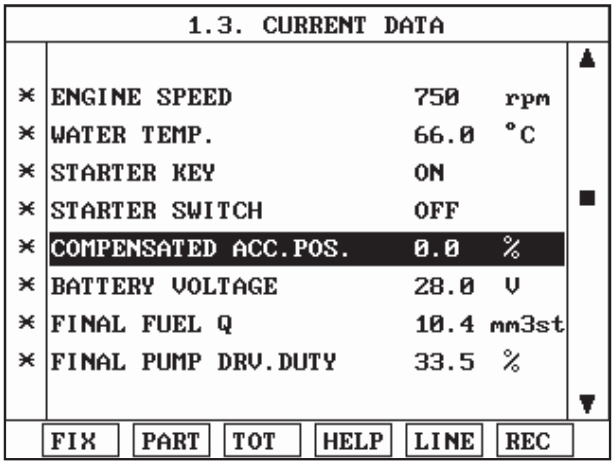


Fig. 2 Accelerator pedal position sensor data at idle

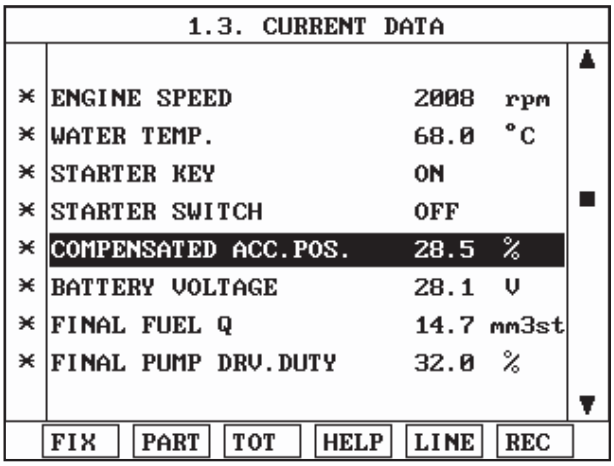


Fig. 3 Accelerator pedal position sensor data at 2,000rpm

SUDFL8049L

TERMINAL & CONNECTOR INSPECTION EF127FEE

Refer to DTC P0112.

SIGNAL INSPECTION E7FE4AF2

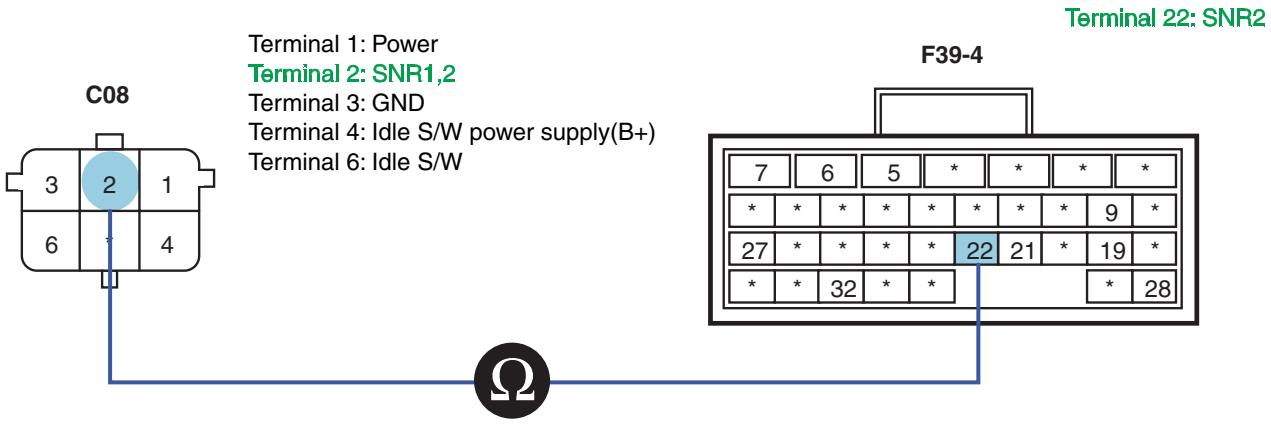
1. Signal Voltage Inspection

   1) Leave the accelerator pedal sensor connector(C08) and ECM(F39-4) installed.

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 2 of accelerator pedal position sensor harness connector and chassis ground.

3



SNBFL8065L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Ground Inspection" procedure.

NO

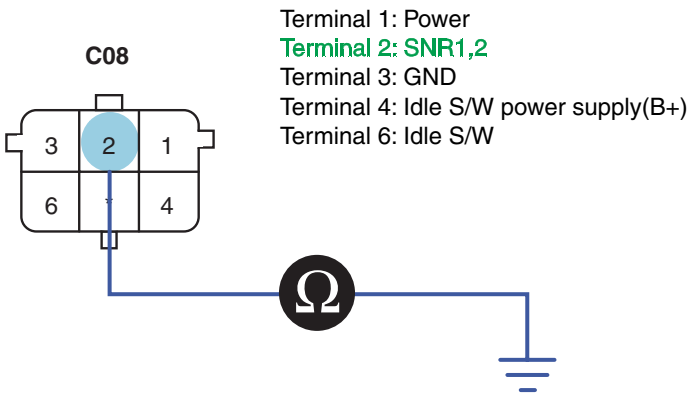
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Signal Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

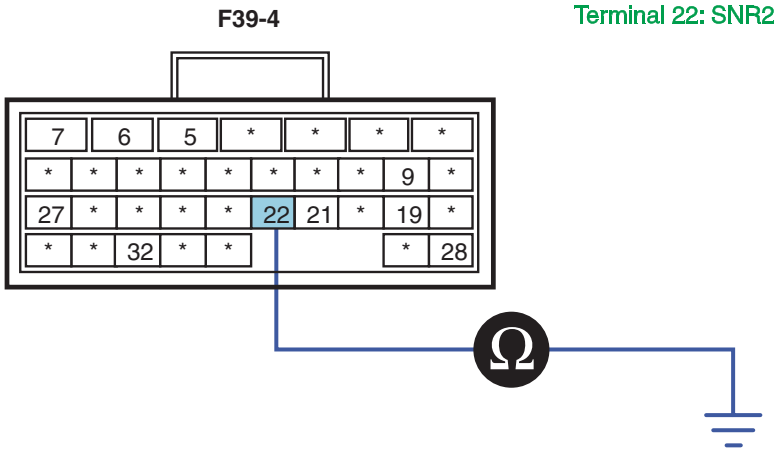
3) Measure resistance between terminal 2 of accelerator pedal position sensor harness connector(C08) and chassis ground.



SNBFL8025L

4) Measure resistance between terminal 22 of ECM connector and chassis ground.

[ECM]



SNBFL8066L

■ Specification: Infinite

5) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

POWER SUPPLY INSPECTION E94857AF

1. Signal Supply Voltage Inspection

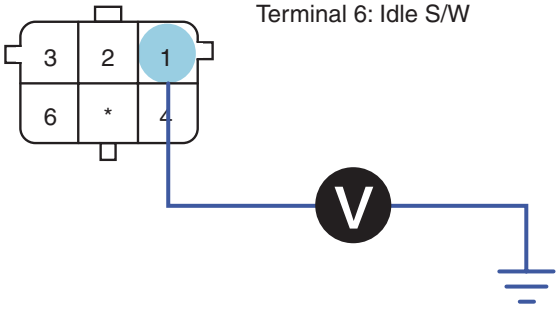
   1) Leave accelerator pedal position sensor connector(C08) and ECM connector(F39-2) installed.

   2) Turn the ignition ON. The engine stops.

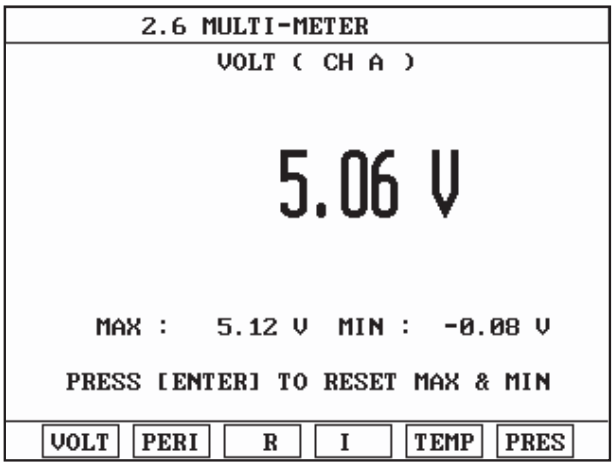
   3) Measure voltage between terminal 1 of accelerator pedal position sensor harness connector(C08) and chassis ground.

[Sensor side]

C08



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W



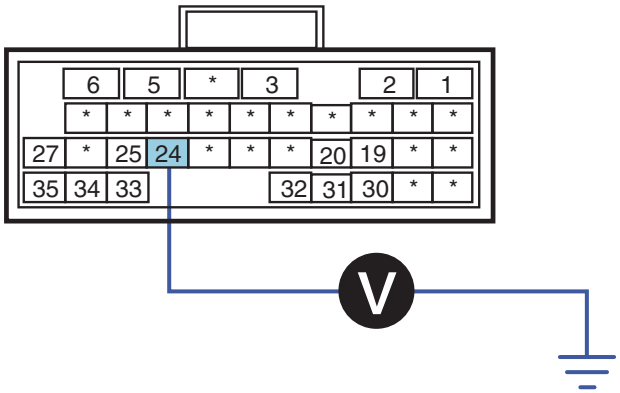
▶ With accelerator pedal position sensor connector disconnected/connected(At IG ON)

SNBFL8027L

4) Measure voltage between terminal 24 of ECM connector and chassis ground.

[ECM]

F39-2



Terminal 24: Power

SNBFL8028L

■ Specification: Accelerator pedal position sensor signal power approx. 5.21V

5) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

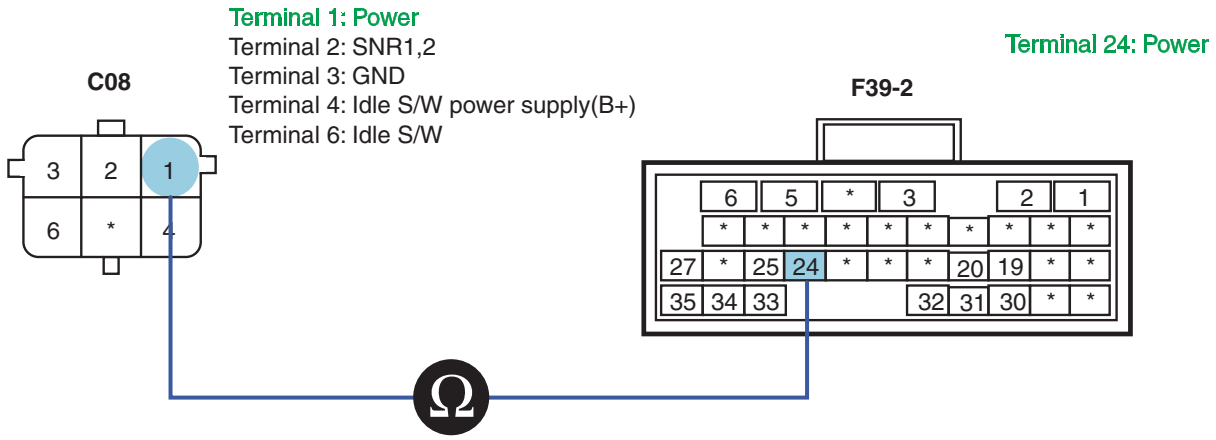
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply open Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 1 of accelerator pedal position sensor harness connector(C08) and terminals 24 of ECM connector(F39-2).



SNBFL8029L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

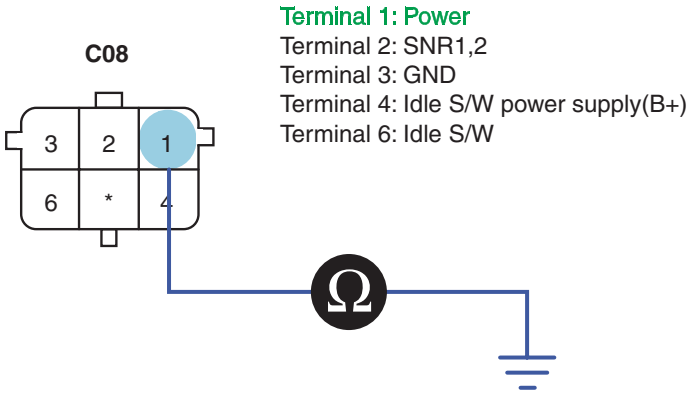
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

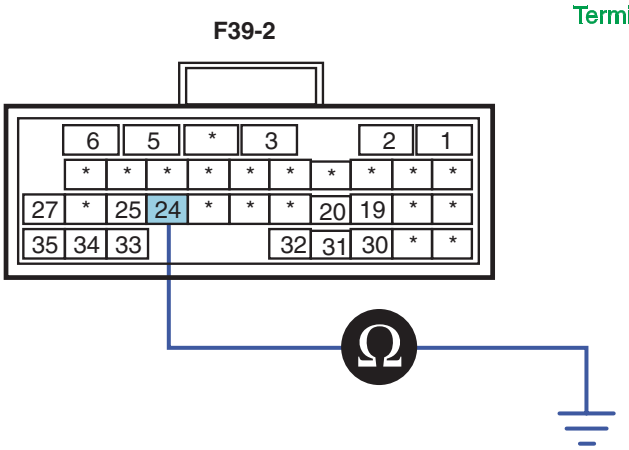
3) Measure resistance between terminal 1 of accelerator pedal position sensor harness connector(C08) and chassis ground.



SNBFL8031L

4) Measure resistance between terminals 24 of ECM connector and chassis ground.

[ECM]



SNBFL8032L

■ Specification: Infinite

5) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

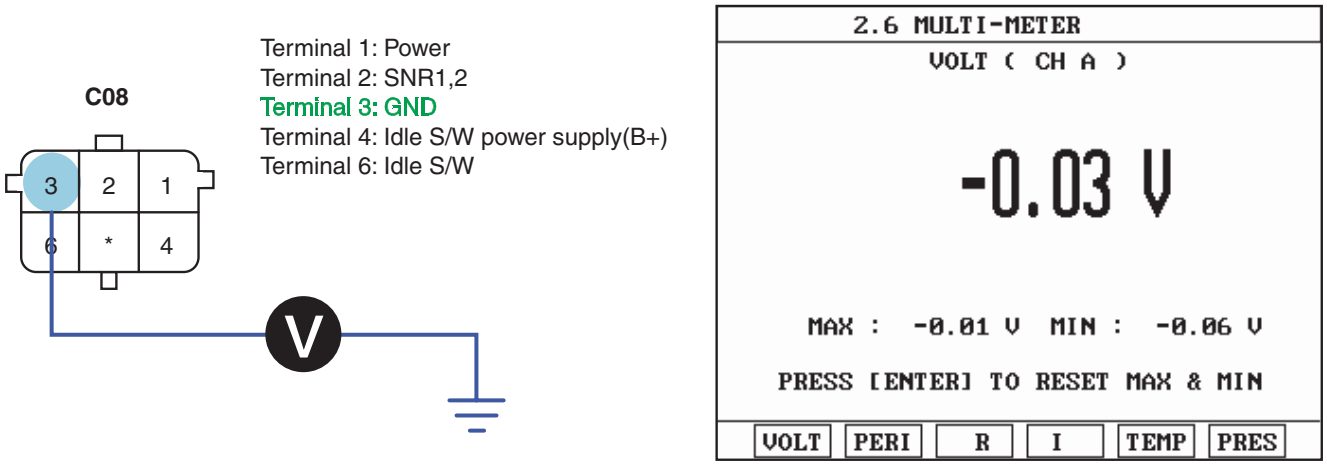
GROUND CIRCUIT INSPECTION E323065A

1. Ground Voltage Drop Inspection

   1) Disconnect accelerator pedal position sensor connector(C08).

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage drop between terminal 3 of accelerator pedal position sensor harness connector and chassis ground.



SNBFL8033L

■ Specification: Ground Voltage Drop - Within 200mV

4) Is the ground voltage drop measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

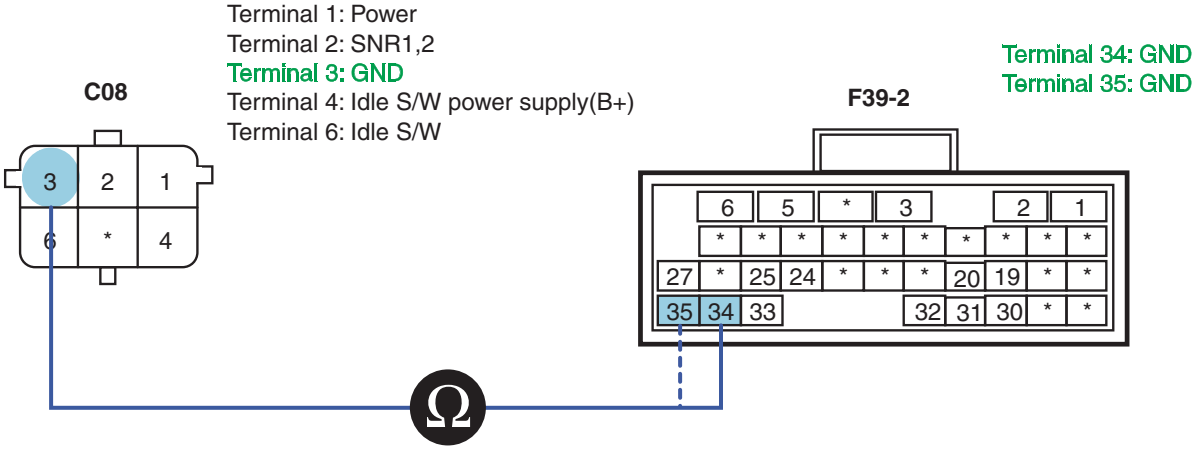
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 3 of accelerator pedal position sensor harness connector and terminals 34,35 of ECM connector(F39-2).



SNBFL8034L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

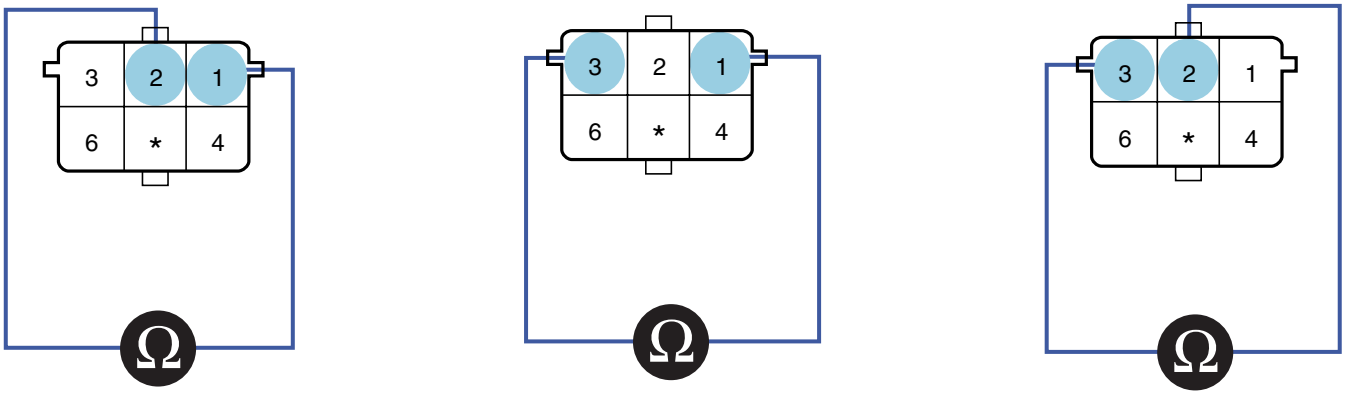
COMPONENT INSPECTION E688A256

1. Accelerator Pedal Position Sensor Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08).

3) Measure resistance between terminals 1-2, 2-3, 1-3 of accelerator pedal position sensor connector.



Resistance between terminals of accelerator pedal position sensor

Terminals 1-2(Not operating)	Terminals 1-2(Operating)	Terminals 1-3(Not operating)	Terminals 1-3(Operating)
Approx. 2.67kΩ	Approx. 1.06kΩ	Approx. 2.64kΩ	Approx. 2.64kΩ

Terminals 2-3(Not operating)	Terminals 2-3(Operating)
Approx. 0.732kΩ	Approx. 2.59kΩ

SUDFL8064L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace accelerator pedal position sensor and then go to "Verification of Vehicle Repair" procedure.

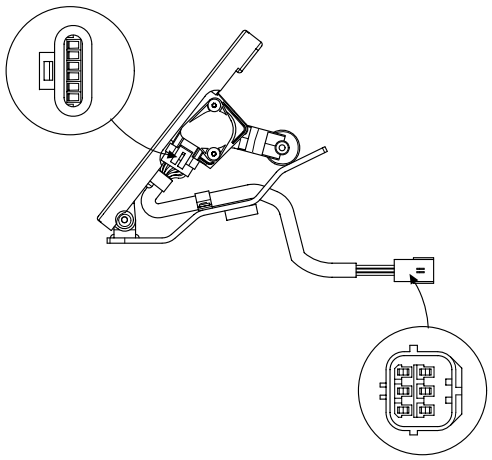
VERIFICATION OF VEHICLE REPAIR EAF51384

Refer to DTC P0112.

DTC P0223 PEDAL SENSOR NO.2 SIGNAL HIGH

COMPONENT LOCATION EFCED189

Accelerator pedal position sensor



SUDFL8046L

DESCRIPTION E890456E

1. GENERAL DESCRIPTION
   The accelerator pedal position sensor detects pedal position and sends signal to ECM. It is composed of two potentiometers(dual variable resistor type). Power supply is provided separately to detect acceleration condition exactly. The voltage of accelerator pedal position sensor is generated by potentiometer and the position of accelerator pedal is calculated by using characteristic curve programmed beforehand.

2. DTC DESCRIPTION
   When the accelerator pedal sensor "2" outputs above 4.2V for more than 524.3ms, the ECM judges this as a fault and DTC is set. The possible causes are defective sensor, wiring problem etc. When the accelerator pedal sensor "2" is defective, ECM is controlled by using data of the accelerator pedal sensor "1" and the vehicle is being driven in normal condition.

DTC DETECTING CONDITION E66F767A

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="5">• Wiring problem
• Defective sensor</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG ON/ Running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• Above 4.2V</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 524.3ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• When sensor "2" is defective, ECM uses data of sensor "1". Normal driving is possible.</td></tr>
<tr><td>Fuel Limit</td><td>No</td></tr>
<tr><td>MIL</td><td>OFF</td></tr>
</table>

SPECIFICATION ED84FEB4

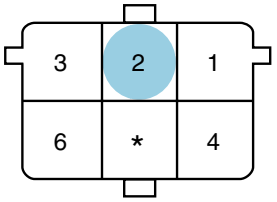
Resistance between terminals of accelerator pedal position sensor

Terminals 1-2(Not operating)	Terminals 1-2(Operating)	Terminals 1-3(Not operating)	Terminals 1-3(Operating)
Approx. 2.67kΩ	Approx. 1.06kΩ	Approx. 2.64kΩ	Approx. 2.64kΩ

Terminals 2-3(Not operating)	Terminals 2-3(Operating)
Approx. 0.732kΩ	Approx. 2.59kΩ

Accelerator pedal position sensor track "1", "2"	Specification	
	Idle state((0%)	Wide open(100%)
Output voltage	0.65V	3.85V

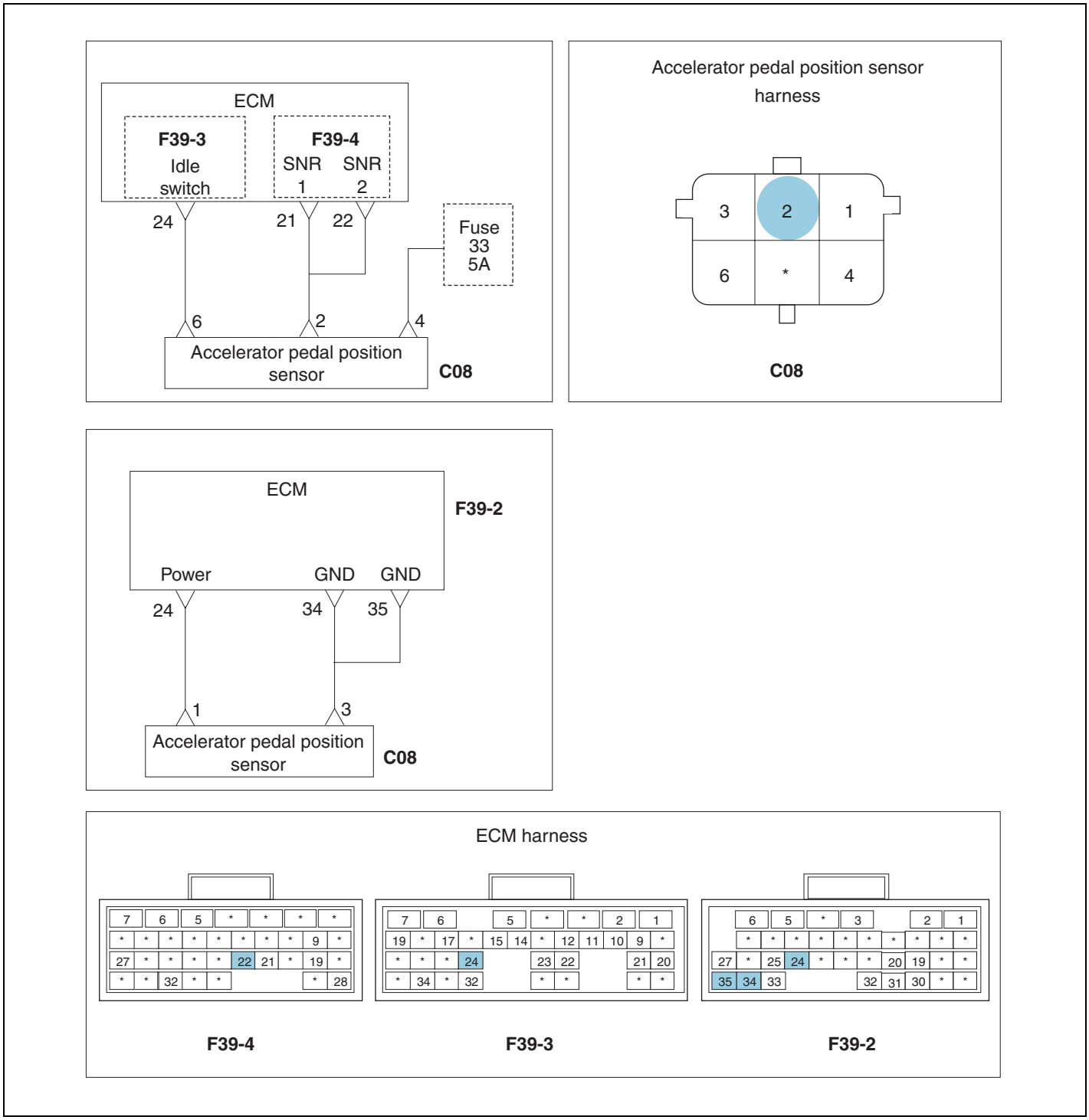
Terminal 2: Sensor "1", "2"



Sensor connector

SUDFL8065L

SCHEMATIC DIAGRAM E2B8F322



SNBFL8063L

MONITOR SCAN TOOL DATA E39DDE91

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Accelerator Pedal Position" parameter on the scan tool.

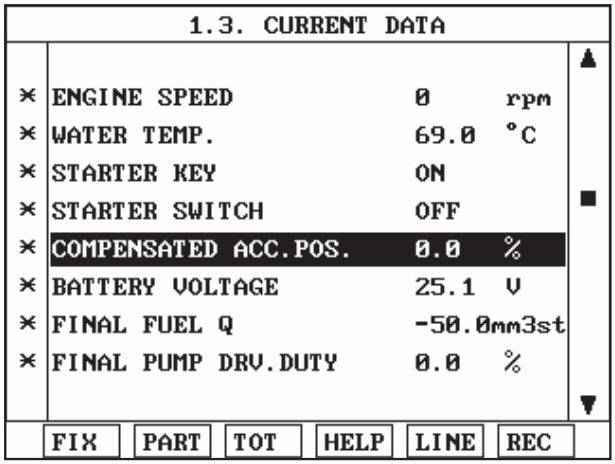


Fig. 1 Accelerator pedal position sensor data at ignition ON

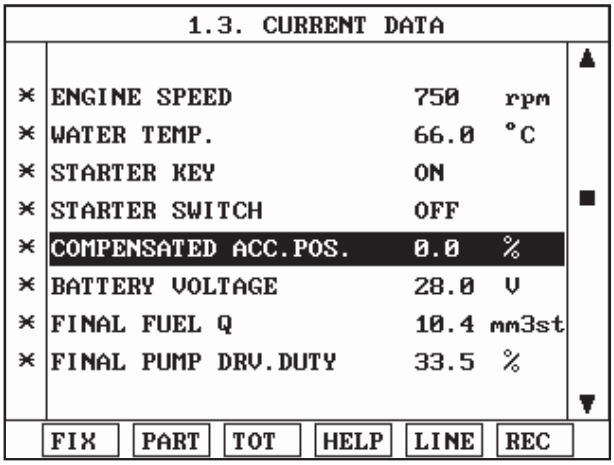


Fig. 2 Accelerator pedal position sensor data at idle

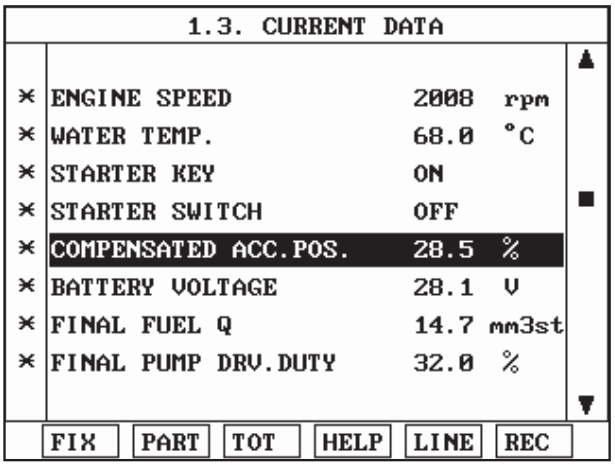


Fig. 3 Accelerator pedal position sensor data at 2,000rpm

SUDFL8049L

TERMINAL & CONNECTOR INSPECTION EA332810

Refer to DTC P0112.

SIGNAL INSPECTION E5FD7760

1. Signal Voltage Inspection

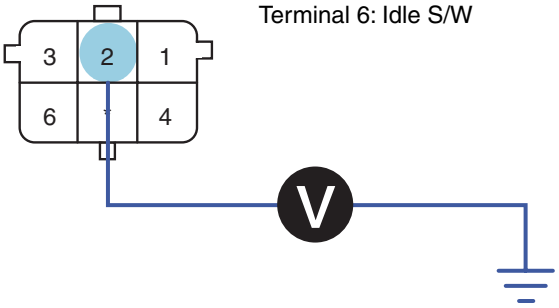
   1) Leave the accelerator pedal sensor connector(C08) and ECM(F39-4) installed.

   2) Turn the ignition ON. The engine stops.

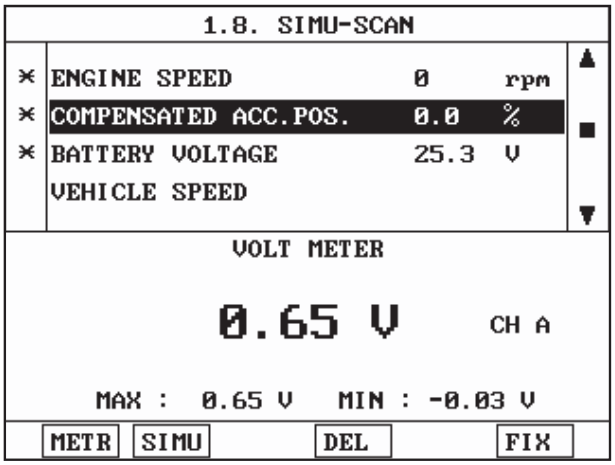
   3) Measure voltage between terminal 2 of accelerator pedal position sensor harness connector and chassis ground.

[Sensor side]

C08



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W



▶ With accelerator pedal position sensor connector installed (At IG ON)

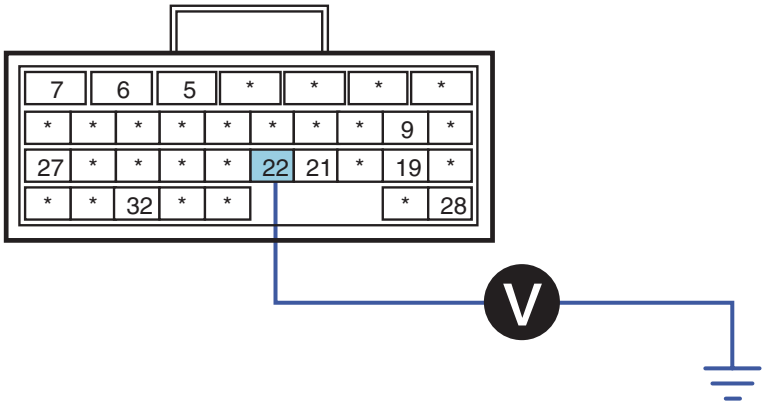
SNBFL8021L

4) Measure voltage between terminal 22 of ECM connector and chassis ground.

[ECM]

F39-4

Terminal 22: SNR2



SNBFL8064L

■ Specification: Accelerator pedal position signal power approx.0.13V(Not operating)

5) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

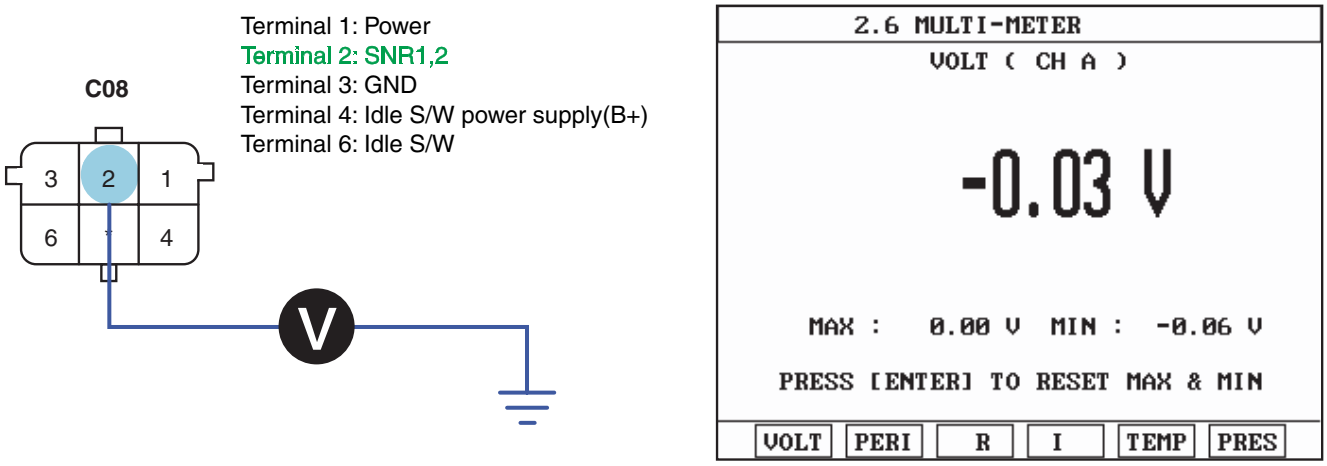
▶ Go to "Signal Short to Power Inspection" procedure.

2. Signal Short to Power Inspection

1) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

2) Turn the ignition ON. The engine stops.

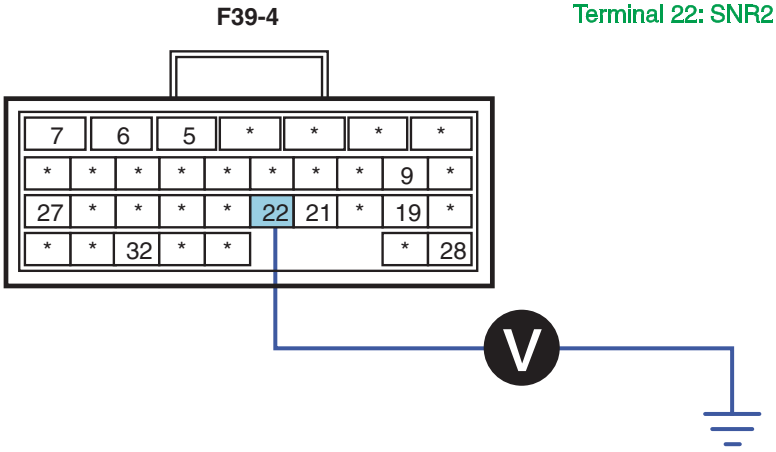
3) Measure voltage between terminal 2 of accelerator pedal position sensor harness connector(C08) and chassis ground.



SNBFL8024L

4) Measure voltage between terminal 22 of ECM connector and chassis ground.

[ECM]



SNBFL8064L

■ Specification: Below 0~0.1V

5) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

POWER SUPPLY INSPECTION EFB5891B

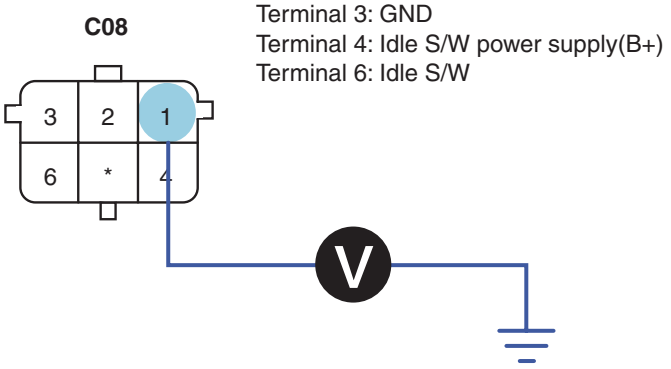
1. Power Supply Voltage Inspection

1) Leave accelerator pedal position sensor connector(C08) and ECM connector(F39-2) installed.

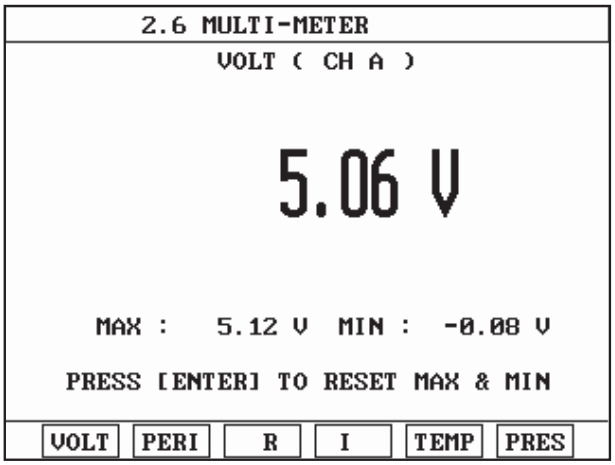
2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of accelerator pedal position sensor harness connector(C08) and chassis ground.

[Sensor side]



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W

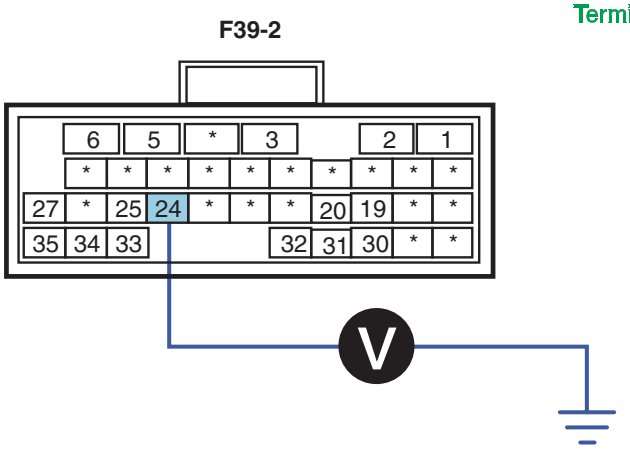


▶ With accelerator pedal position sensor connector disconnected/connected(At IG ON)

SNBFL8027L

4) Measure voltage between terminals 24 of ECM connector and chassis ground.

[ECM]



Terminal 24: Power

SNBFL8028L

■ Specification: Accelerator pedal position sensor signal power approx. 5.21V

5) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

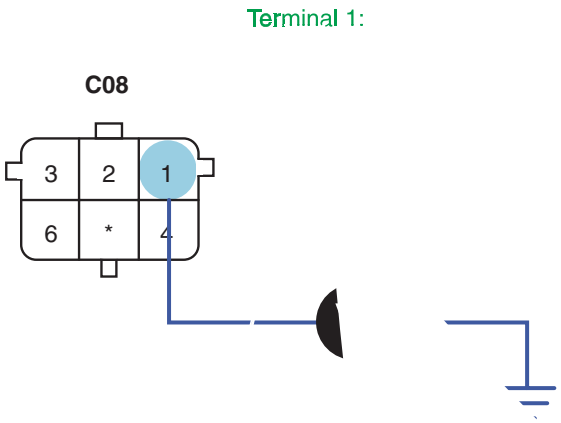
▶ Go to "Power Supply Short to Power Inspection" procedure.

2. Power Supply Short to Power Inspection

1) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

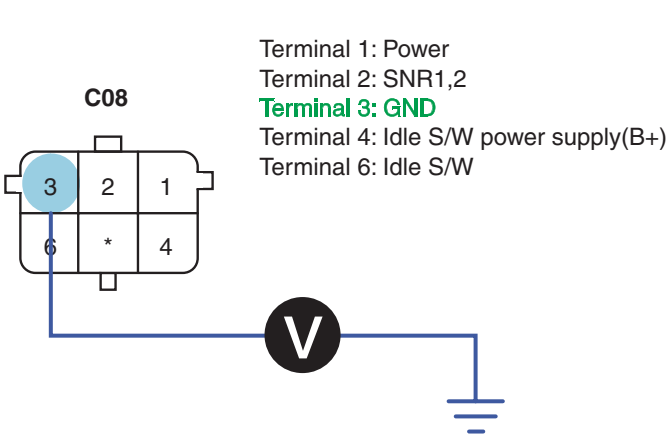
2) Turn the ignition ON. The engine stops.

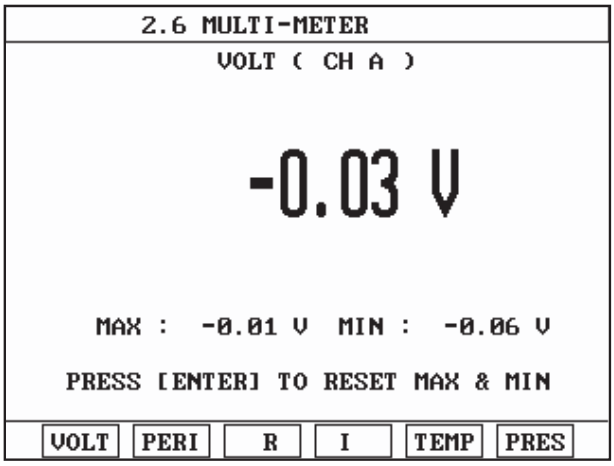
3) Measure voltage between terminal 1 of accelerator pedal position sensor harness connector and chassis ground.



2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 3 of accelerator pedal position sensor harness connector and chassis ground.





SNBFL8033L

■ Specification: Ground Voltage Drop - Within 200mV

4) Is the ground voltage drop measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

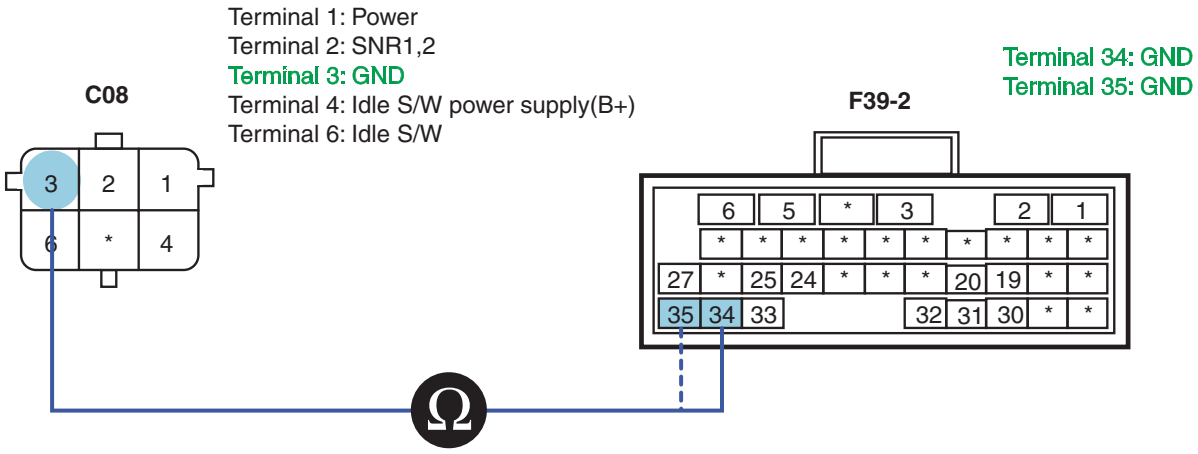
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 3 of accelerator pedal position sensor harness connector and terminals 34,35 of ECM connector(F39-2).



SNBFL8034L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

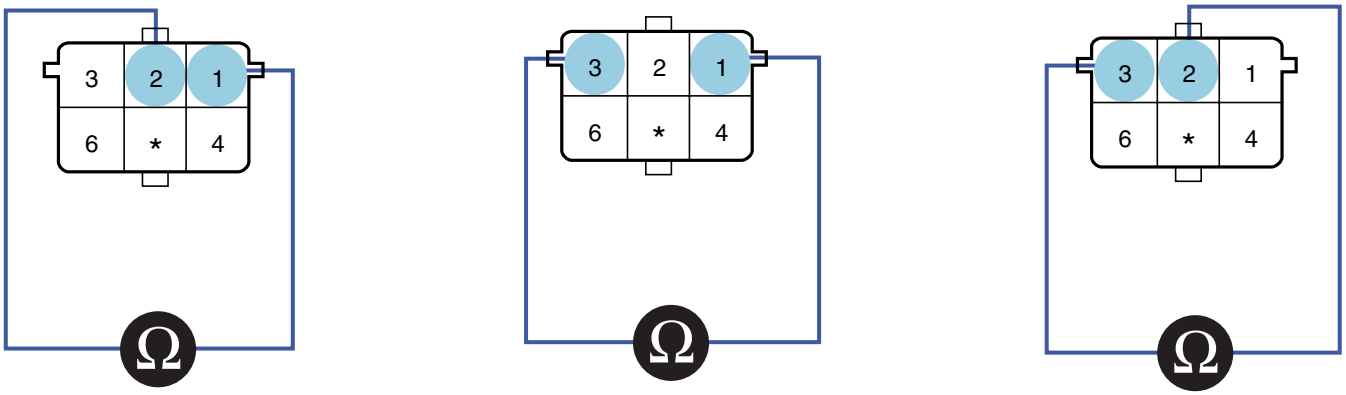
COMPONENT INSPECTION EDED1EE0

1. Accelerator Pedal Position Sensor Inspection

   1) Turn the ignition OFF.

   2) Disconnect accelerator pedal position sensor connector(C08).

   3) Measure resistance between terminals 1-2, 2-3, 1-3 of accelerator pedal position sensor connector.



Resistance between terminals of accelerator pedal position sensor

Terminals 1-2(Not operating)	Terminals 1-2(Operating)	Terminals 1-3(Not operating)	Terminals 1-3(Operating)
Approx. 2.67kΩ	Approx. 1.06kΩ	Approx. 2.64kΩ	Approx. 2.64kΩ

Terminals 2-3(Not operating)	Terminals 2-3(Operating)
Approx. 0.732kΩ	Approx. 2.59kΩ

SUDFL8064L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace accelerator pedal position sensor and then go to "Verification of Vehicle Repair" procedure.

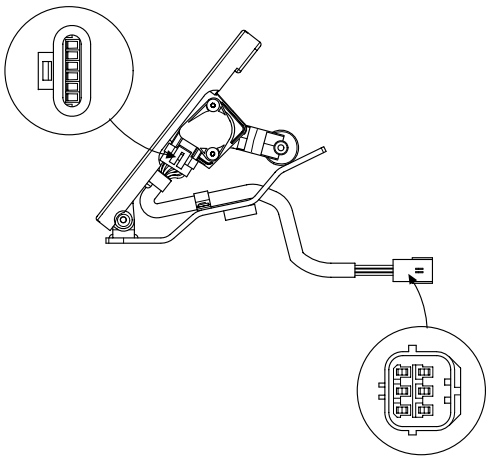
VERIFICATION OF VEHICLE REPAIR E24371EC

Refer to DTC P0112.

DTC P0225 IDLE SWITCH STUCK CLOSED

COMPONENT LOCATION E40C5E33

Accelerator pedal position sensor



SUDFL8046L

DESCRIPTION E1846F30

1. GENERAL DESCRIPTION
   Electronic control fuel injection is injected by engine control module(ECM) via factors received from various components. The accelerator pedal position sensor detects pedal position and sends signal to ECM.
   The idle switch is installed together with the accelerator pedal position sensor, the ECM controls fuel injection amount after the ECM received signal from the idle switch judges that the vehicle is under idle or acceleration.

2. DTC DESCRIPTION
   If it will take 1048.6ms or more with the condition that the idle switch is not opened even though the idle switch is depressed, the ECM judges this as a fault and DTC is set. The possible causes are switch stuck, defective ECM or wiring problem etc.

DTC DETECTING CONDITION EE5DDBDC

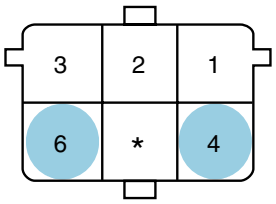
Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Idle switch stuck • Open wiring in terminals 34, 35 of connector F39-2 at the same time • Defective ECM
Enable Conditions	• IG ON/ Running			
Threshold Value	• The idle switch is not opened when the accelerator pedal is depressed.			
Diagnosis Time	• 1,048.6ms or more			
Fail Safe	Fuel Cut	No		
	Fuel Limit	Yes		
	MIL	OFF		

SPECIFICATION EC21D198

Idle switch specification

Idle switch	Specification	
	Idle state((0%)	Wide open(100%)
Output voltage	B+(V)	0(V)

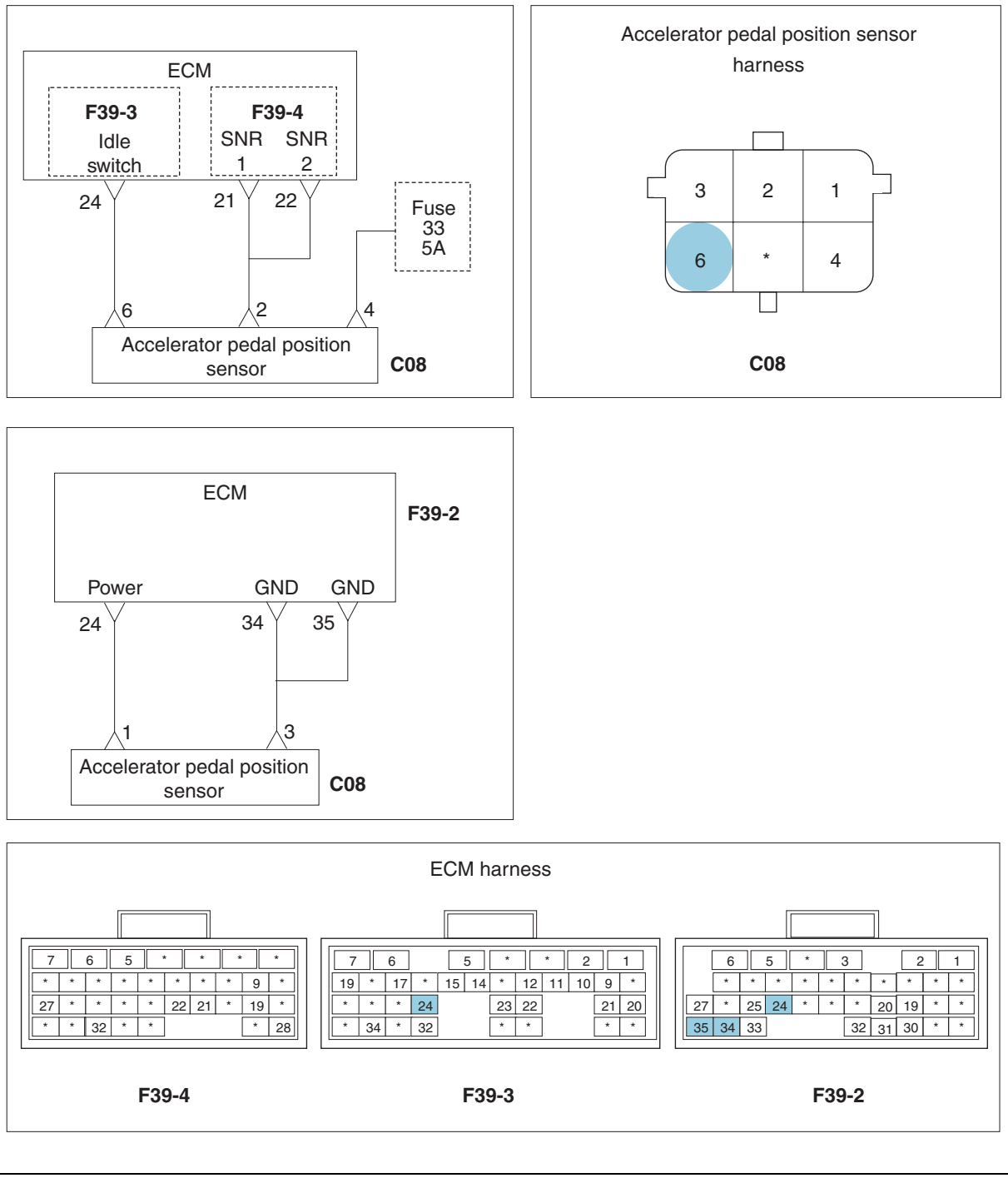
Terminal 4: Power input(B+)
Terminal 6: Idle switch



Sensor connector

SUDFL8156L

SCHEMATIC DIAGRAM EC3C2D25



SNBFL8067L

MONITOR SCAN TOOL DATA EA2BFF6B

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Accelerator Pedal Position" parameter on the scan tool.

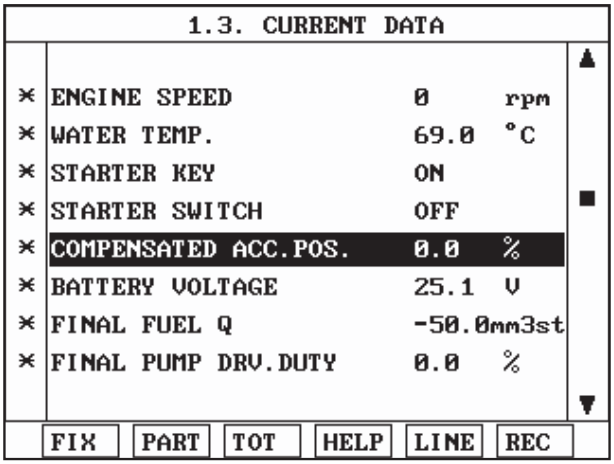


Fig. 1 Accelerator pedal position sensor data at ignition ON

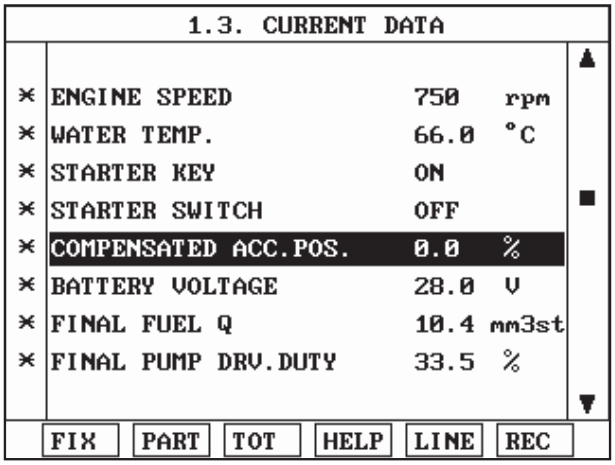


Fig. 2 Accelerator pedal position sensor data at idle

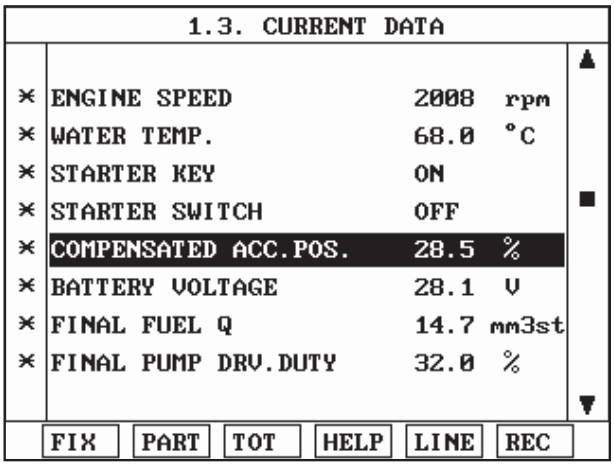


Fig. 3 Accelerator pedal position sensor data at 2,000rpm

SUDFL8049L

TERMINAL & CONNECTOR INSPECTION E6747652

Refer to DTC P0112.

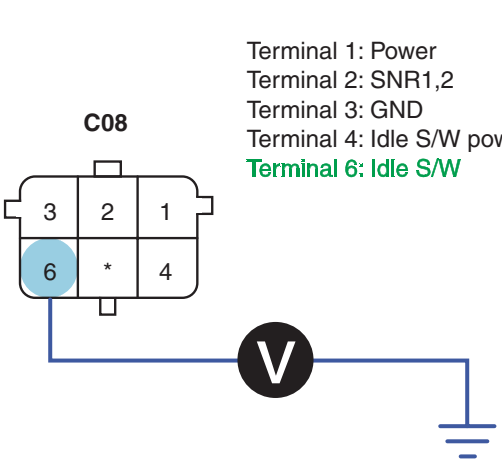
SIGNAL INSPECTION E60C974B

1. Signal Voltage Inspection

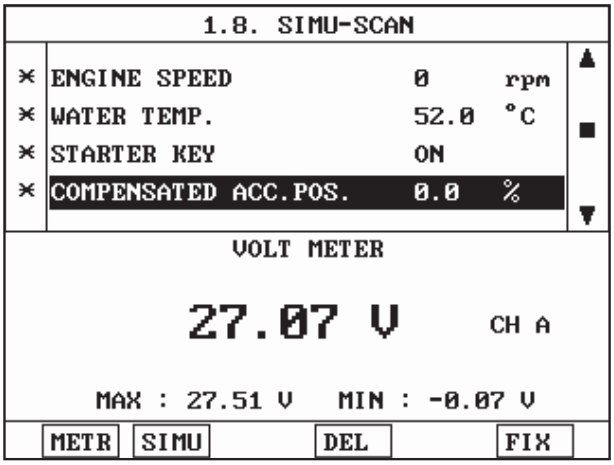
   1) Leave the accelerator pedal sensor connector(C08) and ECM(F39-3) connected.

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 6 of accelerator pedal position sensor harness connector and chassis ground.



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W



▶ With accelerator pedal position sensor connector connected (At not operating)

SNBFL8068L

■ Specification: Idle switch signal power B+V(At not operating the accelerator pedal)
■ Specification: Idle switch signal power approx. 0 V(At operating the accelerator pedal)

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

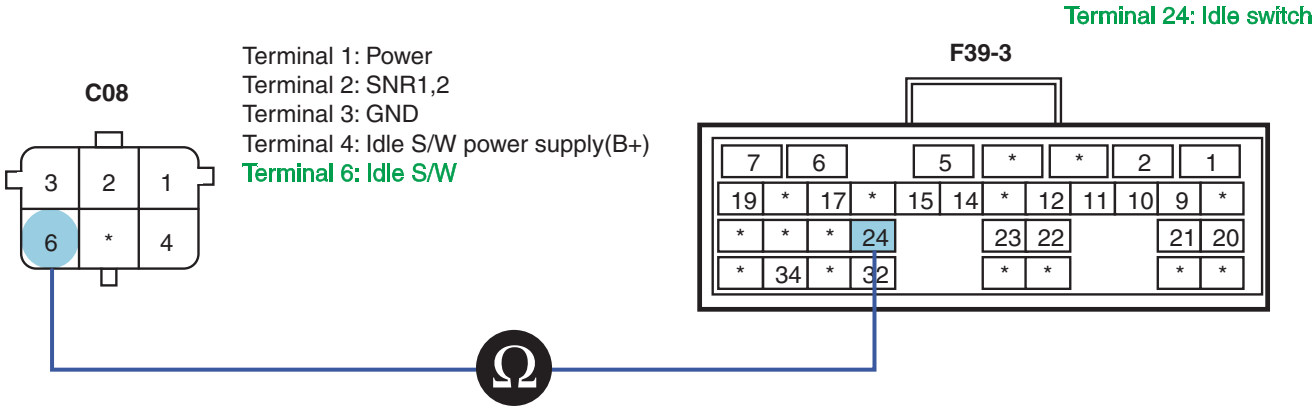
▶ Go to "Signal Open Inspection" procedure.

2. Signal Open Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-3).

3) Measure resistance between terminal 6 of accelerator pedal position sensor harness connector(C08) and terminal 24 of ECM connector(F39-3).



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W

SNBFL8069L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Power Inspection" procedure.

NO

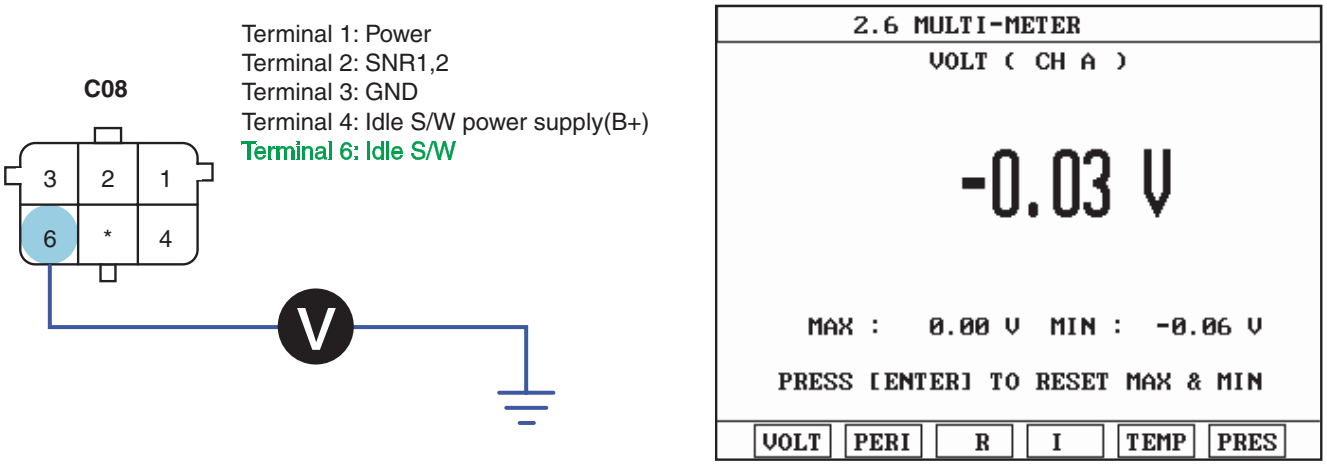
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Signal Short to Power Inspection

1) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-3).

2) Turn the ignition ON. The engine stops.

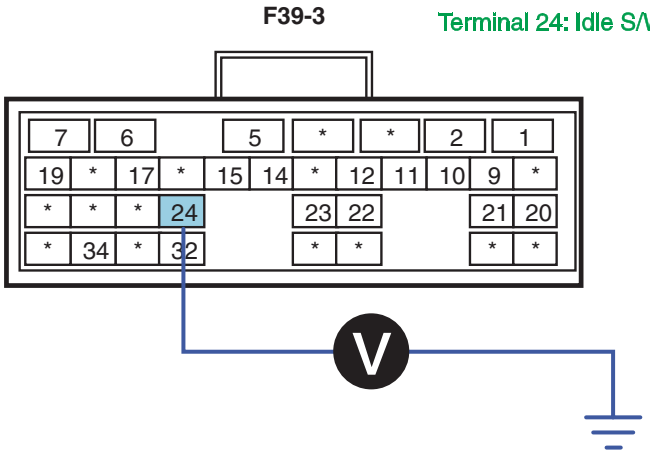
3) Measure voltage between terminal 6 of accelerator pedal position sensor harness connector(C08) and chassis ground.



SNBFL8070L

4) Depress the accelerator pedal and measure voltage between terminal 24 of ECM connector and chassis ground.

[ECM]



SNBFL8071L

■ Specification: Below 0~0.1V

5) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

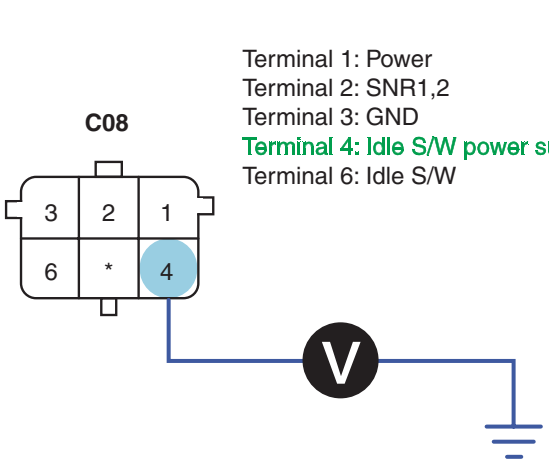
POWER SUPPLY INSPECTION EA04C1D9

1. Power Supply Voltage Inspection

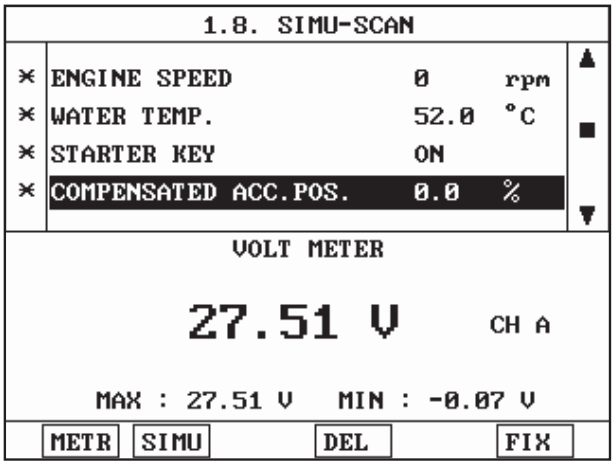
   1) Leave accelerator pedal position sensor connector(C08) and ECM connector(F39-3) connected.

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 4 of accelerator pedal position sensor harness connector(C08) and chassis ground.



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W



▶ With the accelerator pedal position sensor disconnected /connected(At IG key ON)

SNBFL8072L

■ Specification: Idle switch supply power approx. B+V

   4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

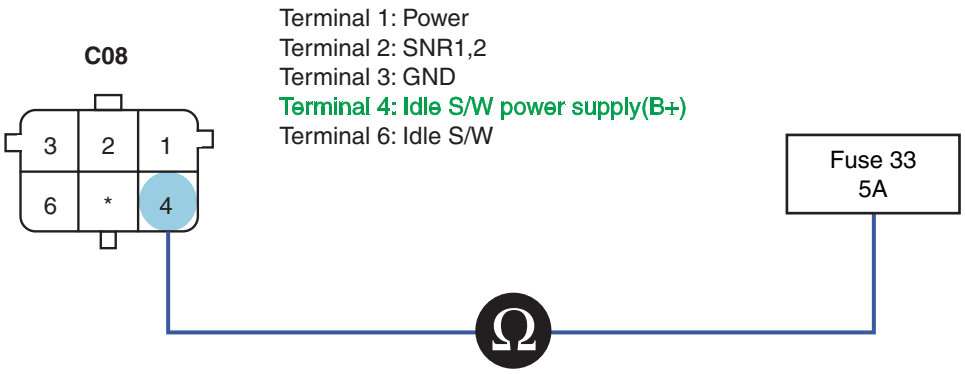
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

   1) Turn the ignition OFF.

   2) Disconnect fuse 32(5A) and accelerator pedal position sensor connector(C08).

   3) Measure resistance between fuse 32(5A) and terminal 4 of accelerator pedal position sensor harness connector(C08).



SNBFL8073L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

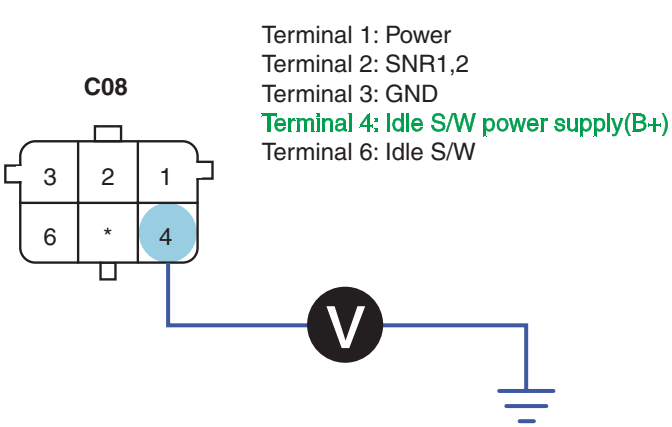
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

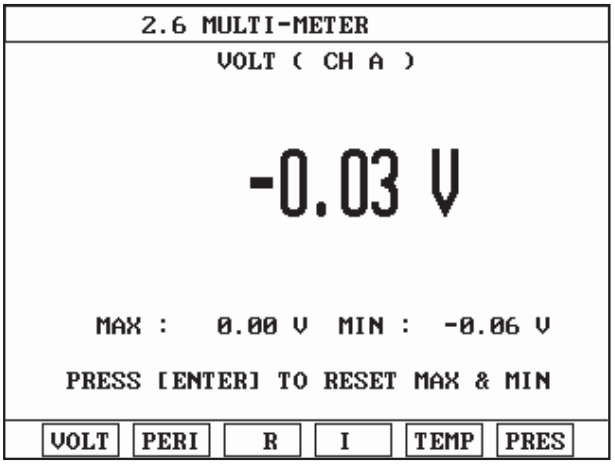
3. Power Supply Short to Power Inspection

1) Disconnect fuse 32(5A) and accelerator pedal position sensor connector(C08).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 4 of accelerator pedal position sensor harness connector and chassis ground.





SNBFL8074L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

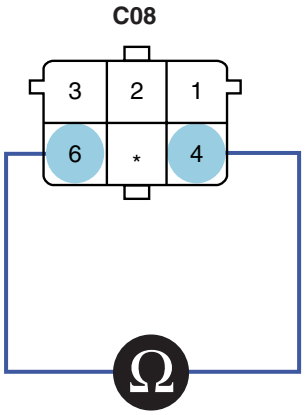
COMPONENT INSPECTION EA28DA8B

1. Accelerator Pedal Position Sensor Inspection

   1) Turn the ignition OFF.

   2) Disconnect accelerator pedal position sensor connector(C08).

   3) Measure resistance between terminal 4 and 6 of accelerator pedal position sensor connector.



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W

■ Specification

Terminals 4-6(At not operating)	Terminals 4-6(At operating)
Approx. 0Ω	Infinite

SNBFL8075L

   4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace accelerator pedal position sensor and then go to "Verification of Vehicle Repair" procedure.

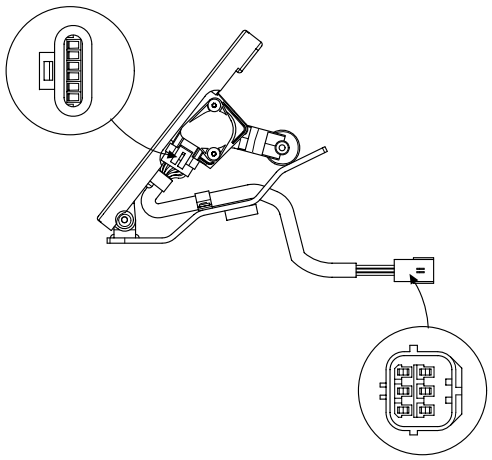
VERIFICATION OF VEHICLE REPAIR EC9A78BD

Refer to DTC P0112.

DTC P0226 IDLE SWITCH STUCK OPENED

COMPONENT LOCATION E1E89016

Accelerator pedal position sensor



SUDFL8046L

DESCRIPTION E3A3DFFD

1. GENERAL DESCRIPTION
   Electronic control fuel injection is injected by engine control module(ECM) via factors received from various components. The accelerator pedal position sensor detects pedal position and sends signal to ECM.
   The idle switch is installed together with the accelerator pedal position sensor, the ECM controls fuel injection amount after the ECM received signal from the idle switch judges that the vehicle is under idle or acceleration.

2. DTC DESCRIPTION
   If it takes 1048.6ms or more with the condition that the idle switch is opened even though the idle switch is not depressed, the ECM judges this as a fault and DTC is set. The possible causes are switch stuck, defective ECM or wiring problem etc.

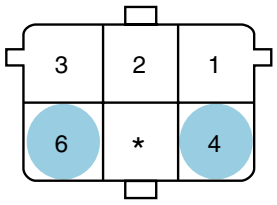
DT

SPECIFICATION EF01E95D

Idle switch specification

Idle switch	Specification	
	Idle state((0%)	Wide open(100%)
Output voltage	B+(V)	0(V)

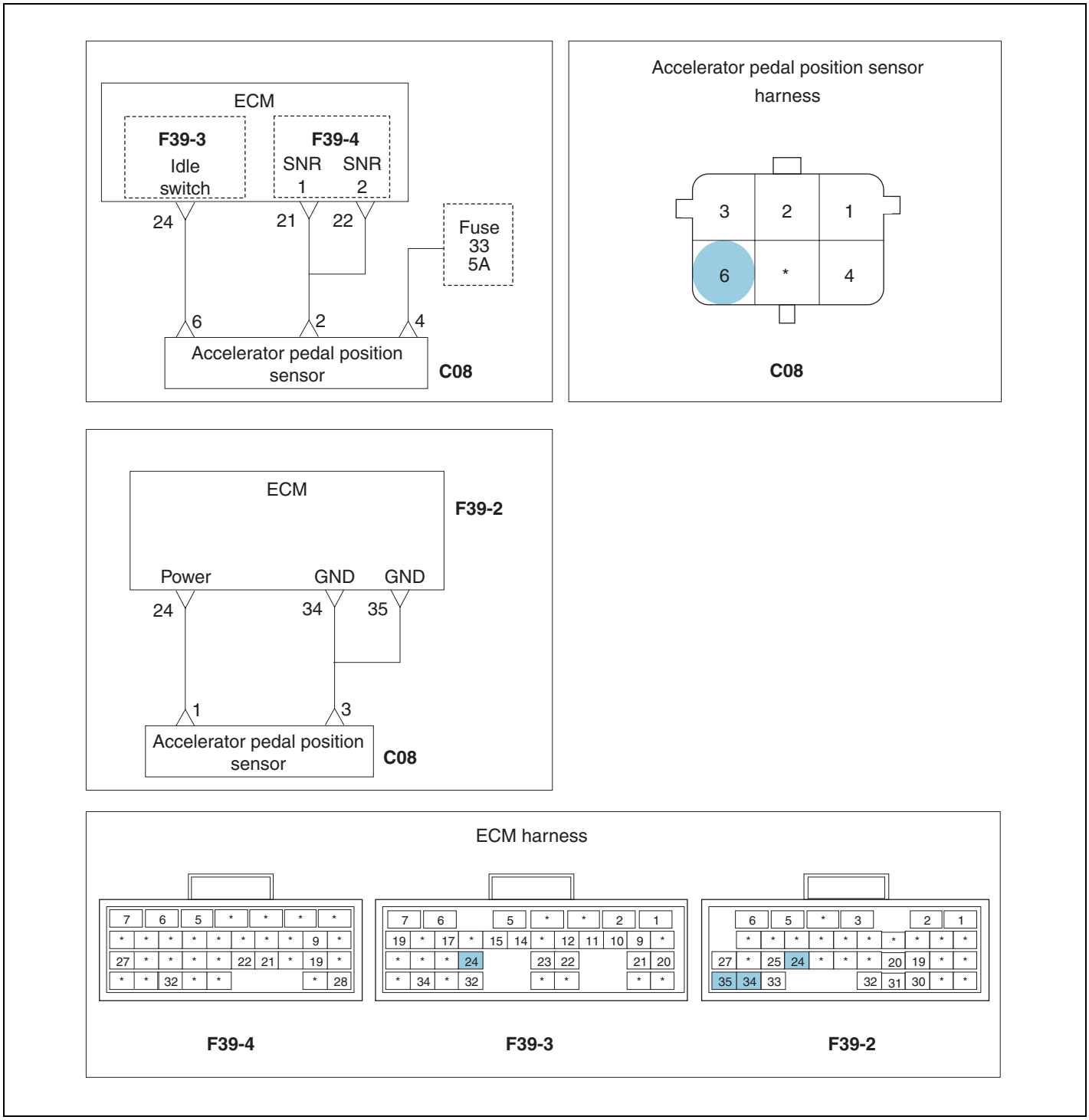
Terminal 4: Power input(B+)
Terminal 6: Idle switch



Sensor connector

SUDFL8156L

SCHEMATIC DIAGRAM ED9B5F16



SNBFL8067L

MONITOR SCAN TOOL DATA E7AC20AE

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Accelerator Pedal Position" parameter on the scan tool.

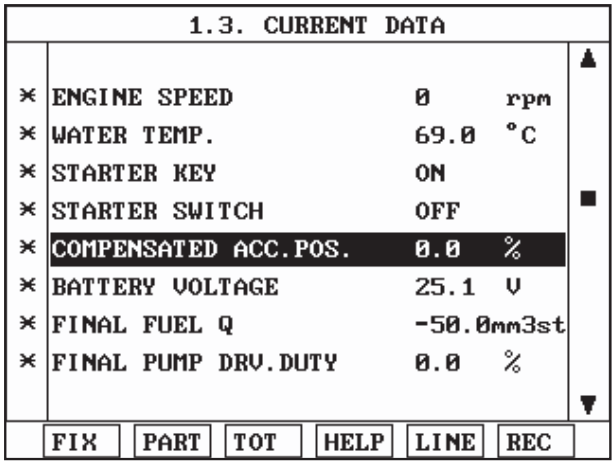


Fig. 1 Accelerator pedal position sensor data at ignition ON

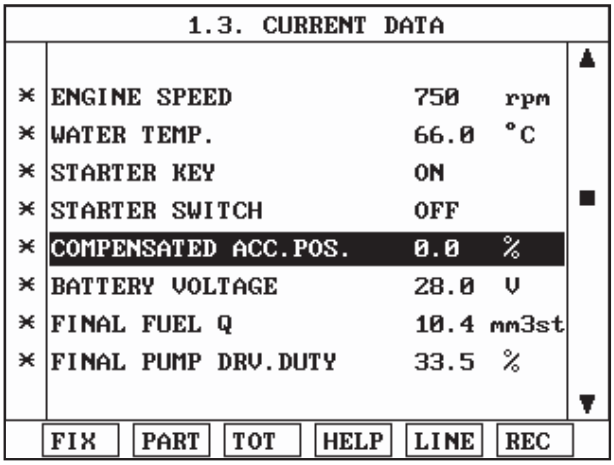


Fig. 2 Accelerator pedal position sensor data at idle

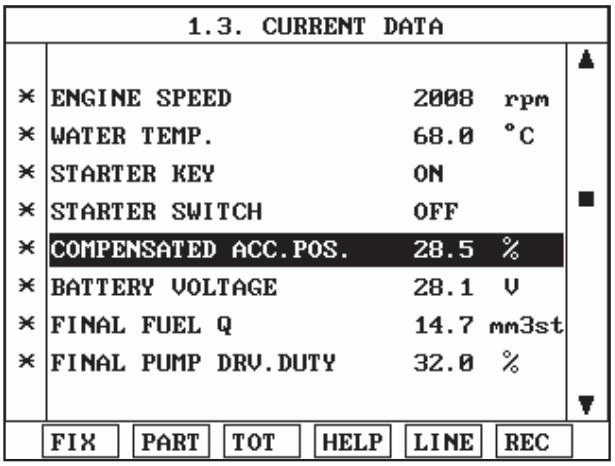


Fig. 3 Accelerator pedal position sensor data at 2,000rpm

SUDFL8049L

TERMINAL & CONNECTOR INSPECTION EFD8D1ED

Refer to DTC P0112.

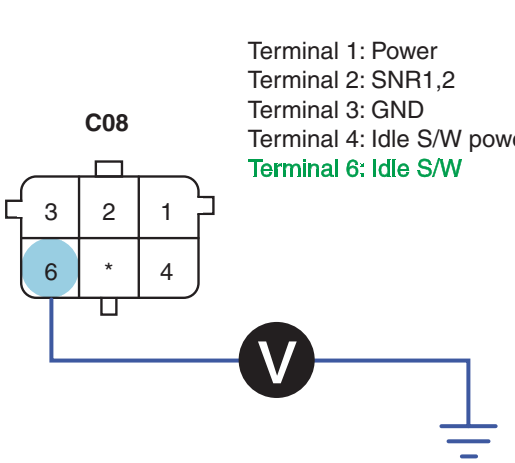
SIGNAL INSPECTION E4EA796C

1. Signal Voltage Inspection

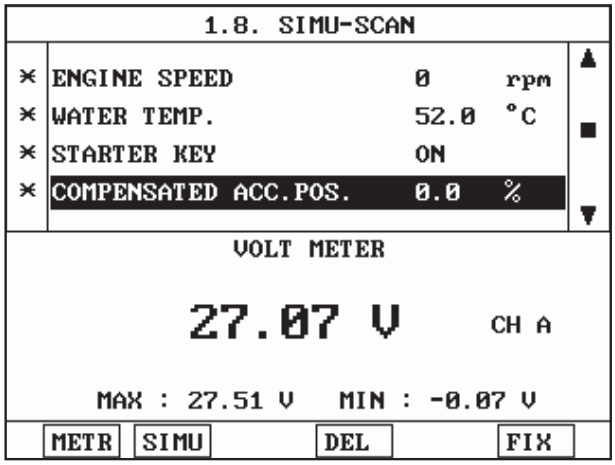
   1) Leave the accelerator pedal sensor connector(C08) and ECM(F39-3) connected.

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 6 of accelerator pedal position sensor harness connector and chassis ground.



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W



▶ With accelerator pedal position sensor connector connected (At not operating)

SNBFL8068L

■ Specification: Idle switch signal power B+V(At not operating the accelerator pedal)
■ Specification: Idle switch signal power approx. 0 V(At operating the accelerator pedal)

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Go to "Signal Open Inspection" procedure.

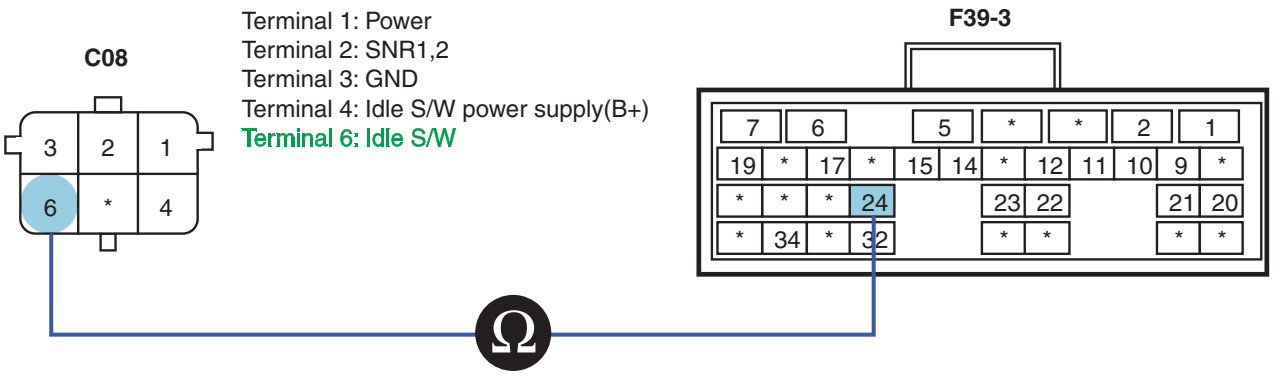
2. Signal Open Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-3).

3) Measure resistance between terminal 6 of accelerator pedal position sensor harness connector(C08) and terminal 24 of ECM connector(F39-3).

Terminal 24: Idle switch



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W

SNBFL8069L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Power Inspection" procedure.

NO

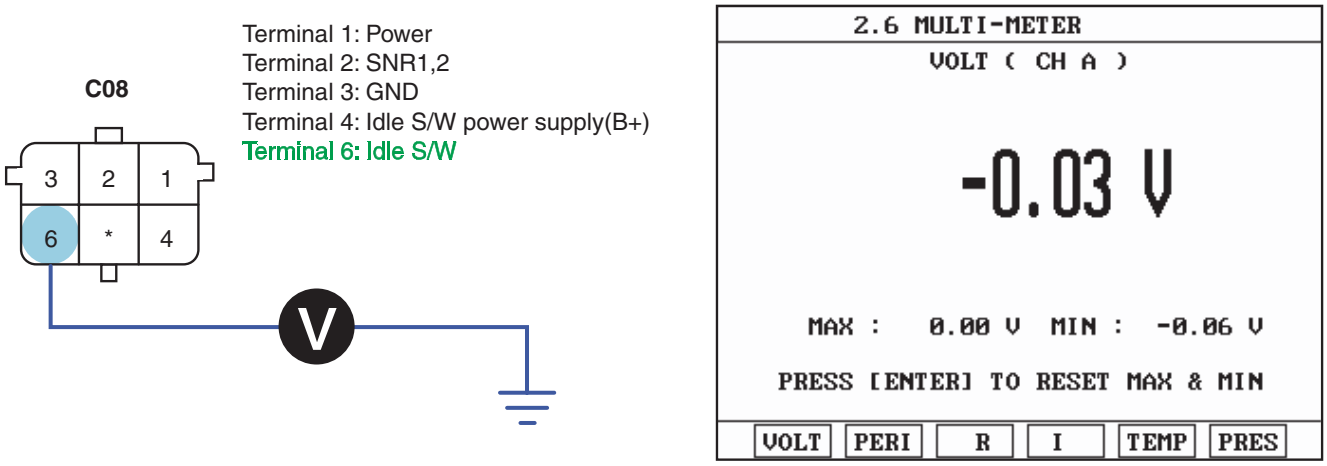
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Signal Short to Power Inspection

1) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-3).

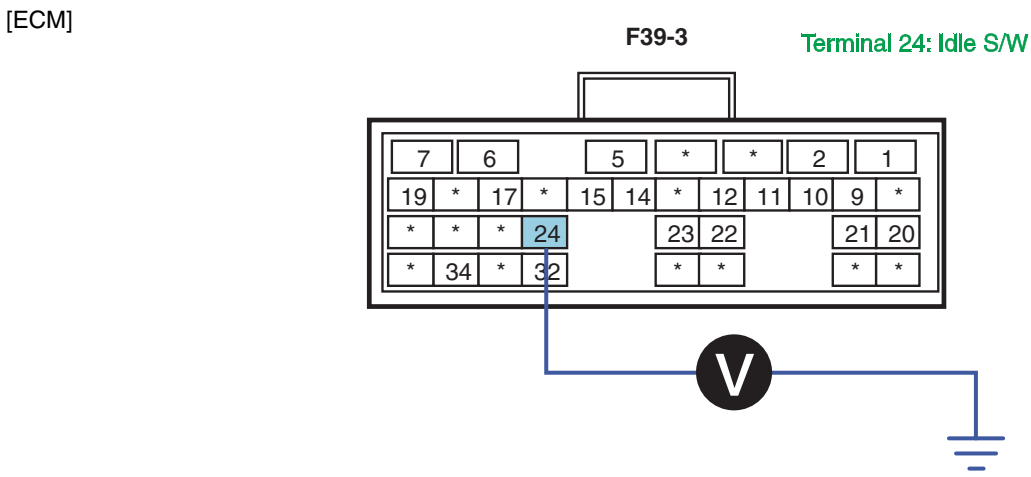
2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 6 of accelerator pedal position sensor harness connector(C08) and chassis ground.



SNBFL8070L

4) Depress the accelerator pedal and measure voltage between terminal 24 of ECM connector and chassis ground.



SNBFL8071L

■ Specification: Below 0~0.1V

5) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

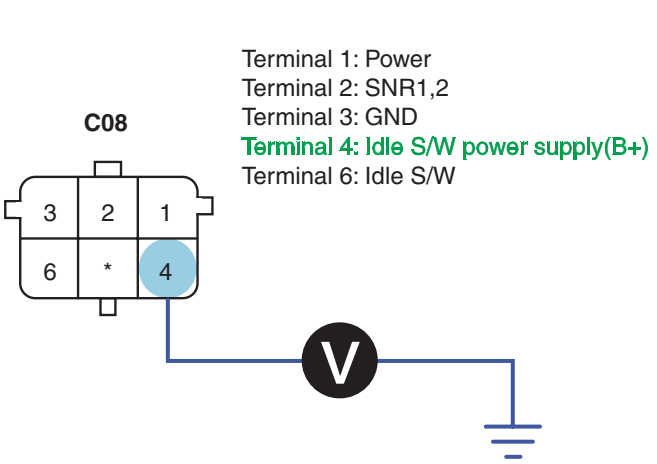
POWER SUPPLY INSPECTION EA932456

1. Power Supply Voltage Inspection

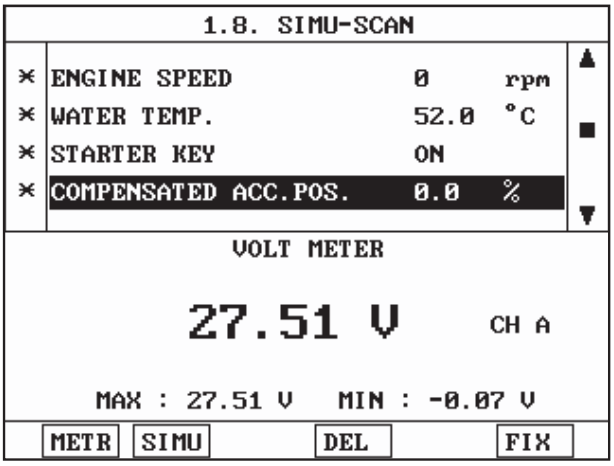
   1) Leave accelerator pedal position sensor connector(C08) and ECM connector(F39-3) connected.

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 4 of accelerator pedal position sensor harness connector(C08) and chassis ground.



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W



▶ With the accelerator pedal position sensor disconnected /connected(At IG key ON)

SNBFL8072L

■ Specification: Idle switch supply power approx. B+V

   4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

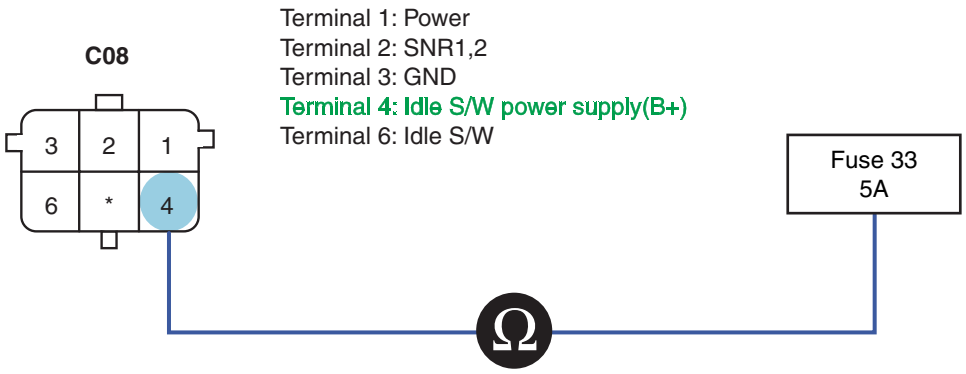
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

   1) Turn the ignition OFF.

   2) Disconnect fuse 32(5A) and accelerator pedal position sensor connector(C08).

   3) Measure resistance between fuse 32(5A) and terminal 4 of accelerator pedal position sensor harness connector(C08).



SNBFL8073L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

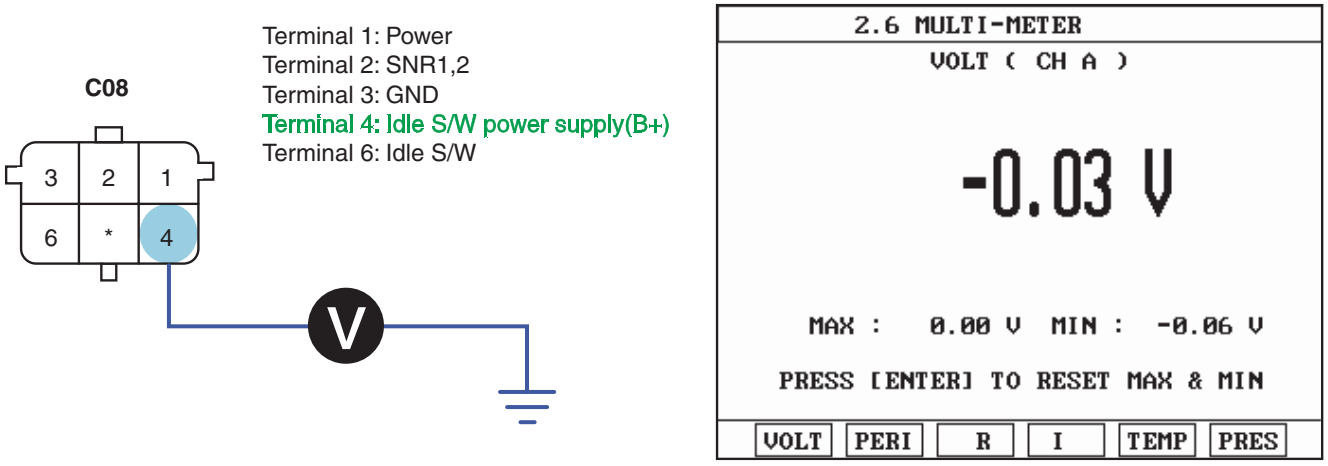
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Power Supply Short to Power Inspection

1) Disconnect fuse 32(5A) and accelerator pedal position sensor connector(C08).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 4 of accelerator pedal position sensor harness connector and chassis ground.



SNBFL8074L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

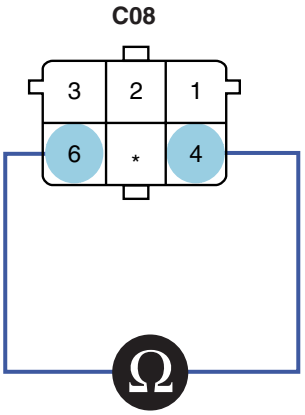
COMPONENT INSPECTION E9566135

1. Accelerator Pedal Position Sensor Inspection

   1) Turn the ignition OFF.

   2) Disconnect accelerator pedal position sensor connector(C08).

   3) Measure resistance between terminals 4 and 6 of accelerator pedal position sensor connector.



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W

■ Specification

Terminals 4-6(At not operating)	Terminals 4-6(At operating)
Approx. 0Ω	Infinite

SNBFL8075L

   4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace accelerator pedal position sensor and then go to "Verification of Vehicle Repair" procedure.

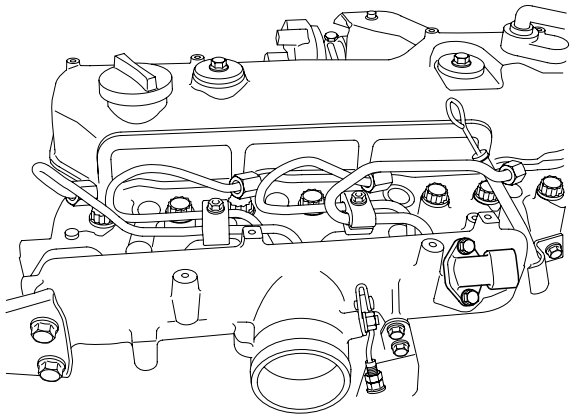
VERIFICATION OF VEHICLE REPAIR EA678918

Refer to DTC P0112.

DTC P0236 BOOST PRESSURE SENSOR INVALID

COMPONENT LOCATION EADD2CFA

Boost pressure & intake air temperature sensor



SUDFL8166L

DESCRIPTION EE6CD676

1. GENERAL DESCRIPTION
   Engine control module(ECM) should detect the exact air amount coming into engine to determine basic fuel injection amount supplied to engine. The booster pressure sensor is used to measure air amount coming into engine indirectly and it measures pressure in the intake manifold. It delivers analogue output signal commensurate with absolute pressure according to pressure change in the intake manifold to ECM. ECM uses the signal as the basic information by calculating intake air amount together with engine revolution.
   Booster pressure sensor is installed on the intake manifold to measure pressure in the intake manifold. The intake air temperature sensor is built-in booster pressure sensor. The intake pressure sensor is composed of piezo-electricity and hybrid IC amplifying output signal of piezo-electricity. Piezo-electricity is a kind of silicon diaphragm type using piezo resistance effect, one part of it is composed of 100% vacuum chamber and the other part of it is composed of structure that the pressure of intake manifold is applied.
   Output value is obtained by silicon change according to the pressure change of intake manifold.

2. DTC DESCRIPTION
   If the output value of the booster pressure sensor is detected with the same value for 10,485.6ms even though other sensors such as atmospheric pressure sensor and fuel pressure sensor change, including the defective booster pressure sensor, the ECM judges this as a fault and DTC is set. In case of fail safe, the vehicle is possible to drive but lack of engine power and smoke will occur since engine power is limited due to fuel correction and timing stop according to intake pressure and fuel amount is limited to below 40mm³/st.

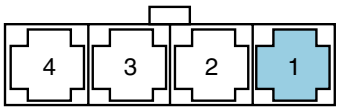
DTC DETECTING CONDITION E40B0FA3

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="5">• Check sensor output value.(Abnormal if output value of it is the same when the output values of atmospheric pressure and fuel pressure change)</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• At IG ON/ running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• Boost pressure sensor malfunction(there is no change value in intake air pressure.</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 10,485.6ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• Fuel amount is limited to below 40mm³/st.
• Engine power is limited.(fuel correction and timing stop according to intake pressure)</td></tr>
<tr><td>Fuel Limit</td><td>Yes</td></tr>
<tr><td>MIL</td><td>ON</td></tr>
</table>

SPECIFICATION EDDBC871

Item	Specificatoin(At idle)
Output signal	Approx. 1.63V
Intake pressure	Approx. 101Kpa

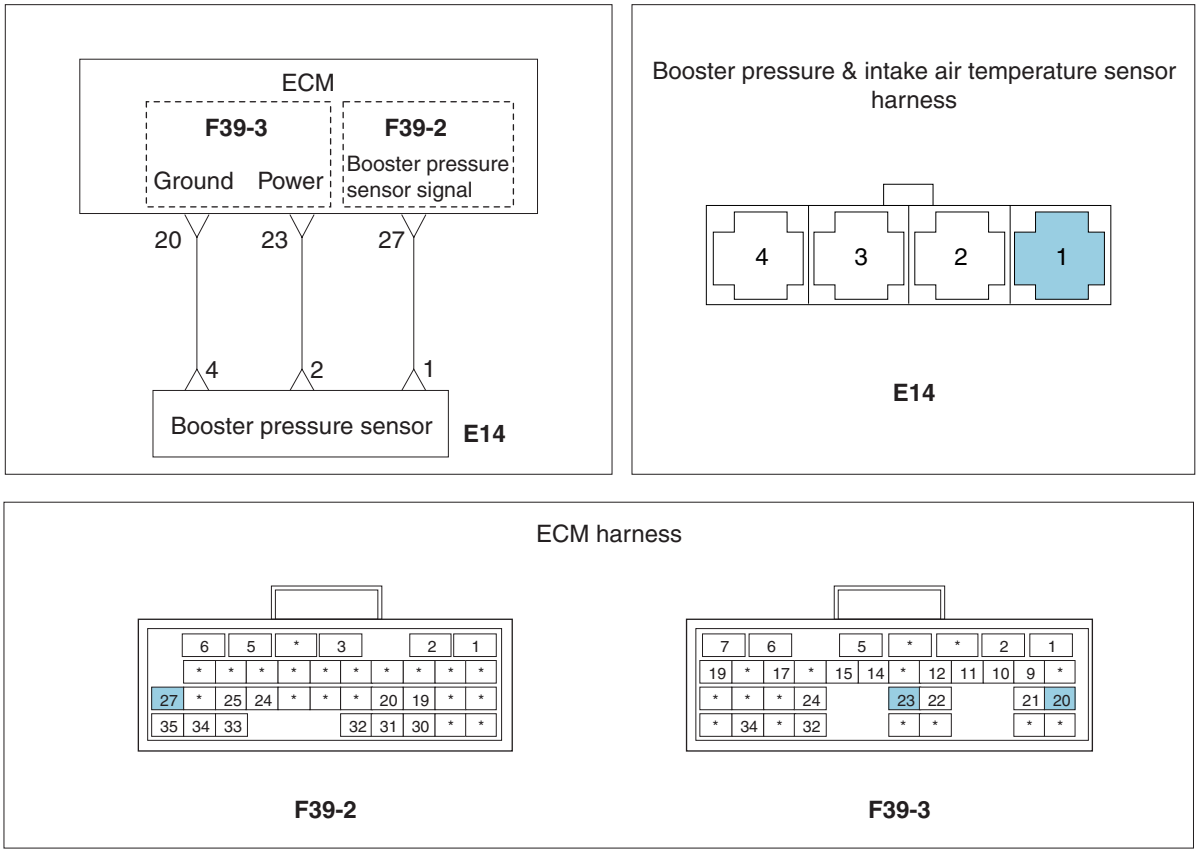
Terminal 1: Booster sensor signal
Terminal 2: Booster pressure sensor power
Terminal 3: Air temperature sensor signal
Terminal 4: Sensor ground



Sensor connector

SUDFL8167L

SCHEMATIC DIAGRAM E863C769



SNBFL8076L

WAVEFORM AND DATA E3773D34

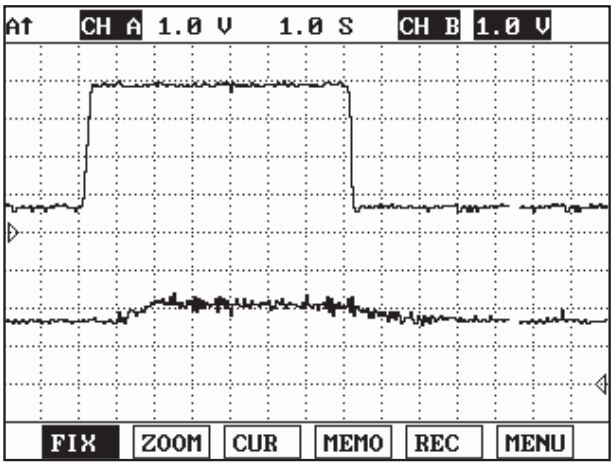
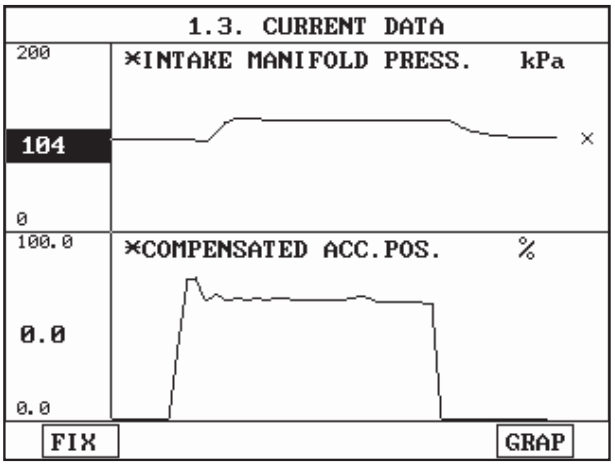


Fig. 1 Acceleration range at operating accelerator pedal



Note Booster pressure increase range

SUDFL8169L

MONITOR SCAN TOOL DATA E2BD11B7

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Booster pressure Sensor" parameter on the scan tool.

NOTE

"Engine intake pressure" value changes according to vehicle operation condition. In case of fail safe. be sure to check output value of "Engine intake pressure" is the same when the values of "Atmospheric pressure/ fuel pressure" change.

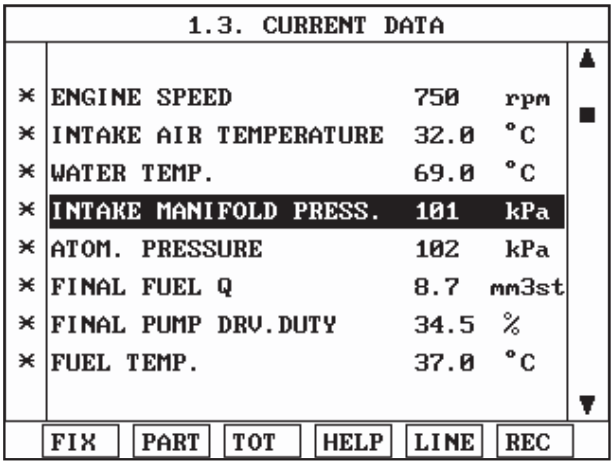


Fig. 1 "Engine intake pressure" data at idle

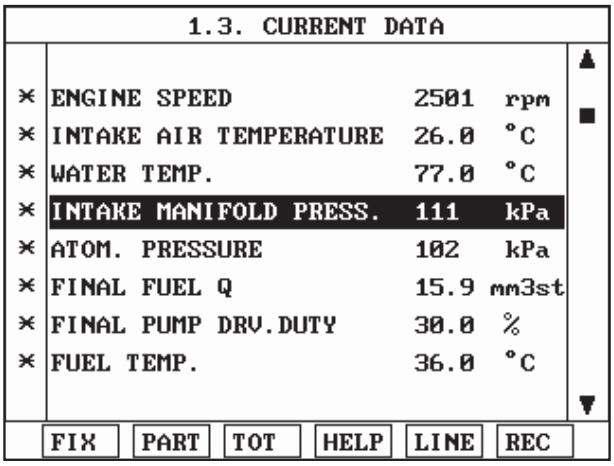


Fig. 2 "Engine intake pressure" data at 2,500rpm

SUDFL8170L

TERMINAL & CONNECTOR INSPECTION E2CF5E84

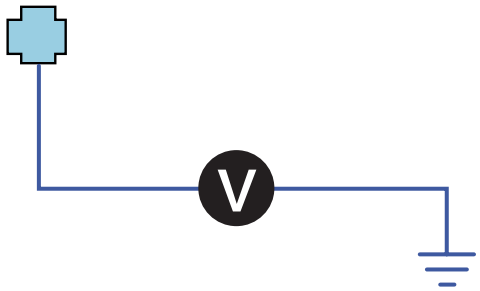
Refer to DTC P0112.

SIGNAL CIRCUIT INSPECTION E3529D13

1. Signal Voltage Inspection
   1) Leave the booster pressure sensor connector(E14) connected.
   2) Turn ignition ON. The engine stops.
   3) Measure voltage between terminal 1 of the booster pressure sensor harness connector and chassis ground.

sensor signal

E14



YES

▶ Go to "Signal Short to Power Inspection" procedure.

NO

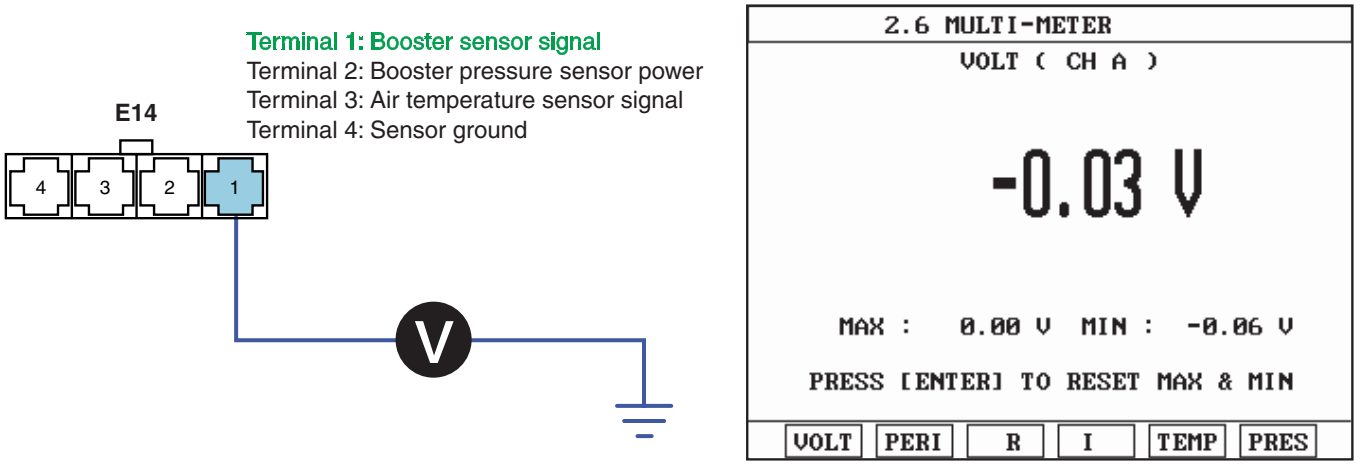
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Signal Short to Power Inspection

1) Disconnect the booster pressure sensor connector(E14) and ECM connector(F39-2).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of the booster pressure sensor harness connector and chassis ground.



SUDFL8173L

■ Specification: Below 0~0.1V

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Ground Inspection" procedure.

NO

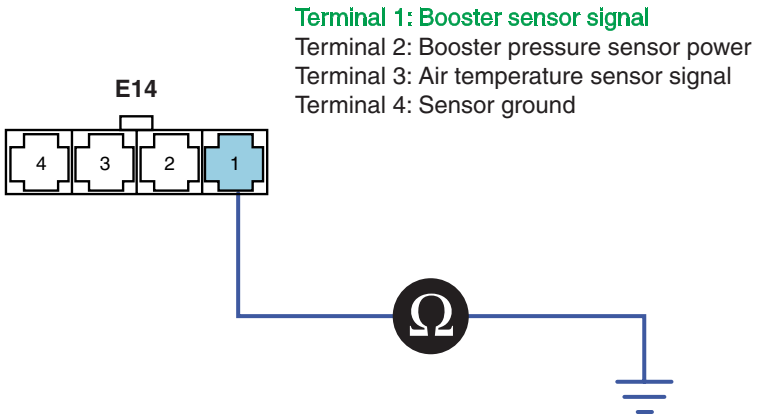
▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

4. Signal Short to Ground Inspection

1) Turn ignition OFF.

2) Disconnect the booster pressure sensor connector(E14) and ETCM connector(F39-2).

3) Measure resistance between terminal 1 of the booster pressure sensor harness connector and chassis ground.



SUDFL8174L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

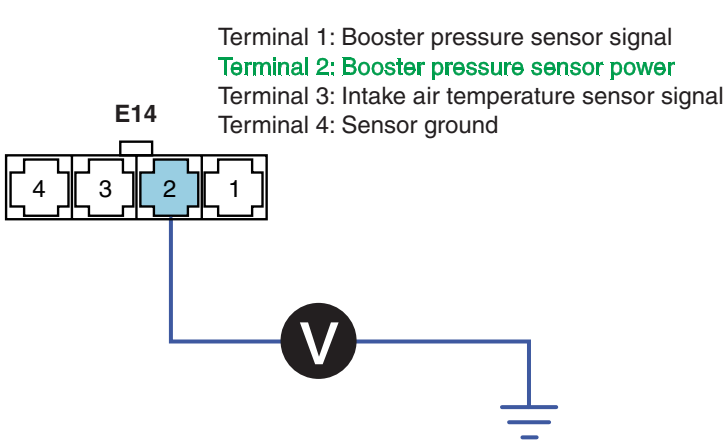
POWER SUPPLY INSPECTION E1D29832

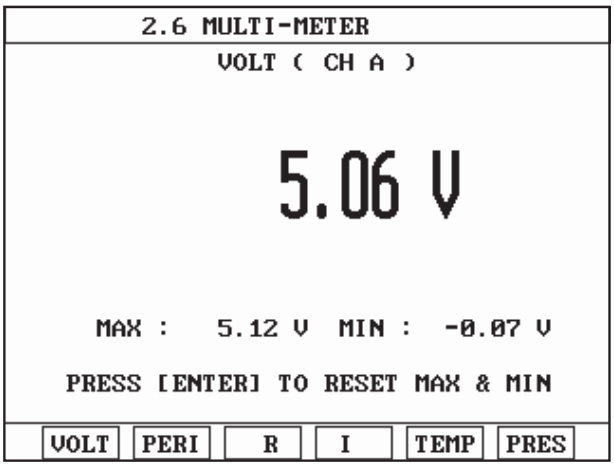
1. Power Supply Voltage Inspection

1) Disconnect the booster pressure sensor connector(E14).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 2 of booster pressure sensor harness connector and chassis ground.





SUDFL8027L

■ Specification: ECM output voltage approx. 5.16V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

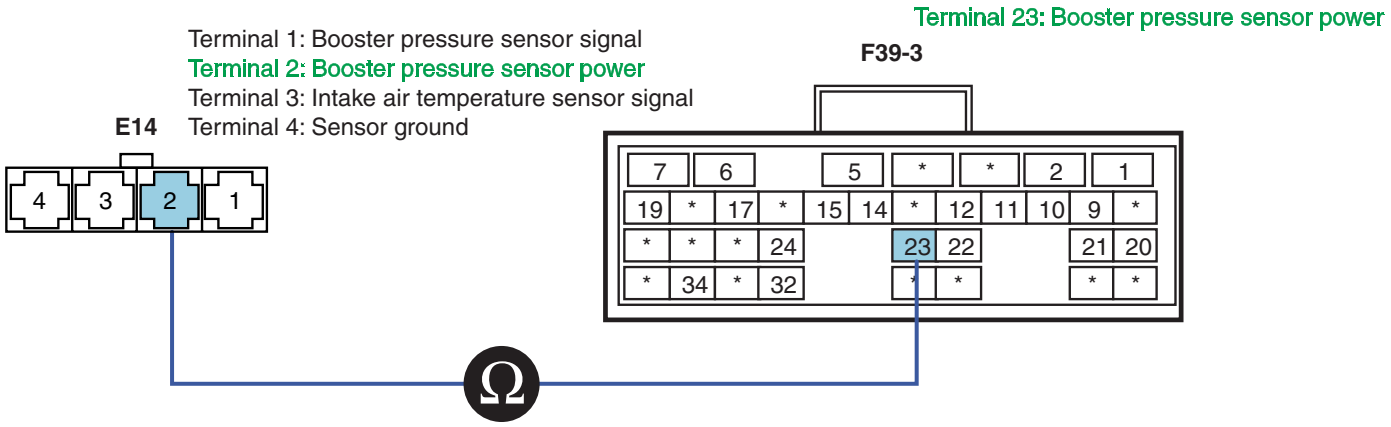
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn the ignition OFF.

2) Disconnect booster pressure sensor connector(E14) and ECM connector(F39-3).

3) Measure resistance between terminal 2 of booster pressure sensor harness connector and terminal 23 of ECM connector(F39-3).



SNBFL8015L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

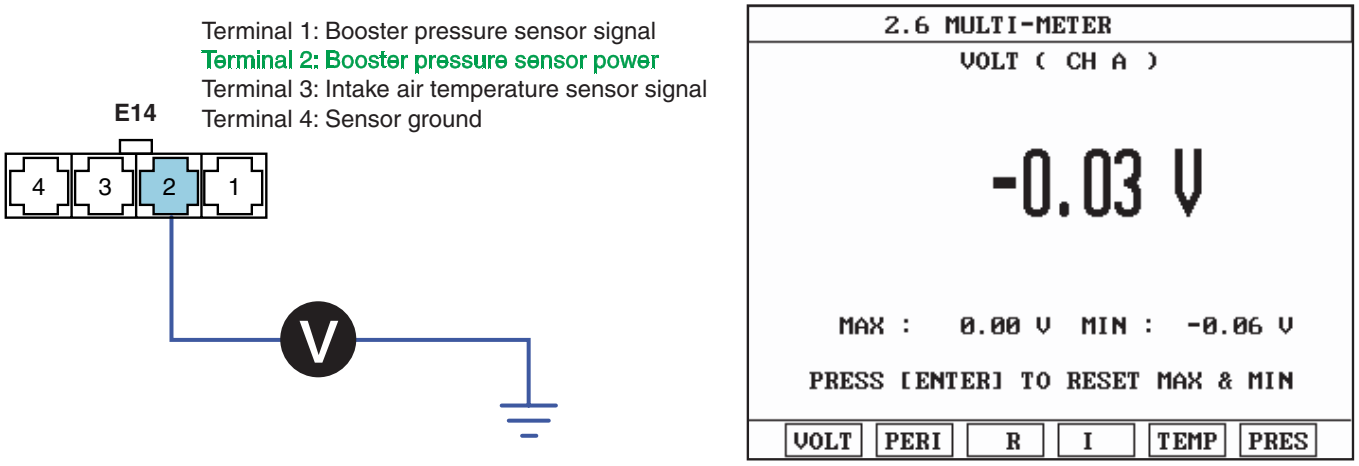
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Power Supply Short to Power Inspection

1) Disconnect booster pressure sensor connector(E14) and ECM connector(F39-3).

2) Turn ignition ON. The engine stops.

3) Measure voltage between terminal 2 of booster pressure sensor harness connector and chassis ground.



SUDFL8034L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

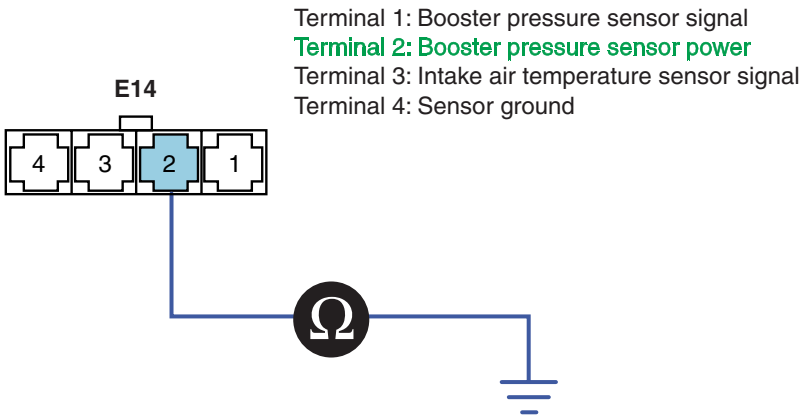
▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

4. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect booster pressure sensor connector(E14) and ECM connector(F39-3).

3) Measure resistance between terminal 2 of booster pressure sensor harness connector and chassis ground.



SUDFL8029L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION EF2DAD0D

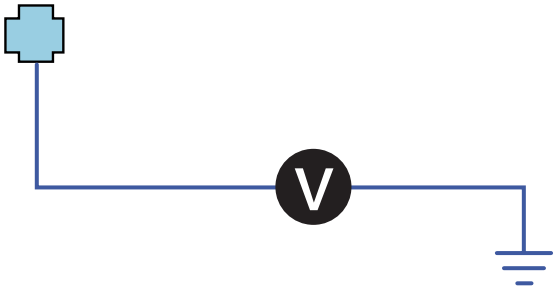
1. Ground Voltage Drop Inspection

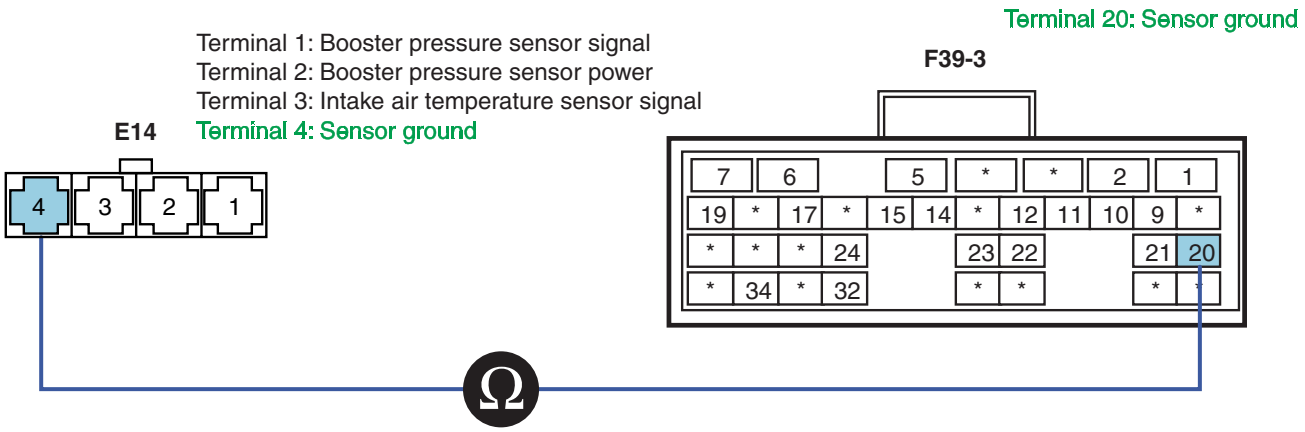
   1) Disconnect booster pressure sensor connector(E14) .

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage drop between terminal 4 of booster pressure sensor harness connector and chassis ground.

Terminal 1: Booster pressure sensor signal
Terminal 2: Booster pressure sensor power
Terminal 3: Intake air temperature sensor signal
Terminal 4: Sensor g





SNBFL8016L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E0D335EF

1. Booster Air Pressure Sensor Visual Inspection

   1) Turn the ignition OFF.

   2) Disconnect the booster pressure sensor connector(E14).

   3) Check terminal of the booster pressure sensor connector for corrosion, contamination.

   4) Check the booster pressure for torque and fuel leaks.

   5) Is there any problem for booster pressure sensor?

   YES

   ▶ Replace the booster pressure sensor if necessary and then go to "Verification of Vehicle Repair" procedure.

   NO

   ▶ Go to "Booster pressure Sensor Waveform Inspection" procedure

2. Booster pressure Sensor Waveform Inspection

   1) Turn the ignition OFF.

   2) Connect the booster pressure sensor connector(E14).

   3) Connect oscilloscope to terminal 1 of the booster pressure sensor connector(E14).

   4) Check waveform for at idle and at acceleration after starting the engine.

Specification: Refer to “ Basic waveform” item in general information.

5) Is the waveform of the booster pressure sensor normal?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the booster pressure sensor and then go to "Verification of Vehicle Repair" procedure.

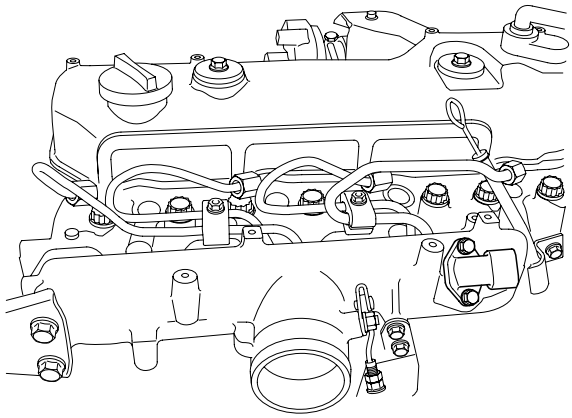
VERIFICATION OF VEHICLE REPAIR E003F28C

Refer to DTC P0112.

DTC P0237 BOOST PRESSURE SENSOR SIGNAL LOW

COMPONENT LOCATION EAAF7651

Boost pressure & intake air temperature sensor



SUDFL8166L

DESCRIPTION EAEFD446

1. GENERAL DESCRIPTION
   Engine control module(ECM) should detect the exact air amount coming into engine to determine basic fuel injection amount supplied to engine. The booster pressure sensor is used to measure air amount coming into engine indirectly and it measures pressure in the intake manifold. It delivers analogue output signal commensurate with absolute pressure according to pressure change in the intake manifold to ECM. ECM uses the signal as the basic information by calculating intake air amount together with engine revolution.
   Booster pressure sensor is installed on the intake manifold to measure pressure in the intake manifold. The intake air temperature sensor is built-in booster pressure sensor. The intake pressure sensor is composed of piezo-electricity and hybrid IC amplifying output signal of piezo-electricity. Piezo-electricity is a kind of silicon diaphragm type using piezo resistance effect, one part of it is composed of 100% vacuum chamber and the other part of it is composed of structure that the pressure of intake manifold is applied.
   Output value is obtained by silicon change according to the pressure change of intake manifold.

2. DTC DESCRIPTION
   If the output value of the booster pressure sensor is detected below 1.5V for 1048.6ms, the ECM judges this as a fault and DTC is set. The probable causes are open circuit of terminals 27 and 33 of ECM connectors(F39-2 and F39-3), open or short to ground. In case of fail safe, the vehicle is possible to drive but lack of engine power and smoke will occur since engine power is limited due to fuel correction and timing stop according as intake pressure is fixed to control with 100Kpa and fuel amount is limited to below 40mm³/st.

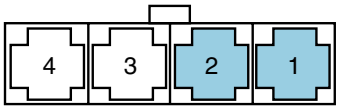
DTC DETECTING CONDITION EE248BC9

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Open circuit of terminals 27 and 23 of ECM connectors(F39-2 and F39-3), open or short to ground. • Booster pressure sensor malfunction
Enable Conditions	• At IG ON/ running			
Threshold Value	• Below 0.5V			
Diagnosis Time	• 1,048.6ms or more			
Fail Safe	Fuel Cut	No	• Fuel amount is limited to below 40mm³/st. • Booster pressure is fixed to control with 100Kpa. • Engine power is limited.(fuel correction and timing stop according to intake pressure)	
	Fuel Limit	Yes		
	MIL	ON		

SPECIFICATION EE7E916E

Item	Specification(At idle)
Output signal	Approx. 1.63V
Intake pressure	Approx. 101Kpa

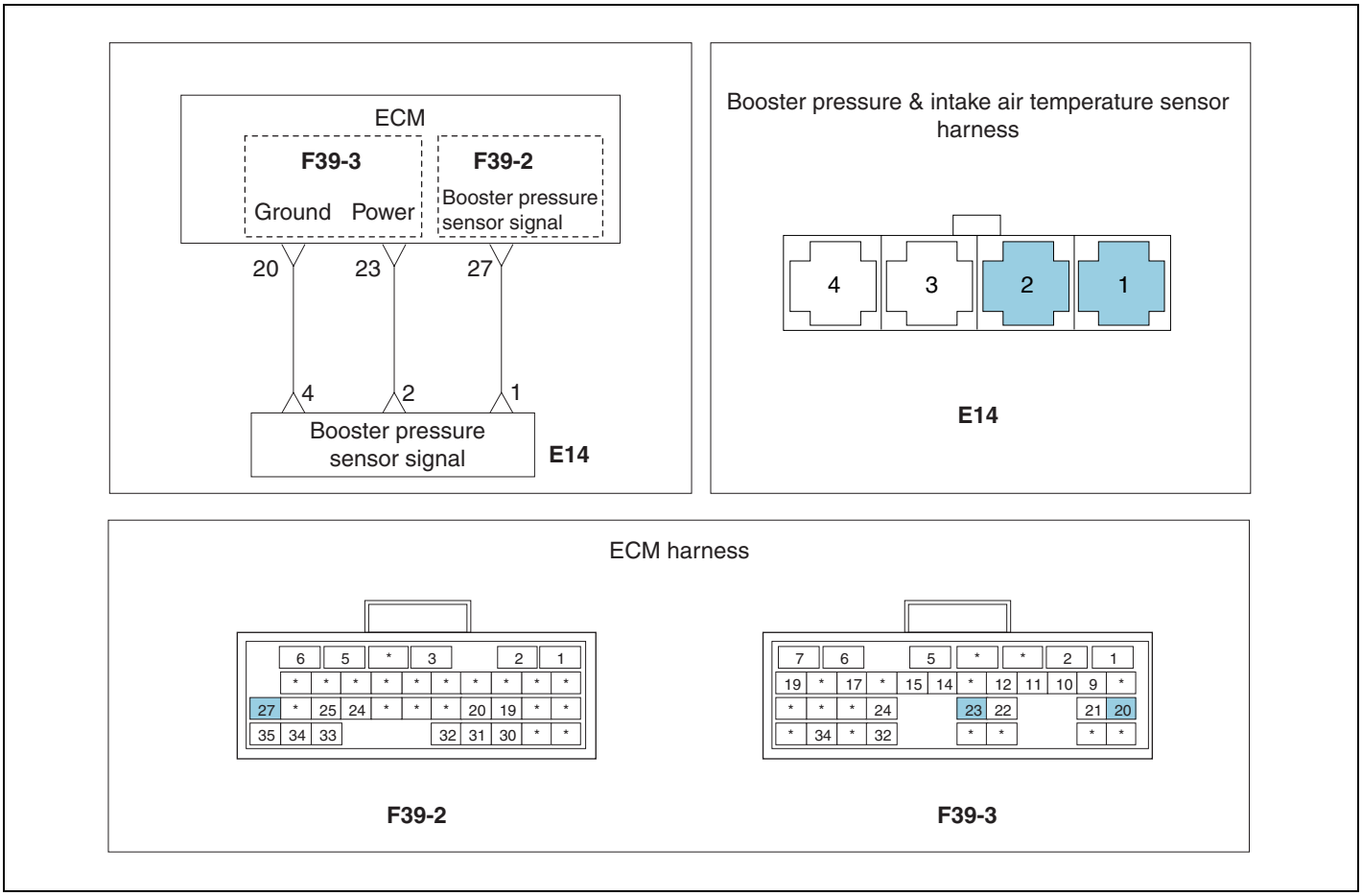
Terminal 1: Booster sensor signal
Terminal 2: Booster pressure sensor power
Terminal 3: Air temperature sensor signal
Terminal 4: Sensor ground



Sensor connector

SUDFL8175L

SCHEMATIC DIAGRAM E5291919



SNBFL8078L

WAVEFORM AND DATA E7B78507

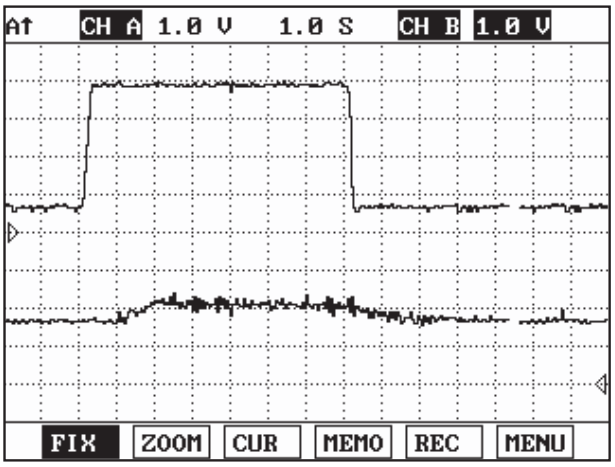
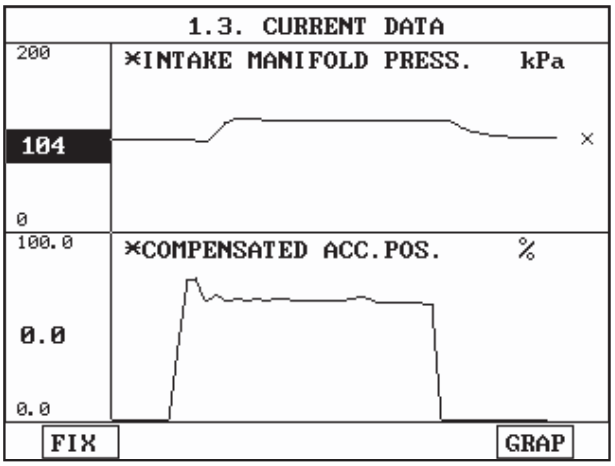


Fig. 1 Acceleration range at operating accelerator pedal



Note Booster pressure increase range

SUDFL8169L

MONITOR SCAN TOOL DATA E132B4C8

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Booster pressure Sensor" parameter on the scan tool.

NOTE

"Engine intake pressure" value changes according to vehicle operation condition. In case of fail safe. be sure to check output value of "Engine intake pressure" is the same when the values of "Atmospheric pressure/ fuel pressure" change.

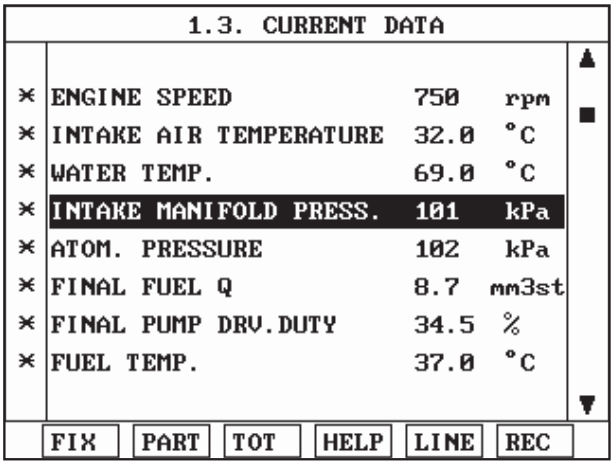


Fig. 1 "Engine intake pressure" data at idle

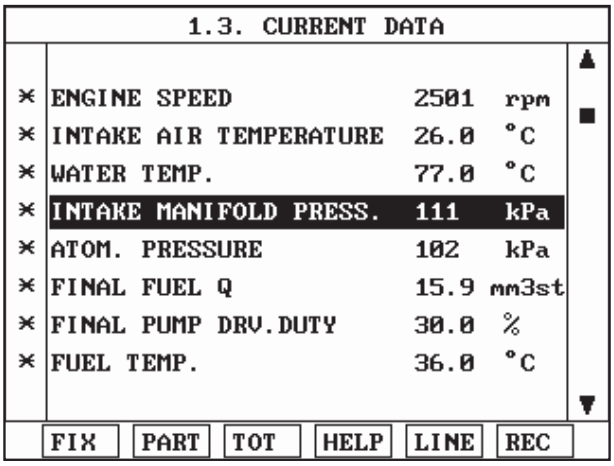


Fig. 2 "Engine intake pressure" data at 2,500rpm

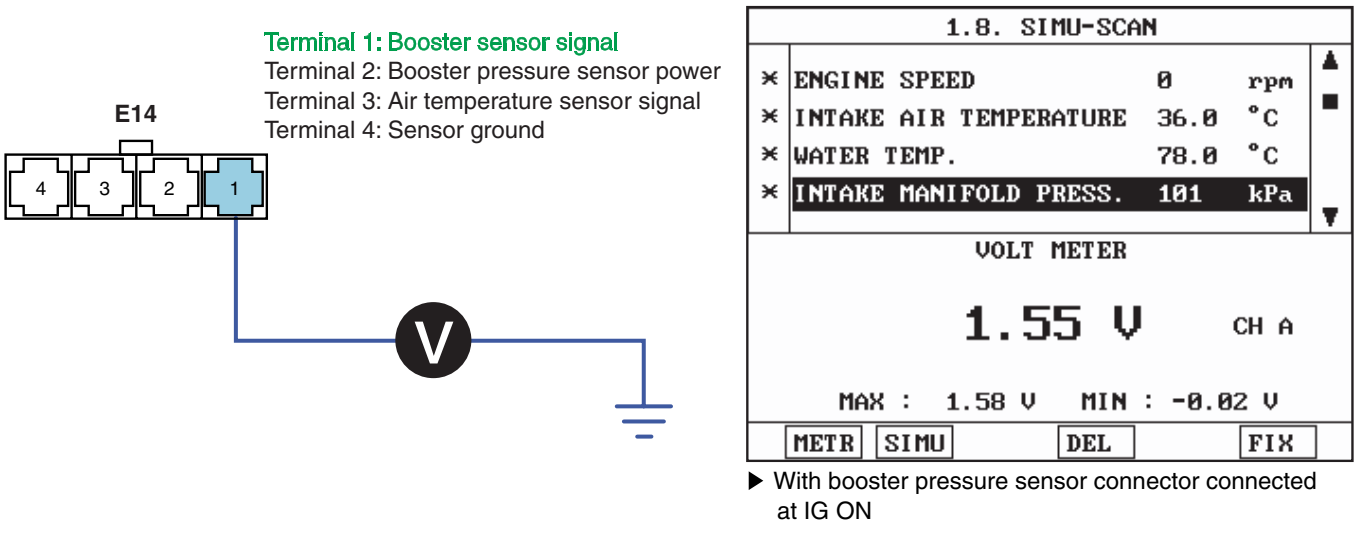
SUDFL8170L

TERMINAL & CONNECTOR INSPECTION EA1D8E45

Refer to DTC P0112.

SIGNAL CIRCUIT INSPECTION E9084090

1. Signal Voltage Inspection
   1) Leave the booster pressure sensor connector(E14) connected.
   2) Turn ignition ON. The engine stops.
   3) Measure voltage between terminal 1 of the booster pressure sensor harness connector and chassis ground.



▶ With booster pressure sensor connector connected at IG ON

SUDFL8171L

■ Specification: Booster pressure sensor signal power approx. 1.55V
Note) Voltage value differs according to booster pressure.

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

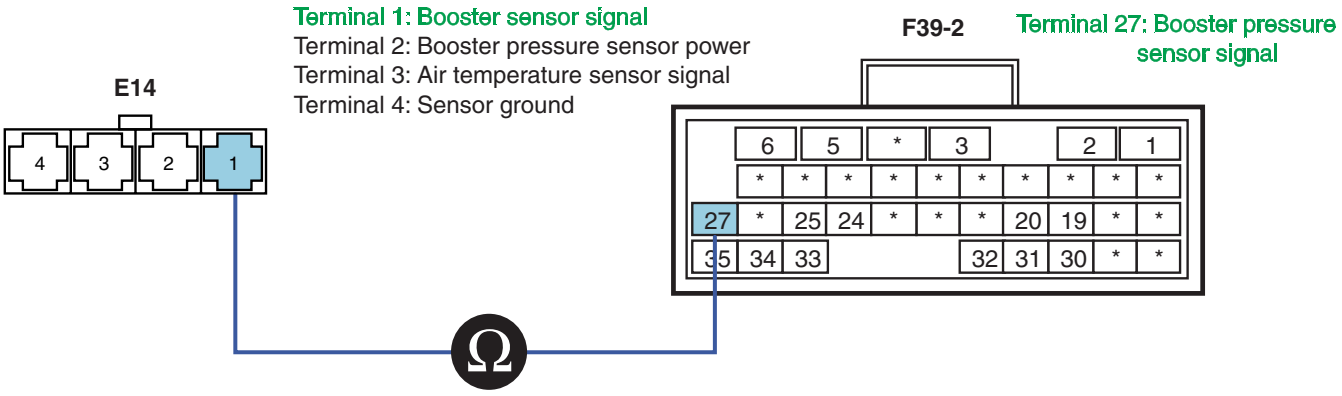
▶ Go to "Signal Open Inspection" procedure.

2. Signal Open Inspection

1) Turn the ignition OFF.

2) Disconnect the booster pressure sensor connector(E14) and the ECM connector(F39-2).

3) Measure resistance between terminal 1 of the booster pressure sensor harness connector and terminal 27 of ECM connector(F39-2).



SNBFL8077L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Ground Inspection" procedure.

NO

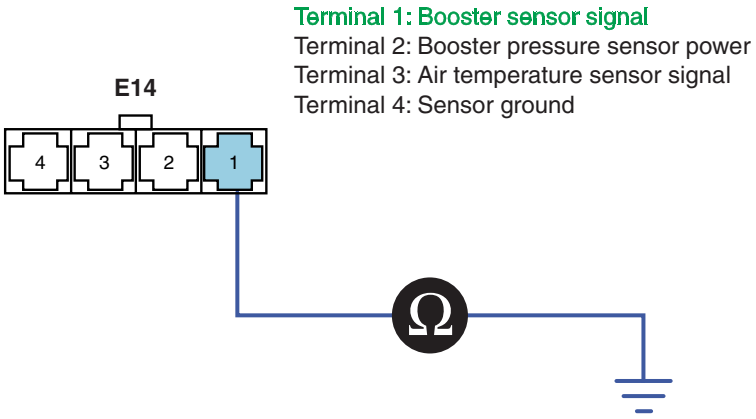
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Signal Short to Ground Inspection

1) Turn ignition OFF.

2) Disconnect the booster pressure sensor connector(E14) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of the booster pressure sensor harness connector and chassis ground.



SUDFL8174L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

POWER SUPPLY INSPECTION EBFA3979

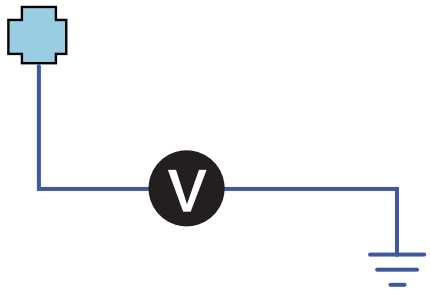
1. Power Supply Voltage Inspection

1) Disconnect the booster pressure sensor connector(E14).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 2 of booster pressure sensor harness connector and chassis ground.

Terminal 1: Booster pressure sensor signal
Terminal 2: Booster pressure sensor po



YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

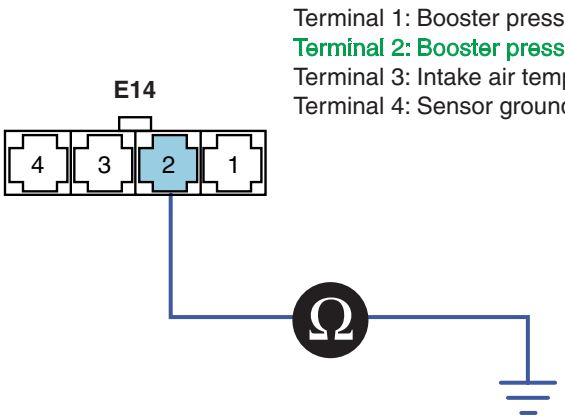
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect booster pressure sensor connector(E14) and ECM connector(F39-3).

3) Measure resistance between terminal 2 of booster pressure sensor harness connector and chassis ground.



SUDFL8029L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

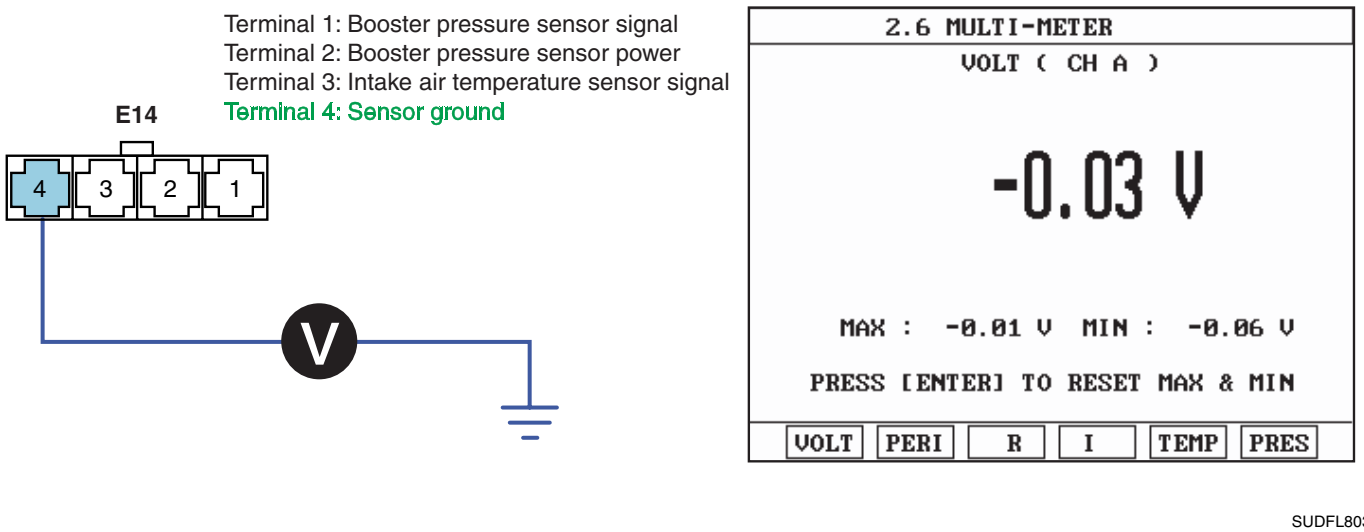
GROUND CIRCUIT INSPECTION EE4A7A0B

1. Ground Voltage Drop Inspection

1) Disconnect booster pressure sensor connector(E14).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 4 of booster pressure sensor harness connector and chassis ground.



SUDFL8030L

■ Specification: Ground voltage drop- within 200mV

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

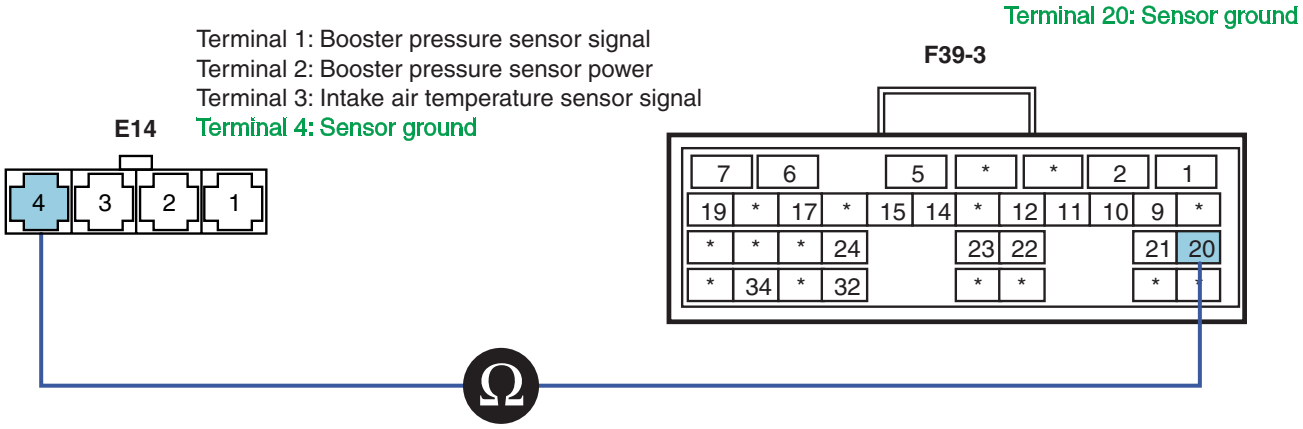
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect booster pressure sensor connector(E14) and ECM connector(F39-3).

3) Measure resistance between terminal 4 of booster pressure sensor harness connector and terminal 20 of ECM connector(F39-3).



SNBFL8016L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E05DCB1E

1. Booster Air Pressure Sensor Visual Inspection
   1) Turn the ignition OFF.
   2) Disconnect the booster pressure sensor connector(E14).
   3) Check terminal of the booster pressure sensor connector for corrosion, contamination.
   4) Check the booster pressure for torque and fuel leaks.
   5) Is there any problem for booster pressure sensor?

YES

▶ Replace the booster pressure sensor if necessary and then go to "Verification of Vehicle Repair" procedure.

NO

▶ Go to "Booster pressure Sensor Waveform Inspection" procedure

2. Booster pressure Sensor Waveform Inspection
   1) Turn the ignition OFF.
   2) Connect the booster pressure sensor connector(E14).
   3) Connect oscilloscope to terminal 1 of the booster pressure sensor connector(E14).
   4) Check waveform for at idle and at acceleration after starting the engine.
      Specification: Refer to "Basic waveform" item in general information.
   5) Is the waveform of the booster pressure sensor normal?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the booster pressure sensor and then go to "Verification of Vehicle Repair" procedure.

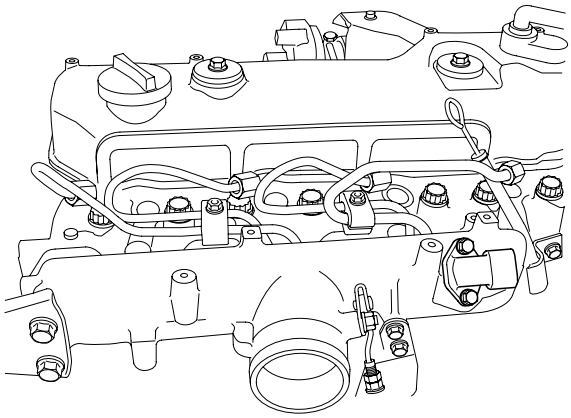
VERIFICATION OF VEHICLE REPAIR EA6A032D

Refer to DTC P0112.

DTC P0238 BOOST PRESSURE SENSOR SIGNAL HIGH

COMPONENT LOCATION ED7FD268

Boost pressure & intake air temperature sensor



SUDFL8166L

DESCRIPTION EAB8E11C

1. GENERAL DESCRIPTION
   Engine control module(ECM) should detect the exact air amount coming into engine to determine basic fuel injection amount supplied to engine. The booster pressure sensor is used to measure air amount coming into engine indirectly and it measures pressure in the intake manifold. It delivers analogue output signal commensurate with absolute pressure according to pressure change in the intake manifold to ECM. ECM uses the signal as the basic information by calculating intake air amount together with engine revolution.
   Booster pressure sensor is installed on the intake manifold to measure pressure in the intake manifold. The intake air temperature sensor is built-in booster pressure sensor. The intake pressure sensor is composed of piezo-electricity and hybrid IC amplifying output signal of piezo-electricity. Piezo-electricity is a kind of silicon diaphragm type using piezo resistance effect, one part of it is composed of 100% vacuum chamber and the other part of it is composed of structure that the pressure of intake manifold is applied.
   Output value is obtained by silicon change according to the pressure change of intake manifold.

2. DTC DESCRIPTION
   If the output value of the booster pressure sensor is detected above 1.5V for 1048.6ms, the ECM judges this as a fault and DTC is set. The probable causes are short circuit of terminals 27 and 23 of ECM connectors(F39-2 and F39-3), open circuit of terminal 20 of ECM connector(F39-3) or sensor malfunction. In case of fail safe, the vehicle is possible to drive but lack of engine power and smoke will occur since engine power is limited due to fuel correction and timing stop according as intake pressure is fixed to control with 100Kpa and fuel amount is limited to below 40mm³/st.

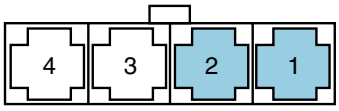
DTC DETECTING CONDITION EC36048B

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="4">• Open circuit of terminals 27 and 23 of ECM connectors(F39-2 and F39-3)
• Open circuit of terminal 20 of ECM connector(F39-3)
• Booster pressure sensor malfunction</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• At IG ON/ running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• Below 0.5V</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 1048.6ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• Fuel amount is limited to below 40mm³/st.
• Booster pressure is fixed to control with 100Kpa.
• Engine power is limited.(fuel correction and timing stop according to intake pressure)</td><td rowspan="3"></td></tr>
<tr><td>Fuel Limit</td><td>Yes</td></tr>
<tr><td>MIL</td><td>ON</td></tr>
</table>

SPECIFICATION EF1C0015

Item	Specification(At idle)
Output signal	Approx. 1.63V
Intake pressure	Approx. 101Kpa

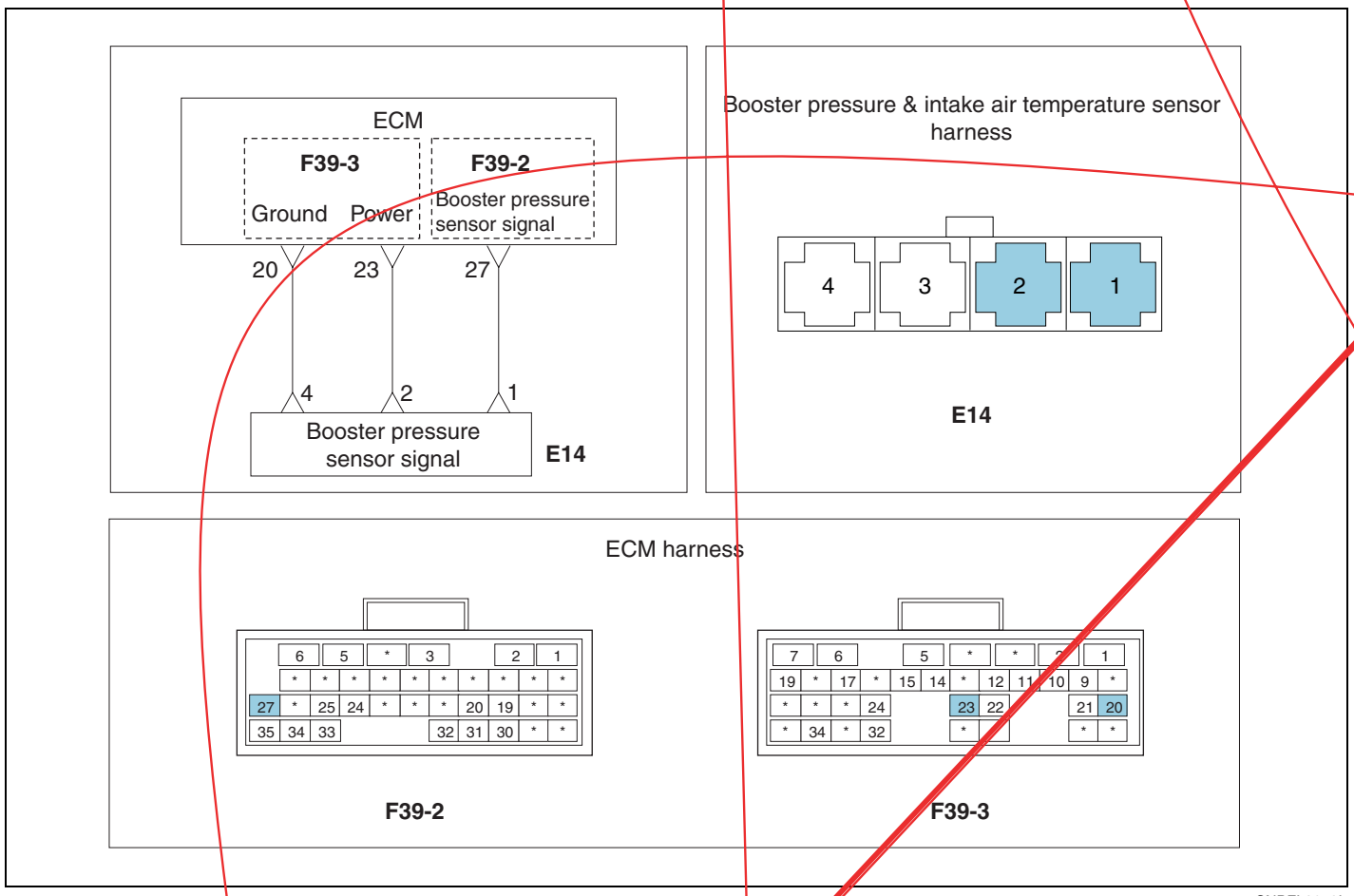
Terminal 1: Booster sensor signal
Terminal 2: Booster pressure sensor power
Terminal 3: Air temperature sensor signal
Terminal 4: Sensor ground



Sensor connector

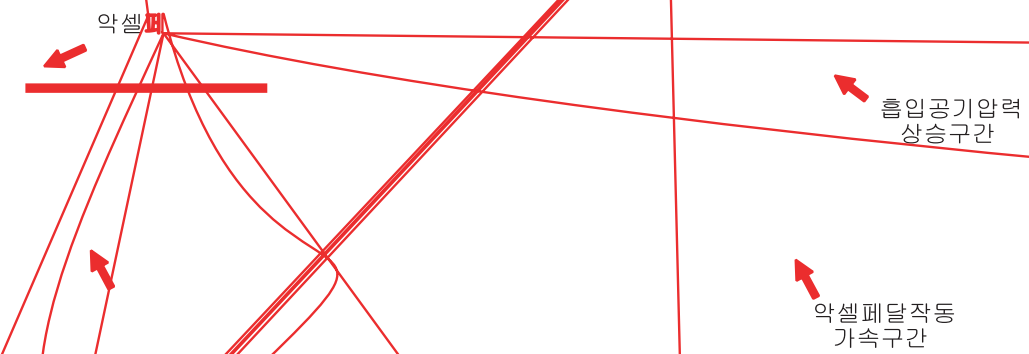
SUDFL8175L

SCHEMATIC DIAGRAM E2ACB307



SNBFL8079L

WAVEFORM AND DATA E53620AA



MONITOR SCAN TOOL DATA E16F7E1D

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Booster pressure Sensor" parameter on the scan tool.

NOTE

"Engine intake pressure" value changes according to vehicle operation condition. In case of fail safe. be sure to check output value of "Engine intake pressure" is the same when the values of "Atmospheric pressure/ fuel pressure" change.

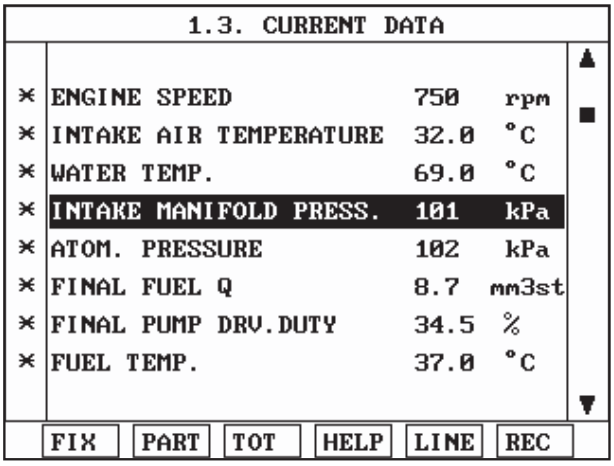


Fig. 1 "Engine intake pressure" data at idle

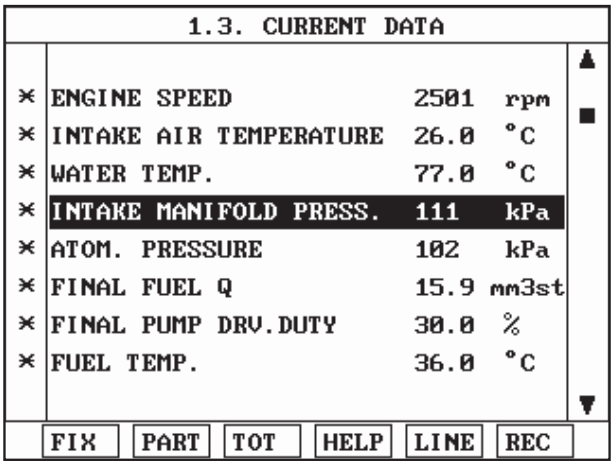


Fig. 2 "Engine intake pressure" data at 2,500rpm

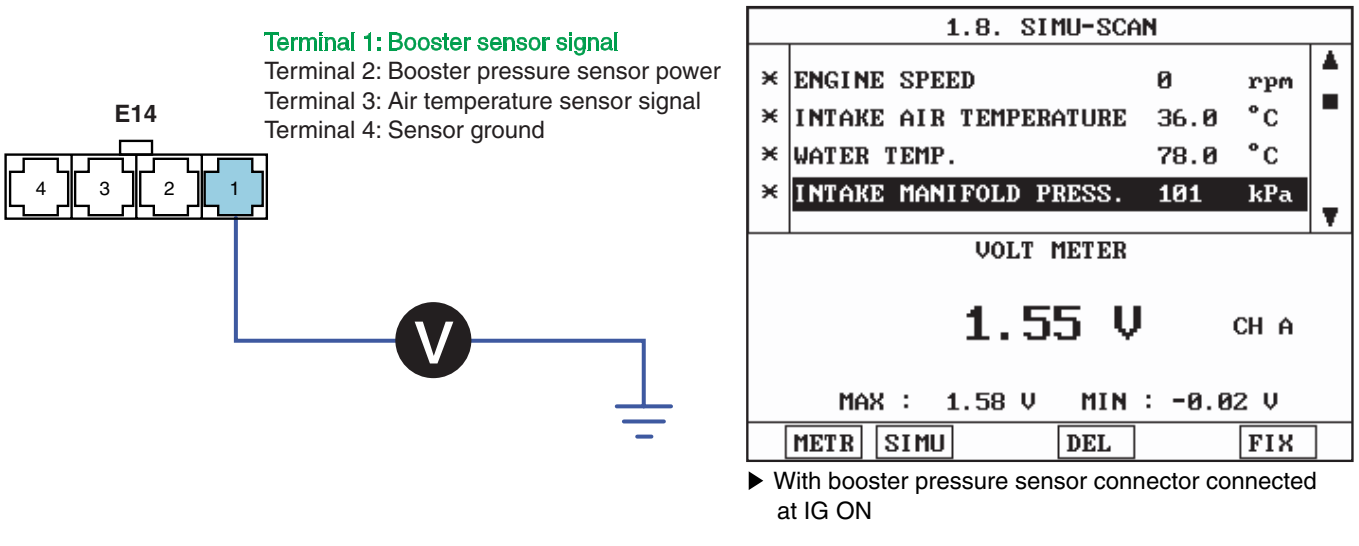
SUDFL8170L

TERMINAL & CONNECTOR INSPECTION E42CB543

Refer to DTC P0112.

SIGNAL CIRCUIT INSPECTION E8645715

1. Signal Voltage Inspection
   1) Leave the booster pressure sensor connector(E14) connected.
   2) Turn ignition ON. The engine stops.
   3) Measure voltage between terminal 1 of the booster pressure sensor harness connector and chassis ground.



▶ With booster pressure sensor connector connected at IG ON

SUDFL8171L

■ Specification: Booster pressure sensor signal power approx. 1.55V
Note) Voltage value differs according to booster pressure.

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

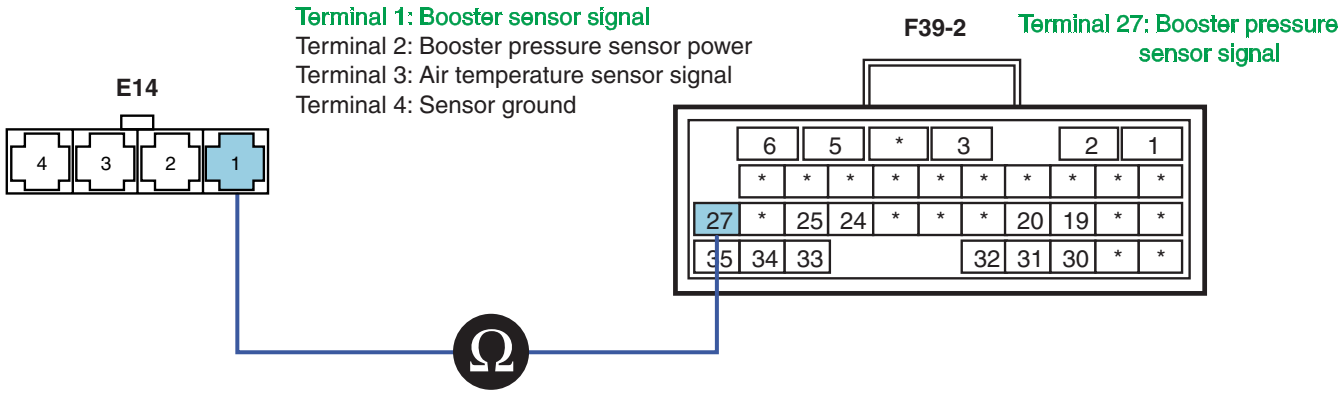
▶ Go to "Signal Open Inspection" procedure.

2. Signal Open Inspection

1) Turn the ignition OFF.

2) Disconnect the booster pressure sensor connector(E14) and the ECM connector(F39-2).

3) Measure resistance between terminal 1 of the booster pressure sensor harness connector and terminal 27 of ECM connector(F39-2).



SNBFL8077L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Power Inspection" procedure.

NO

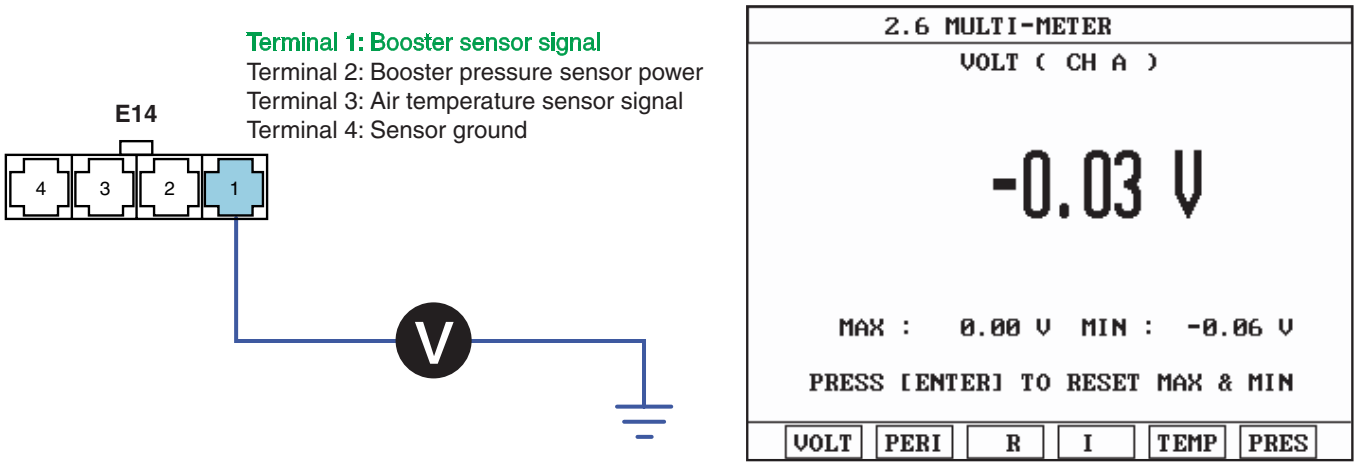
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Signal Short to Power Inspection

1) Disconnect the booster pressure sensor connector(E14) and ECM connector(F39-2).

2) Turn ignition ON. The engine stops.

3) Measure voltage between terminal 1 of the booster pressure sensor harness connector and chassis ground.



SUDFL8173L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

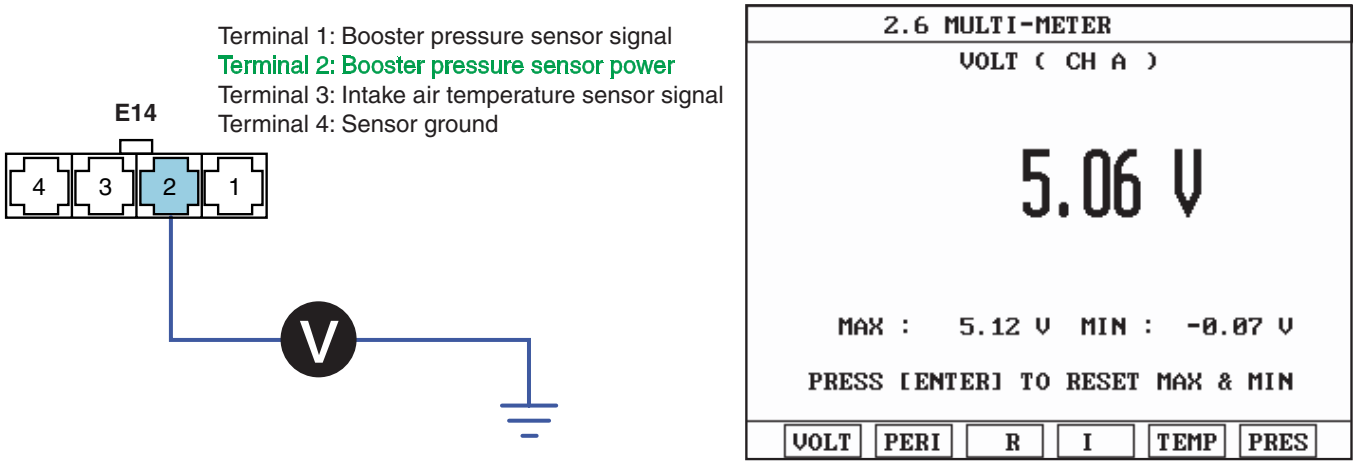
POWER SUPPLY INSPECTION E302783E

1. Power Supply Voltage Inspection

1) Disconnect the booster pressure sensor connector(E14).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 2 of booster pressure sensor harness connector and chassis ground.



SUDFL8027L

■ Specification: ECM output voltage approx. 5.16V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

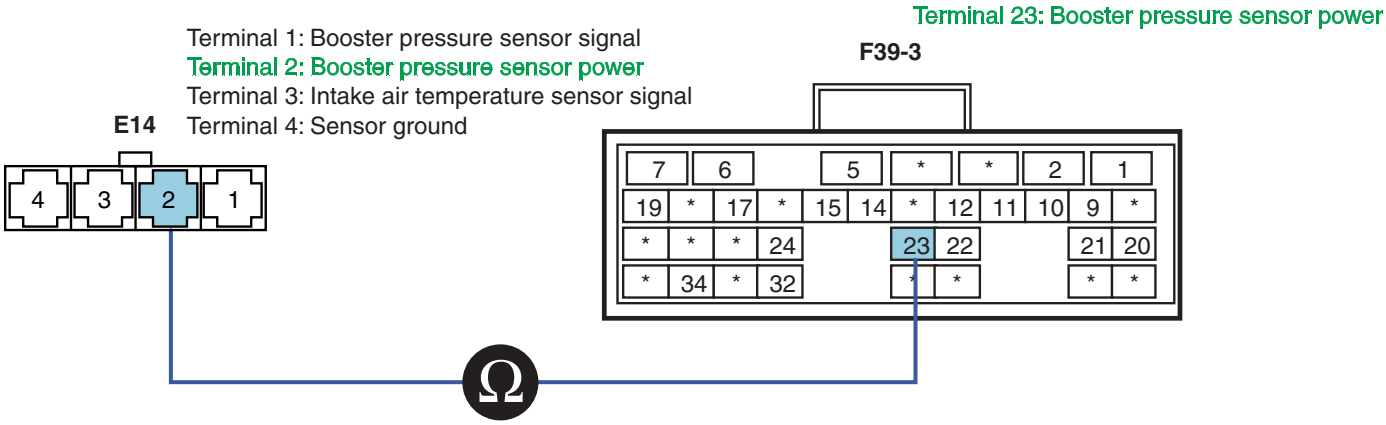
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn the ignition OFF.

2) Disconnect the booster pressure sensor connector(E14) and ECM connector(F39-3).

3) Measure resistance between terminal 2 of booster pressure sensor harness connector and terminal 23 of ECM connector(F39-3).



SNBFL8015L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

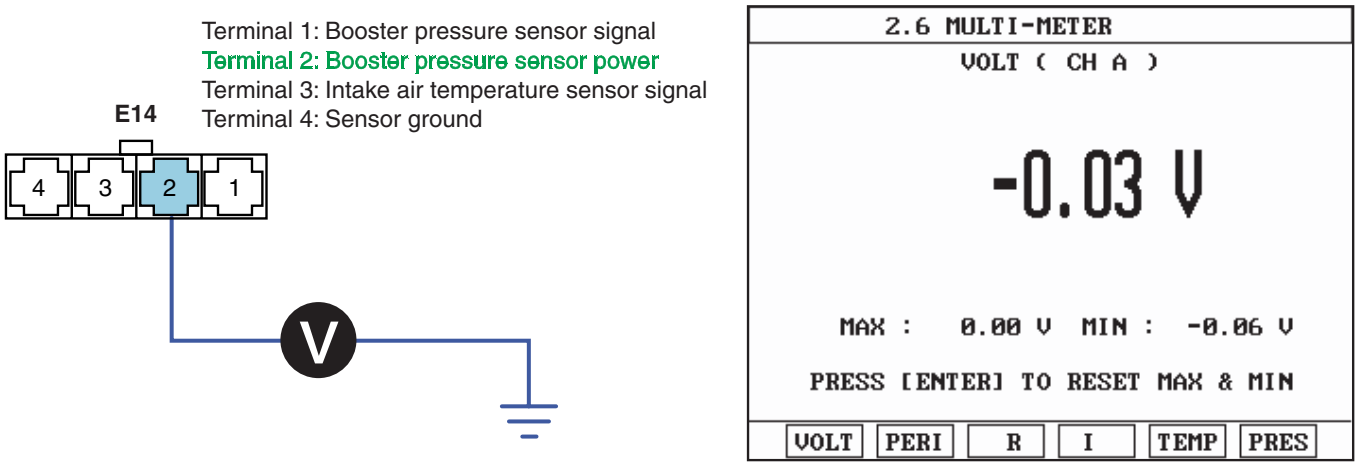
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Power Supply Short to Power Inspection

1) Disconnect booster pressure sensor connector(E14) and ECM connector(F39-3).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 2 of booster pressure sensor harness connector and chassis ground.



SUDFL8034L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

GROUND CIRCUIT INSPECTION EC85CACC

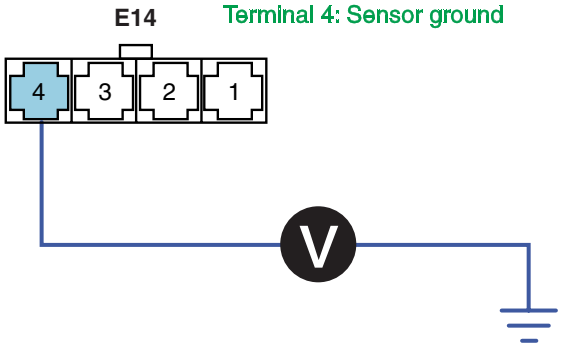
1. Ground Voltage Drop Inspection

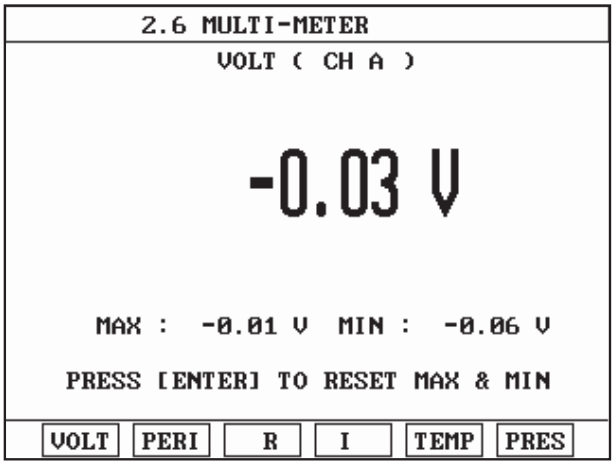
1) Disconnect booster pressure sensor connector(E14).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 4 of booster pressure sensor harness connector and chassis ground.

Terminal 1: Booster pressure sensor signal
Terminal 2: Booster pressure sensor power
Terminal 3: Intake air temperature sensor signal
Terminal 4: Sensor ground





SUDFL8030L

■ Specification: Ground voltage drop- within 200mV

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect booster pressure sensor connector(E14) and ECM connector(F39-3).

3) Measure resistance between terminal 4 of booster pressure sensor harness connector and terminal 20 of ECM connector(F39-3).

Terminal 1: Booster pressure sensor signal
Terminal 2: Booster pressure sensor power
Terminal 3: Intake air temperature sensor signal
Terminal 4: Sensor ground

F39-3

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EDF314DF

1. Booster Air Pressure Sensor Visual Inspection
   1) Turn the ignition OFF.
   2) Disconnect the booster pressure sensor connector(E14).
   3) Check terminal of the booster pressure sensor connector for corrosion, contamination.
   4) Check the booster pressure for torque and fuel leaks.
   5) Is there any problem for booster pressure sensor?

YES

▶ Replace the booster pressure sensor if necessary and then go to "Verification of Vehicle Repair" procedure.

NO

▶ Go to "Booster Pressure Sensor Waveform Inspection" procedure

2. Booster Pressure Sensor Waveform Inspection
   1) Turn the ignition OFF.
   2) Connect the booster pressure sensor connector(E14).
   3) Connect oscilloscope to terminal 1 of the booster pressure sensor connector(E14).
   4) Check waveform for at idle and at acceleration after starting the engine.
      Specification: Refer to "Basic waveform" item in general information.
   5) Is the waveform of the booster pressure sensor normal?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the booster pressure sensor and then go to "Verification of Vehicle Repair" procedure.

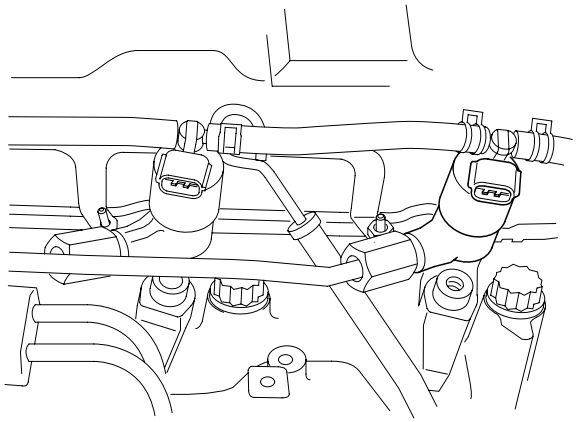
VERIFICATION OF VEHICLE REPAIR ED3EA829

Refer to DTC P0112.

DTC P0301 CYLINDER 1 MISFIRE DETECTED

COMPONENT LOCATION E413569F

Injector



SUDFL8098L

DESCRIPTION E1EA550C

1. GENERAL DESCRIPTION
   Injector carries out function to inject fuel amount calculated by ECM by making diesel spread with small particles to combustion chamber compressed with high pressure. Fuel injected generates power through combustion process.
   Purpose to increase fuel pressure of common rail diesel engine up to Max. 1,600 bar is to make fuel into small particles, small particles of fuel are related to smoke reduction, high power of engine, fuel consumption improvement etc.
   Also, hydraulic servo type is used to control fuel pressure of 1,600 bar with solenoid, injector solenoid is driven by current after increasing solenoid driving voltage up to 135V.
   Multi injection is possible by applying fuel injection which is not mechanic injector but electric control injector.
   ECM injects fuel after dividing into two stages of pilot injection and main injection and it is possible to control Injection time and injection amount independently to each cylinder. Power, torque, exhaust gas, fuel consumption improvement etc. can be optimized by controlling engine to optimum fuel injection amount.

2. DTC DESCRIPTION
   If cylinder balance control fuel amount is detected above 9mm³/st for 30,033.2ms or more, ECM judges this as a fault and DTC is set. The possible causes are open circuit of terminal 2 of ECM connector(F39-2), short to injector coil etc. Check that 9mm³/st or more are displayed by confirming final value of cylinder correction amount with a scan tool if there are DTCs in the ECM.
   Not only the engine is unstable at idle but also the there will be damaged to the engine if the engine is operated for a long time with the injector malfunctioned.

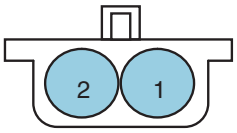
DTC DETECTING CONDITION EAE2F9B9

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Open in terminal 2 of ECM connector(F39-2) • Short to injector coil • Check the injector.
Enable Conditions	• Running			
Threshold Value	• Cylinder balance control fuel amount>9mm³/st or more			
Diagnosis Time	• 30,033.2ms or more			
Fail Safe	Fuel Cut	No	• Unstable at idle	
	Fuel Limit	No		
	MIL	OFF		

SPECIFICATION EEA459D4

Item	Specification
Resistance	0.45Ω (At 20˚C)
Injector driving voltage	135V
Injector driving current	20A
Injector control type	Current control

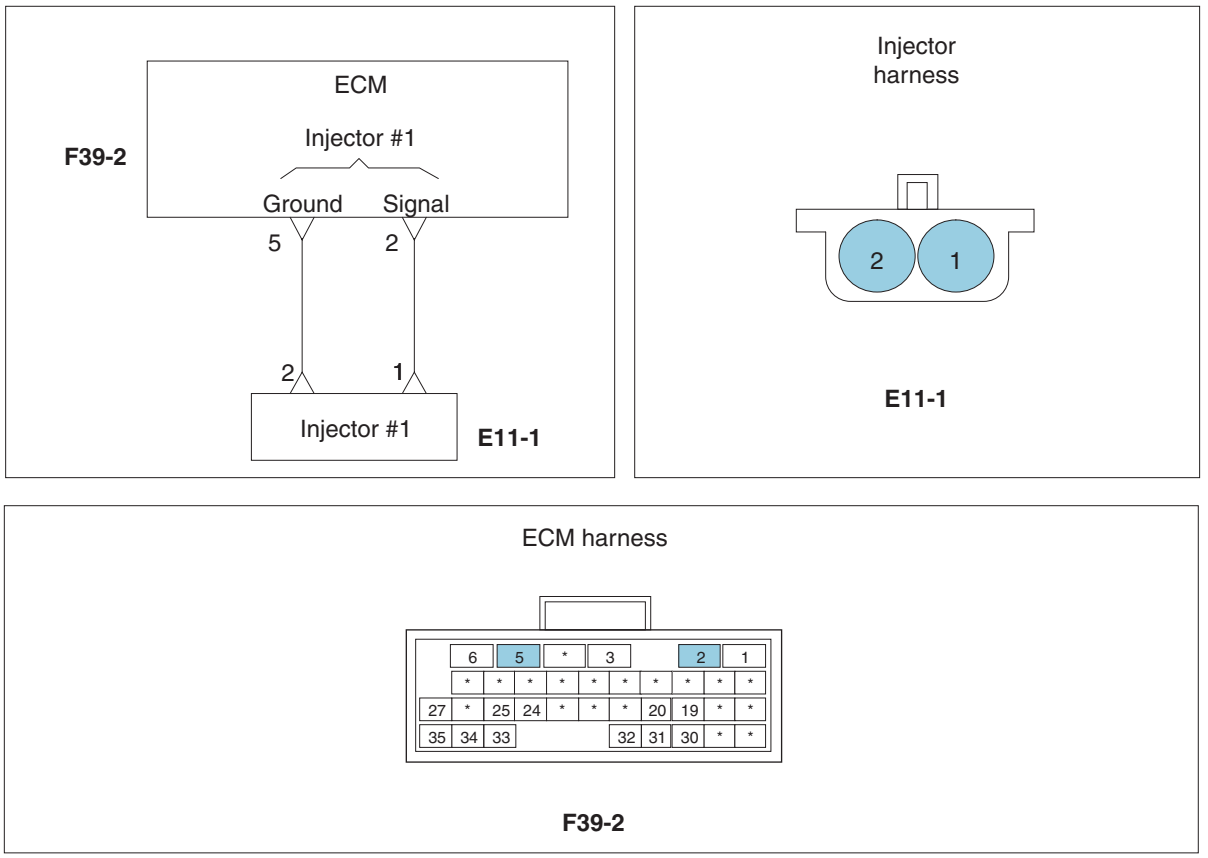
Terminal 1: Signal
Terminal 2: Ground



Sensor connector

SUDFL8099L

SCHEMATIC DIAGRAM EAAE92D5



SNBFL8045L

WAVEFORM AND DATA E090C3C4

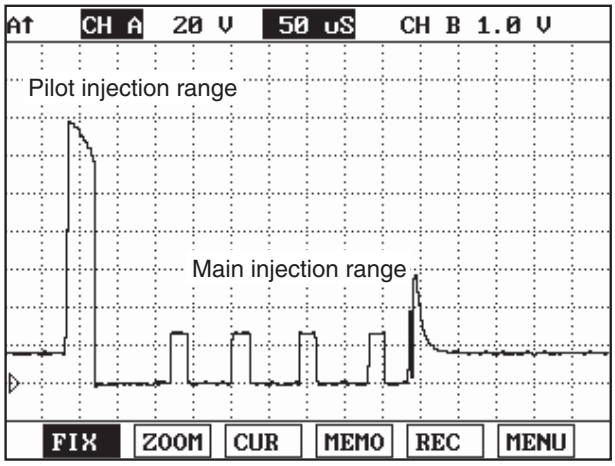


Fig. 1 Low side waveform when activating injector(Ground side)

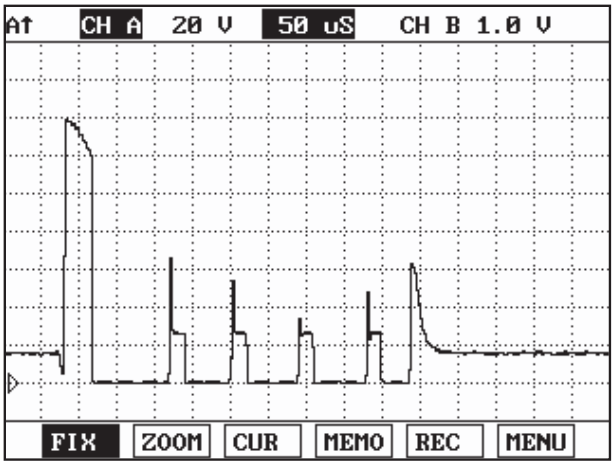


Fig. 2 High side injector power waveform(Signal side)

Fig.1) is divided into pilot injection range and main injection range as low side waveform when activating injector.
Fig.2) is high side injector power waveform.

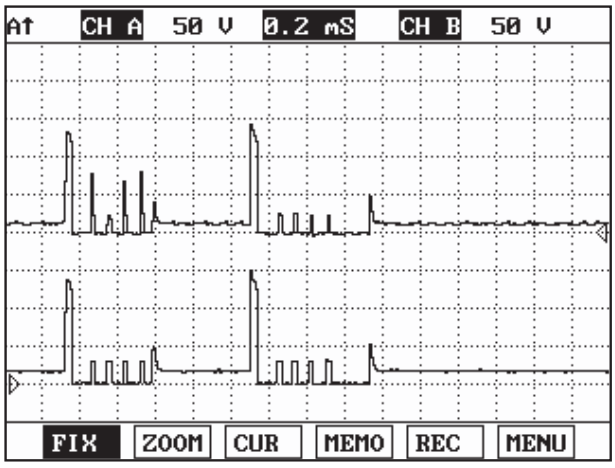


Fig. 3 Injector power waveform combined with High/Low side

SUDFL8101L

NOTE

Waveforms of Fig.1) and Fig.2) are displayed by turns in the course of checking injector waveform in LOW side. The reason that the waveform like a Fig.2) is displayed is used in LOW side in common the power of HIGH side of injector #1, #4 or injector #2, #3 which is not activated.

MONITOR SCAN TOOL DATA EBCFDE3F

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Fuel injection amount" parameter on the scan tool.

■ Specification: Fuel amount - Approx. 9.0~10.5 mm³/st at idle

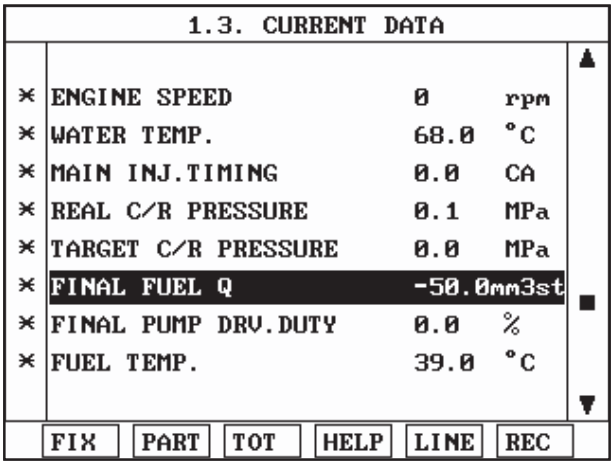


Fig. 1 Fuel injection amount data at ignition ON

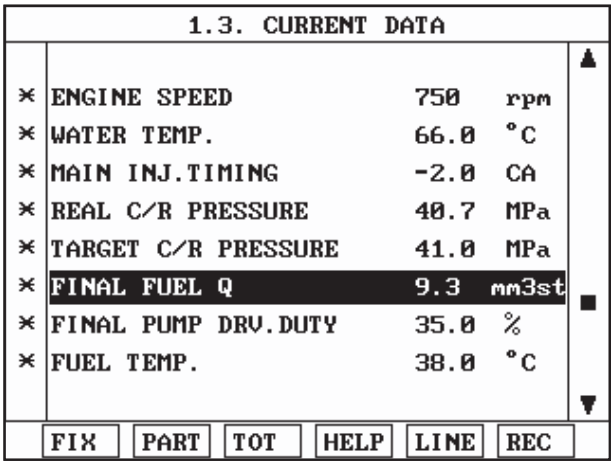


Fig. 2 Fuel injection amount data at idle

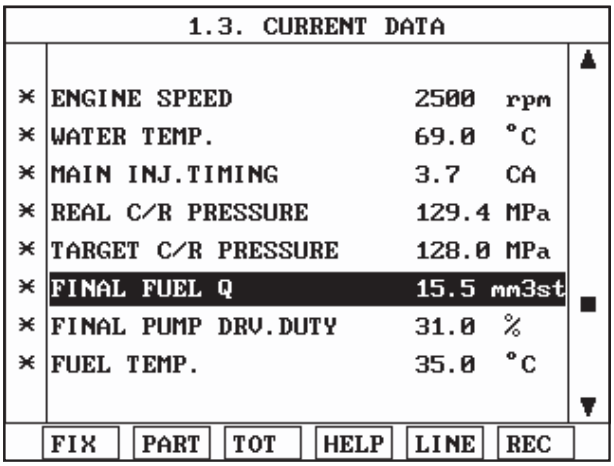


Fig. 3 Fuel injection amount data at 2,500rpm

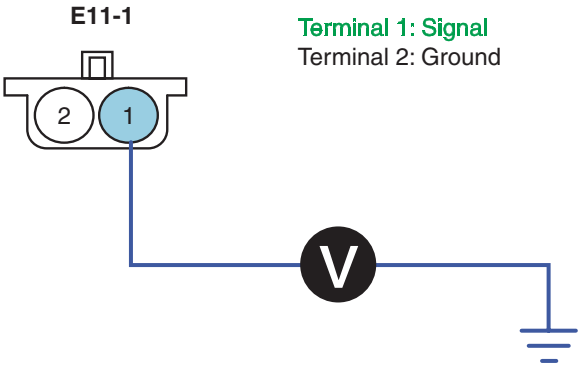
SUDFL8102L

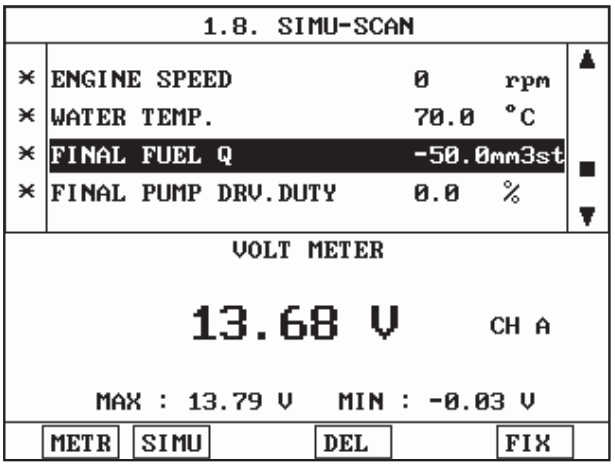
TERMINAL & CONNECTOR INSPECTION E1FFAE34

Refer to DTC P0112.

POWER SUPPLY INSPECTION E316553C

1. Power Supply Voltage Inspection
   1) Leave injector #1 connector(E11-1) connected.
   2) Turn the ignition ON. The engine stops.
   3) Measure voltage between terminal 1 of the injector #1 and chassis ground.





▶ With injector #1 connector disconnected/connected (At IG ON)

SUDFL8178L

■ Specification: Injector #1 signal power approx. 13.57 V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

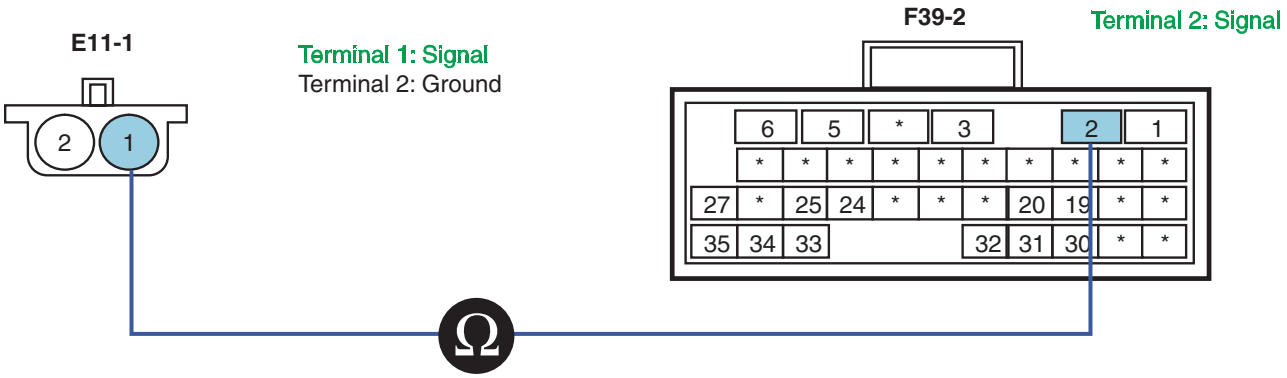
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn the ignition OFF.

2) Disconnect injector #1 connector(E11-1) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of injector #1 harness connector(E11-1) and terminal 2 of ECM connector(F39-2).



SNBFL8080L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

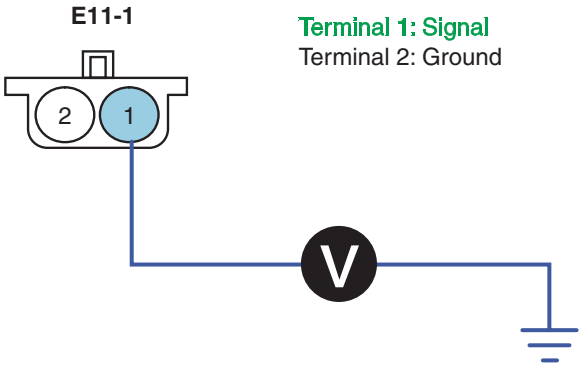
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

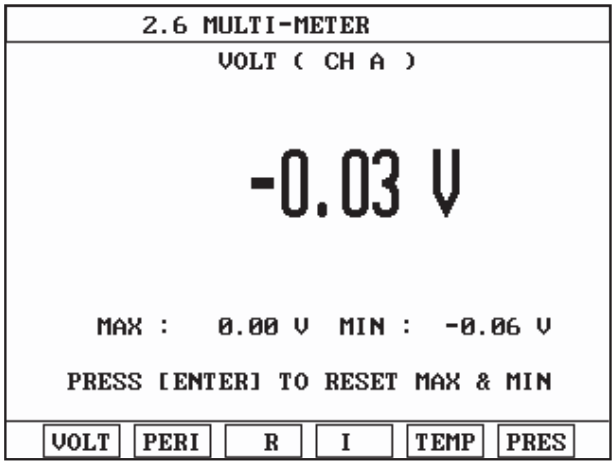
3. Power Supply Short to Power Inspection

1) Disconnect injector #1 connector(E11-1) and ECM connector(F39-2).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of injector #1 harness connector(E11-1) and chassis ground.





SUDFL8180L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

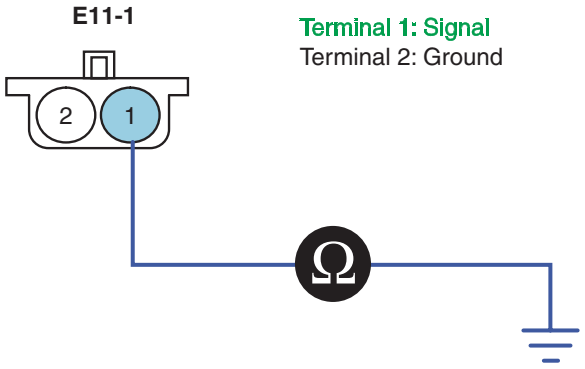
▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

4. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect injector #1 connector(E11-1) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of injector #1 harness connector(E11-1) and chassis ground.



SUDFL8181L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

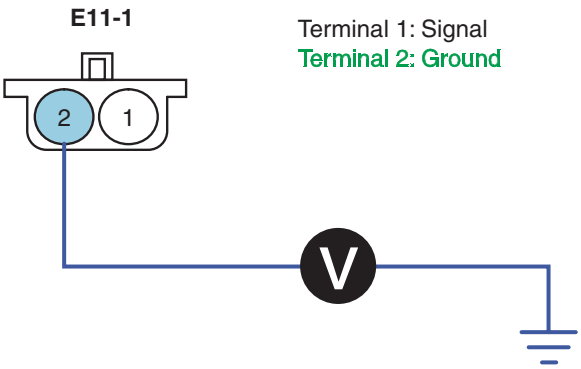
GROUND CIRCUIT INSPECTION E50FB6B5

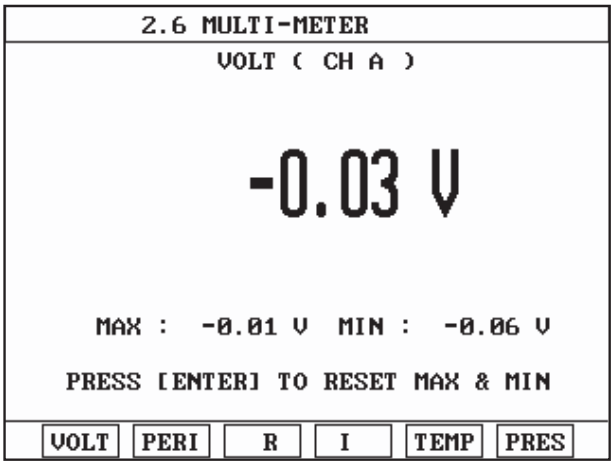
1. Ground Voltage Drop Inspection

1) Disconnect injector #1 connector(E11-1).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 2 of injector #1 harness connector(E11-1) and chassis ground.





SUDFL8182L

■ Specification: Ground voltage drop-Within 200mV

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

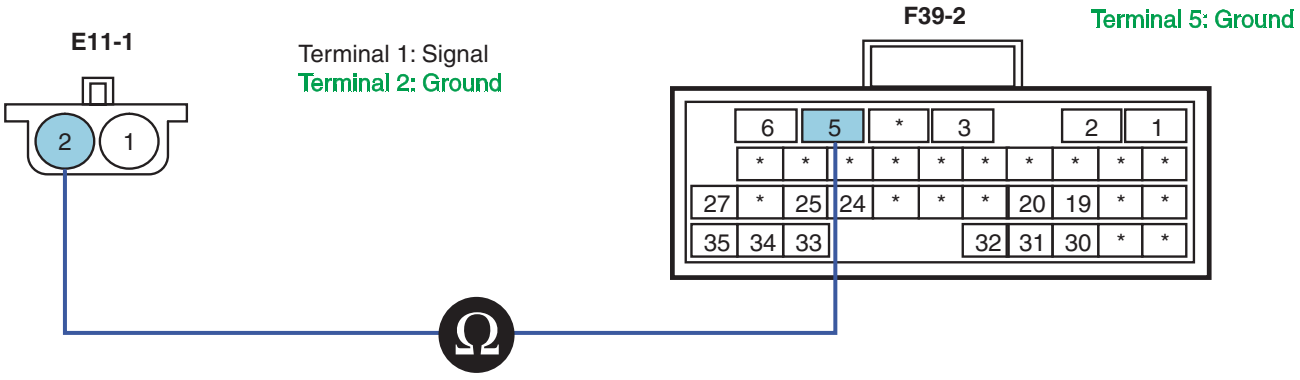
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect injector #1 connector(E11-1) and ECM connector(F39-2).

3) Measure resistance between terminal 2 of injector #1 harness connector(E11-1) and terminal 5 of ECM connector(F39-2).



SNBFL8081L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

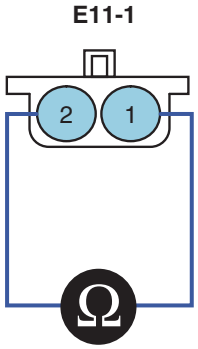
COMPONENT INSPECTION E7996879

1. Injector Component Inspection

1) Turn ignition OFF.

2) Disconnect injector#1 connector(E11-1).

3) Measure resistance between terminals 1 and 2 of injector#1 connector.



Terminal 1: Signal
Terminal 2: Ground

■ Specification

Item	Specification
Resistance	0.45Ω(At 20˚C)

SUDFL8184L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the injector and then go to "Verification of Vehicle Repair" procedure.

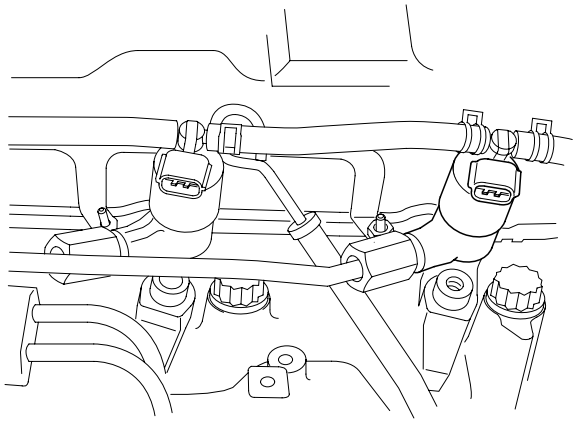
VERIFICATION OF VEHICLE REPAIR E2C7DF24

Refer to DTC P0112.

DTC P0302 CYLINDER 2 MISFIRE DETECTED

COMPONENT LOCATION E85288E7

Injector



SUDFL8098L

DESCRIPTION EBDEEFBA

1. GENERAL DESCRIPTION
   Injector carries out function to inject fuel amount calculated by ECM by making diesel spread with small particles to combustion chamber compressed with high pressure. Fuel injected generates power through combustion process.
   Purpose to increase fuel pressure of common rail diesel engine up to Max. 1,600 bar is to make fuel into small particles, small particles of fuel are related to smoke reduction, high power of engine, fuel consumption improvement etc.
   Also, hydraulic servo type is used to control fuel pressure of 1,600 bar with solenoid, injector solenoid is driven by current after increasing solenoid driving voltage up to 135V.
   Multi injection is possible by applying fuel injection which is not mechanic injector but electric control injector.
   ECM injects fuel after dividing into two stages of pilot injection and main injection and it is possible to control Injection time and injection amount independently to each cylinder. Power, torque, exhaust gas, fuel consumption improvement etc. can be optimized by controlling engine to optimum fuel injection amount.

2. DTC DESCRIPTION
   If cylinder balance control fuel amount is detected above 9mm³/st for 30,033.2ms or more, ECM judges this as a fault and DTC is set. The possible causes are open circuit of terminal 2 of ECM connector(F39-2), short to injector coil etc. Check that 9mm³/st or more are displayed by confirming final value of cylinder correction amount with a scan tool if there are DTCs in the ECM.
   Not only the engine is unstable at idle but also the there will be damaged to the engine if the engine is operated for a long time with the injector malfunctioned.

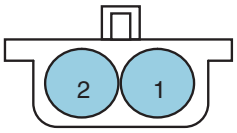
DTC DETECTING CONDITION E3F502A4

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Open in terminal 2 of ECM connector(F39-2) • Short to injector coil • Check the injector.
Enable Conditions	• Running			
Threshold Value	• Cylinder balance control fuel amount>9mm³/st or more			
Diagnosis Time	• 30,033.2ms or more			
Fail Safe	Fuel Cut	No	• Unstable at idle	
	Fuel Limit	No		
	MIL	OFF		

SPECIFICATION EC915485

Item	Specification
Resistance	0.45Ω (At 20˚C)
Injector driving voltage	135V
Injector driving current	20A
Injector control type	Current control

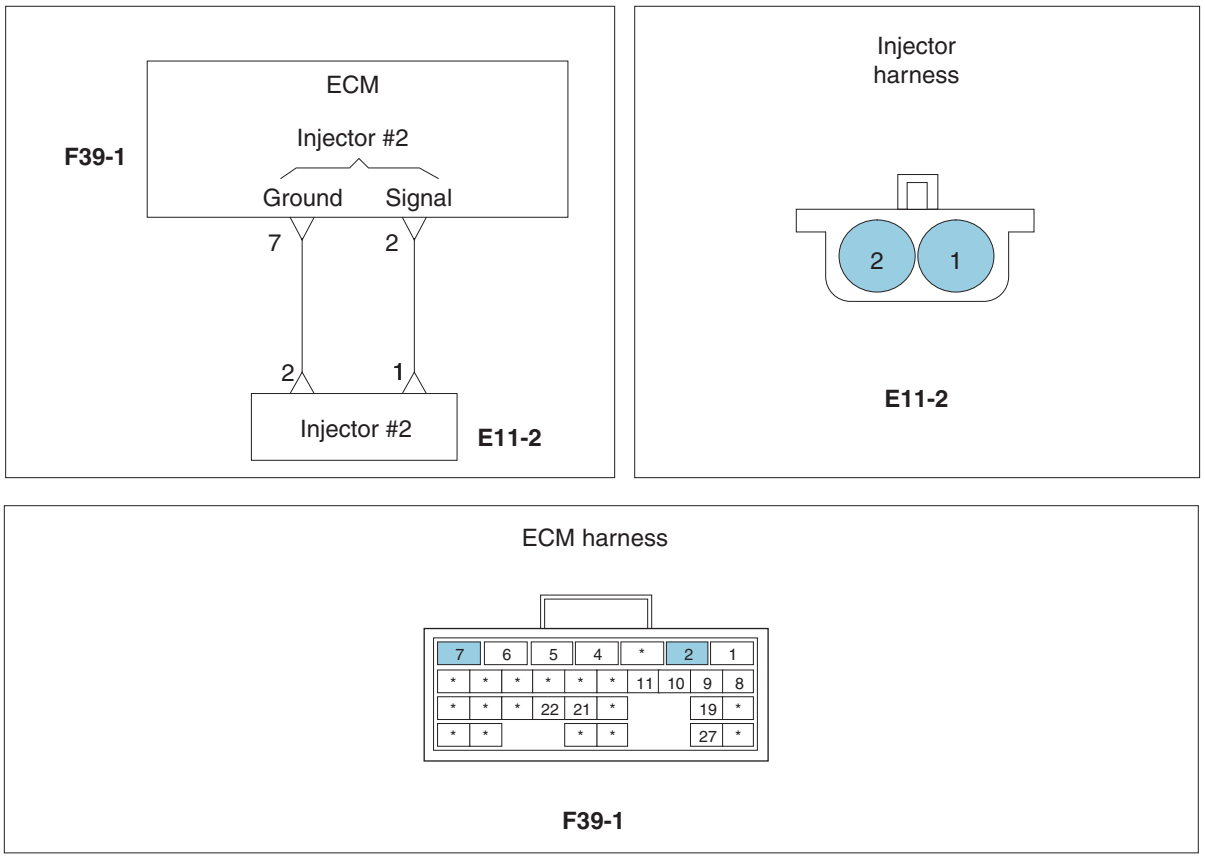
Terminal 1: Signal
Terminal 2: Ground



Sensor connector

SUDFL8099L

SCHEMATIC DIAGRAM E893017F



SNBFL8048L

WAVEFORM AND DATA EA46DBF2

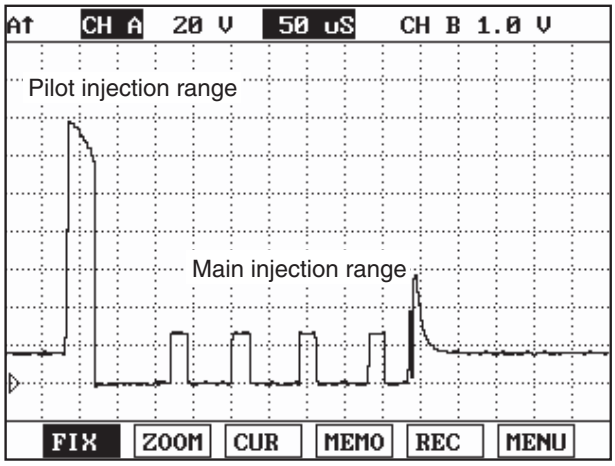


Fig. 1 Low side waveform when activating injector(Ground side)

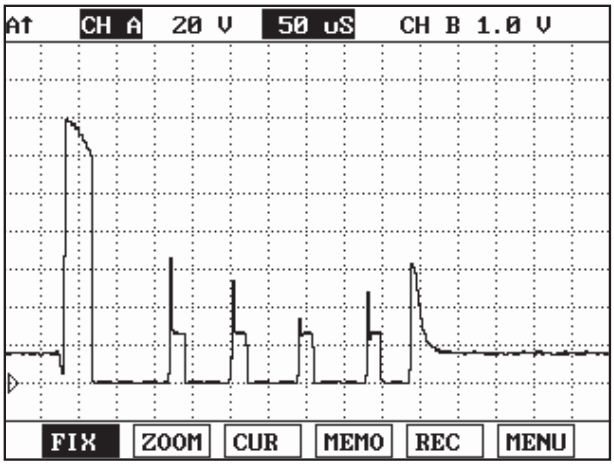


Fig. 2 High side injector power waveform(Signal side)

Fig.1) is divided into pilot injection range and main injection range as low side waveform when activating injector.
Fig.2) is high side injector power waveform.

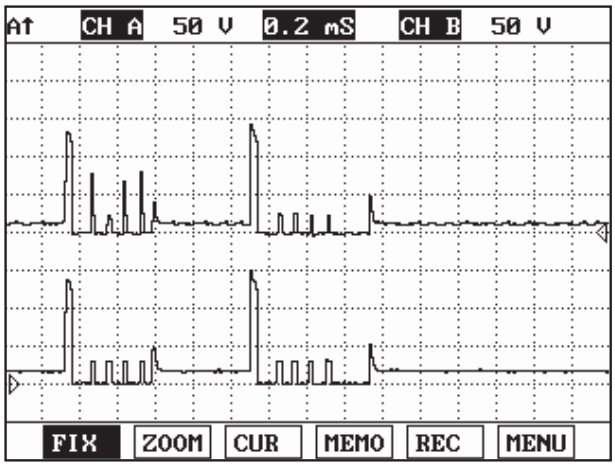


Fig. 3 Injector power waveform combined with High/Low side

SUDFL8101L

NOTE

Waveforms of Fig.1) and Fig.2) are displayed by turns in the course of checking injector waveform in LOW side. The reason that the waveform like a Fig.2) is displayed is used in LOW side in common the power of HIGH side of injector #1, #4 or injector #2, #3 which is not activated.

MONITOR SCAN TOOL DATA EC9D8426

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Fuel injection amount" parameter on the scan tool.

■ Specification: Fuel amount - Approx. 9.0~10.5 mm³/st at idle

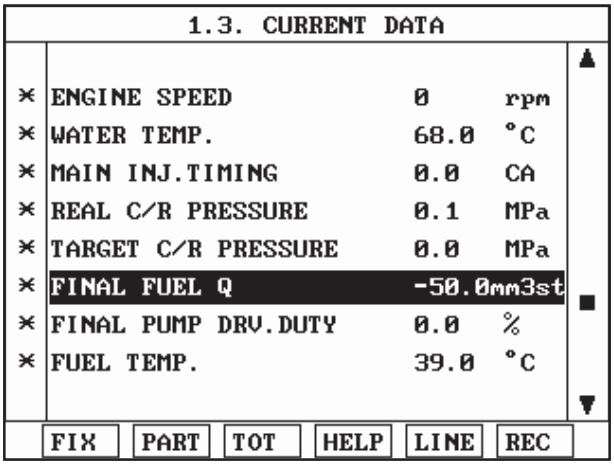


Fig. 1 Fuel injection amount data at ignition ON

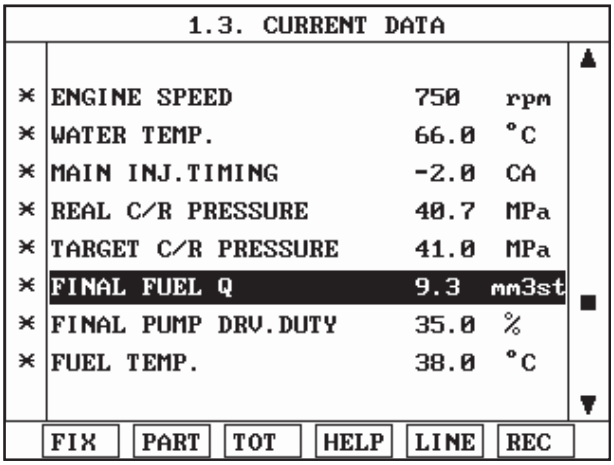


Fig. 2 Fuel injection amount data at idle

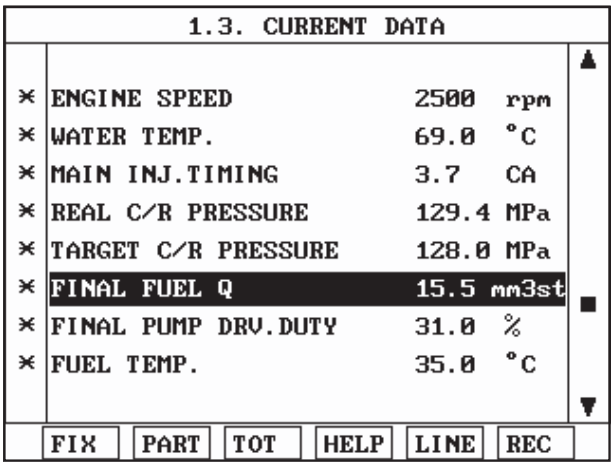


Fig. 3 Fuel injection amount data at 2,500rpm

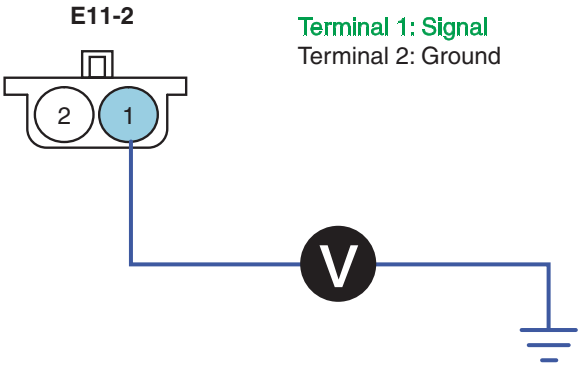
SUDFL8102L

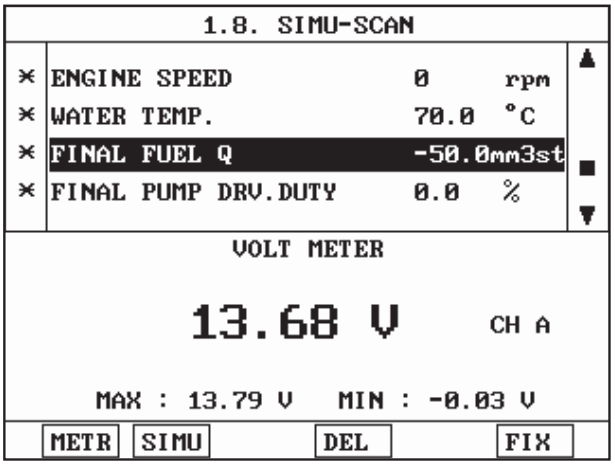
TERMINAL & CONNECTOR INSPECTION E5623B8D

Refer to DTC P0112.

POWER SUPPLY INSPECTION EA71E5AA

1. Power Supply Voltage Inspection
   1) Leave injector #2 connector(E11-2) connected.
   2) Turn the ignition ON. The engine stops.
   3) Measure voltage between terminal 1 of the injector #2 and chassis ground.





▶ With injector #2 connector disconnected/connected (At IG ON)

SUDFL8185L

■ Specification: Injector #2 signal power approx. 13.57 V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

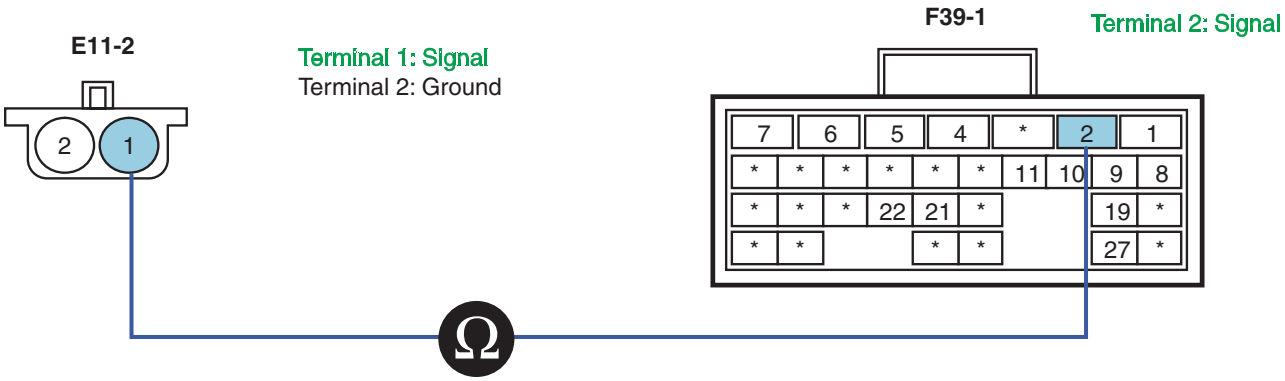
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn the ignition OFF.

2) Disconnect injector #2 connector(E11-2) and ECM connector(F39-1).

3) Measure resistance between terminal 1 of injector #2 harness connector and terminal 2 of ECM connector(F39-1).



SNBFL8082L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

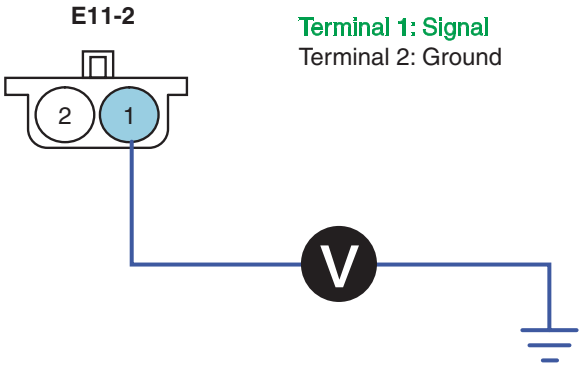
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

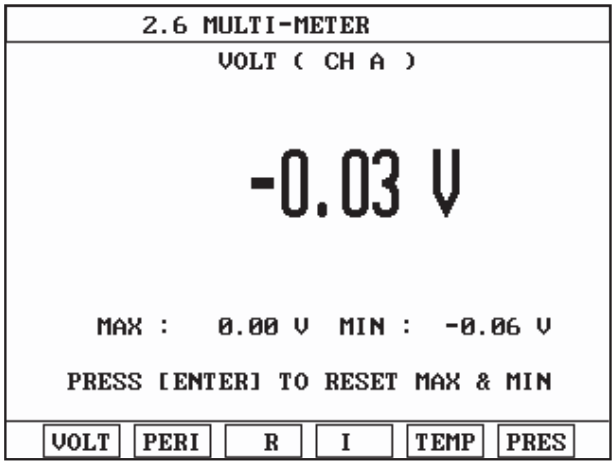
3. Power Supply Short to Power Inspection

1) Disconnect injector #2 connector(E11-2) and ECM connector(F39-1).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of injector #2 harness connector(E11-2) and chassis ground.





SUDFL8187L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

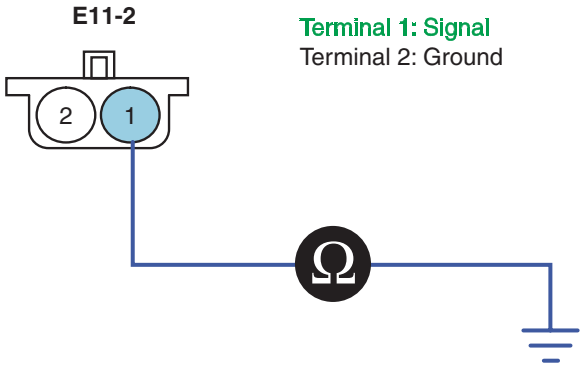
▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

4. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect injector #2 connector(E11-2) and ECM connector(F39-1).

3) Measure resistance between terminal 1 of injector #2 harness connector(E11-2) and chassis ground.



SUDFL8188L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

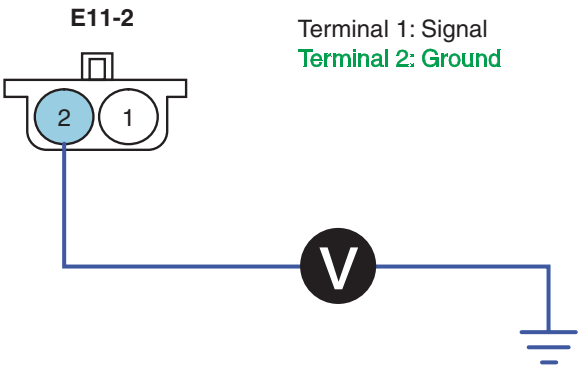
GROUND CIRCUIT INSPECTION EF89896C

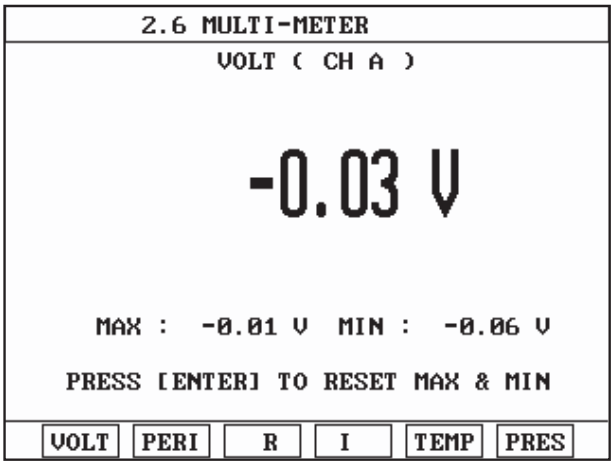
1. Ground Voltage Drop Inspection

1) Disconnect injector #2 connector(E11-2).

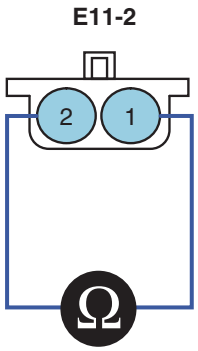
2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 2 of injector #2 harness connector(E11-2) and chassis ground.





SUDFL8189L



Terminal 1: Signal
Terminal 2: Ground

■ Specification

Item	Specification
Resistance	0.45Ω(At 20˚C)

SUDFL8191L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the injector and then go to "Verification of Vehicle Repair" procedure.

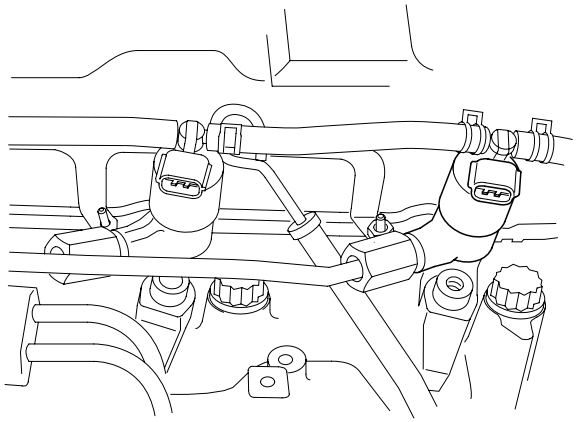
VERIFICATION OF VEHICLE REPAIR E823C796

Refer to DTC P0112.

DTC P0303 CYLINDER 3 MISFIRE DETECTED

COMPONENT LOCATION E132B17A

Injector



SUDFL8098L

DESCRIPTION EDADA5BD

1. GENERAL DESCRIPTION
   Injector carries out function to inject fuel amount calculated by ECM by making diesel spread with small particles to combustion chamber compressed with high pressure. Fuel injected generates power through combustion process.
   Purpose to increase fuel pressure of common rail diesel engine up to Max. 1,600 bar is to make fuel into small particles, small particles of fuel are related to smoke reduction, high power of engine, fuel consumption improvement etc.
   Also, hydraulic servo type is used to control fuel pressure of 1,600 bar with solenoid, injector solenoid is driven by current after increasing solenoid driving voltage up to 135V.
   Multi injection is possible by applying fuel injection which is not mechanic injector but electric control injector.
   ECM injects fuel after dividing into two stages of pilot injection and main injection and it is possible to control Injection time and injection amount independently to each cylinder. Power, torque, exhaust gas, fuel consumption improvement etc. can be optimized by controlling engine to optimum fuel injection amount.

2. DTC DESCRIPTION
   If cylinder balance control fuel amount is detected above 9mm³/st for 30,033.2ms or more, ECM judges this as a fault and DTC is set. The possible causes are open circuit of terminal 1 of ECM connector(F39-1), short to injector coil etc. Check that 9mm³/st or more are displayed by confirming final value of cylinder correction amount with a scan tool if there are DTCs in the ECM.
   Not only the engine is unstable at idle but also the there will be damaged to the engine if the engine is operated for a long time with the injector malfunctioned.

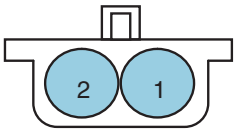
DTC DETECTING CONDITION E6C3490B

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Open in terminal 1 of ECM connector(F39-1) • Short to injector coil • Check the injector.
Enable Conditions	• Running			
Threshold Value	• Cylinder balance control fuel amount>9mm³/st or more			
Diagnosis Time	• 30,033.2ms or more			
Fail Safe	Fuel Cut	No	• Unstable at idle	
	Fuel Limit	No		
	MIL	OFF		

SPECIFICATION ED27A6B3

Item	Specification
Resistance	0.45Ω (At 20˚C)
Injector driving voltage	135V
Injector driving current	20A
Injector control type	Current control

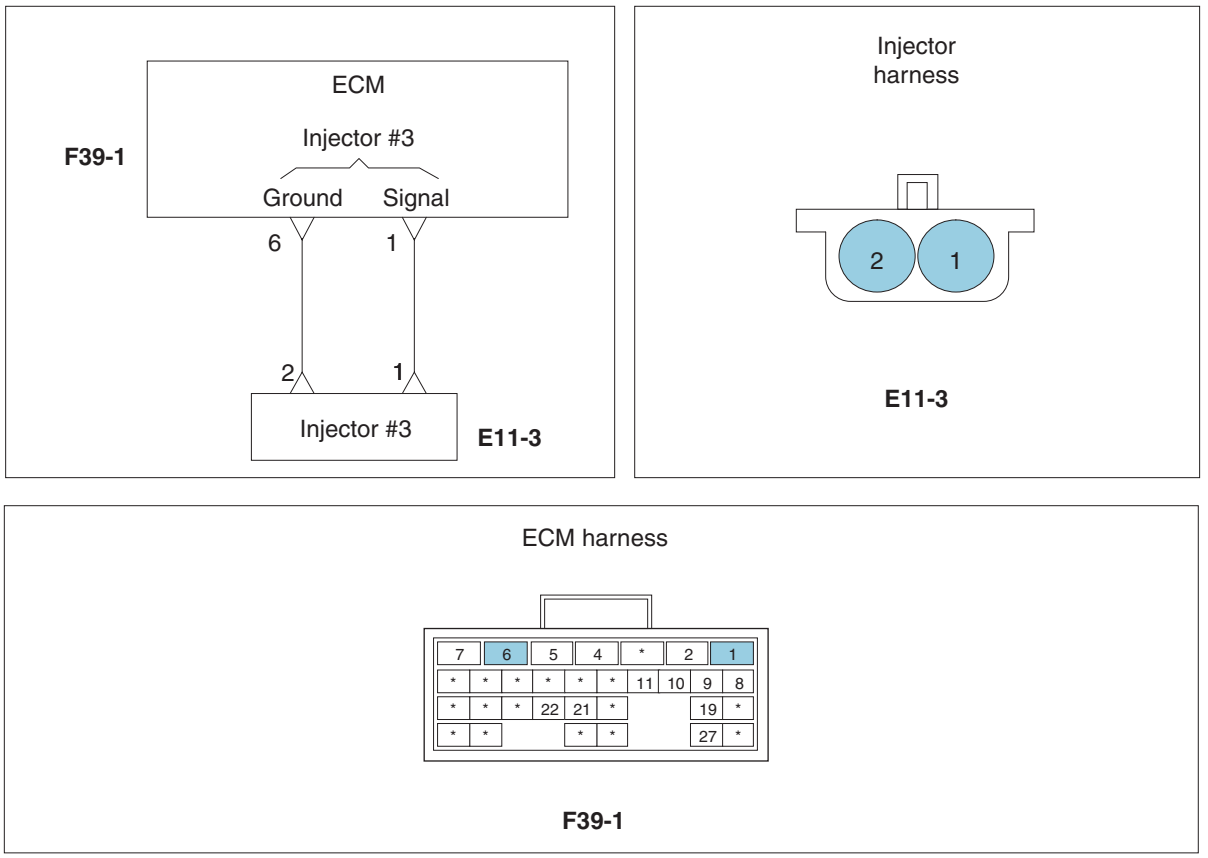
Terminal 1: Signal
Terminal 2: Ground



Sensor connector

SUDFL8099L

SCHEMATIC DIAGRAM EE6EC1BB



SNBFL8051L

WAVEFORM AND DATA E5239155

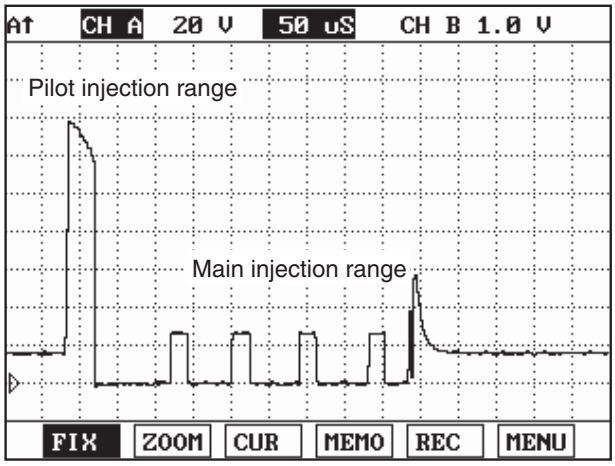


Fig. 1 Low side waveform when activating injector(Ground side)

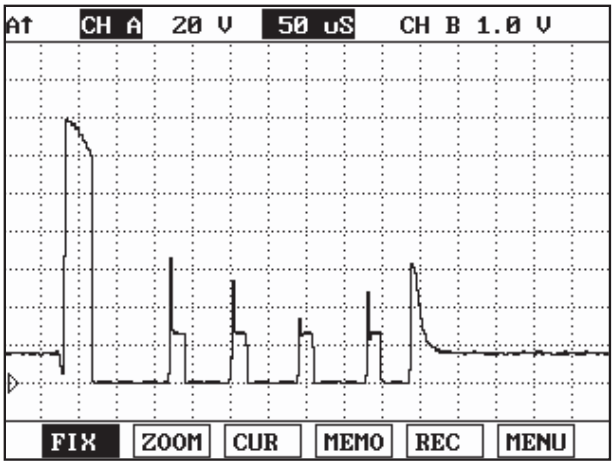


Fig. 2 High side injector power waveform(Signal side)

Fig.1) is divided into pilot injection range and main injection range as low side waveform when activating injector.
Fig.2) is high side injector power waveform.

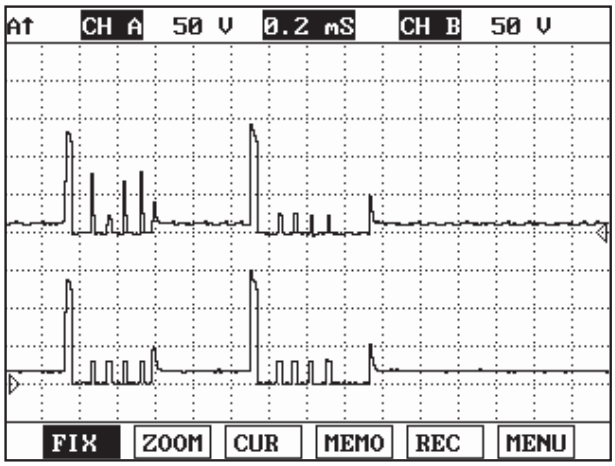


Fig. 3 Injector power waveform combined with High/Low side

SUDFL8101L

NOTE

Waveforms of Fig.1) and Fig.2) are displayed by turns in the course of checking injector waveform in LOW side. The reason that the waveform like a Fig.2) is displayed is used in LOW side in common the power of HIGH side of injector #1, #4 or injector #2, #3 which is not activated.

MONITOR SCAN TOOL DATA E14432E3

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Fuel injection amount" parameter on the scan tool.

■ Specification: Fuel amount - Approx. 9.0~10.5 mm³/st at idle

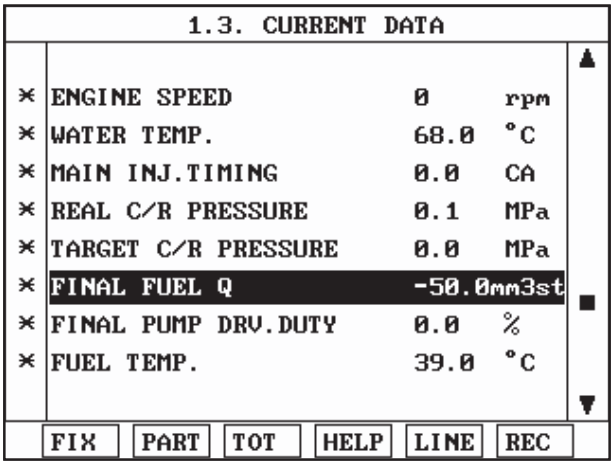


Fig. 1 Fuel injection amount data at ignition ON

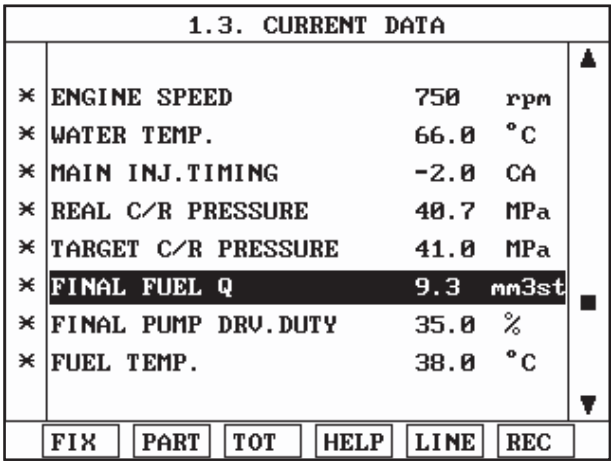


Fig. 2 Fuel injection amount data at idle

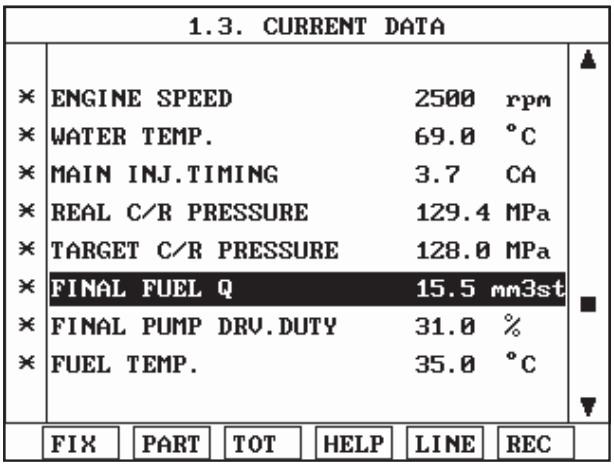


Fig. 3 Fuel injection amount data at 2,500rpm

SUDFL8102L

TERMINAL & CONNECTOR INSPECTION E68AEEE5

Refer to DTC P0112.

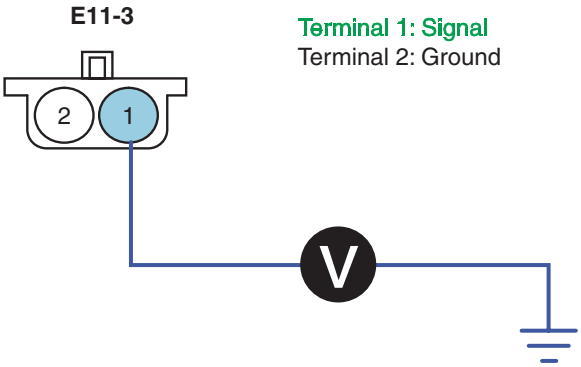
POWER SUPPLY INSPECTION E9B58494

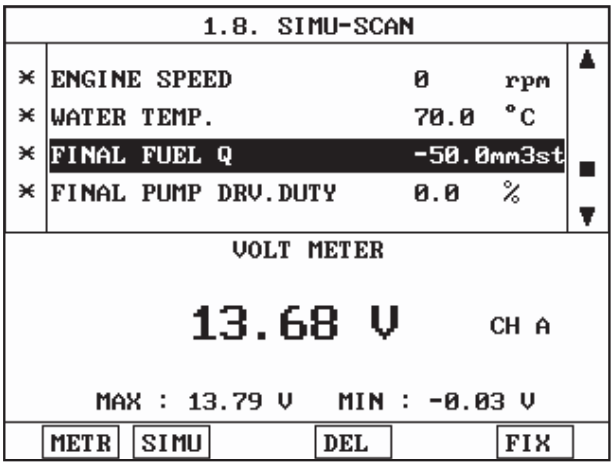
1. Power Supply Voltage Inspection

   1) Leave injector #3 connector(E11-3) connected.

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 1 of the injector #3 and chassis ground.





▶ With injector #3 connector disconnected/connected (At IG ON)

SUDFL8192L

■ Specification: Injector #3 signal power approx. 13.57 V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

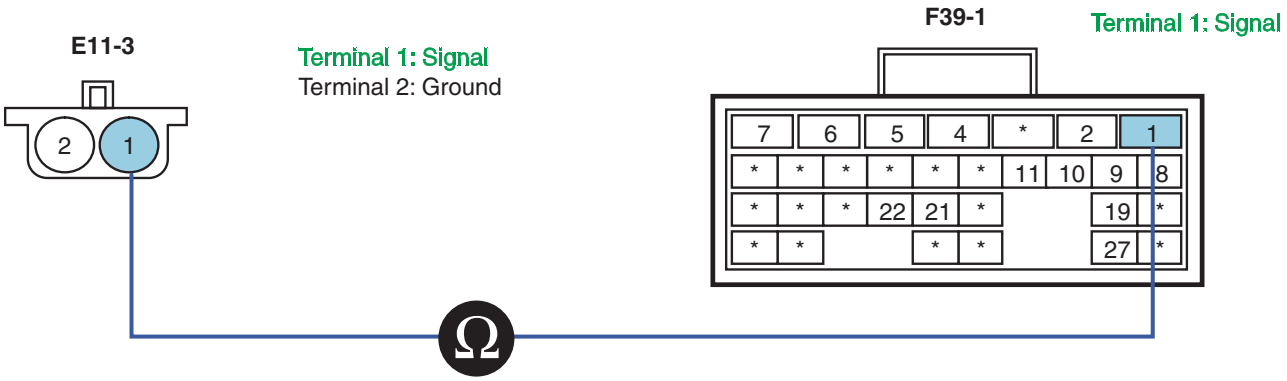
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn the ignition OFF.

2) Disconnect injector #3 connector(E11-3) and ECM connector(F39-1).

3) Measure resistance between terminal 1 of injector #3 harness connector(E11-3) and terminal 1 of ECM connector(F39-1).



SNBFL8084L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

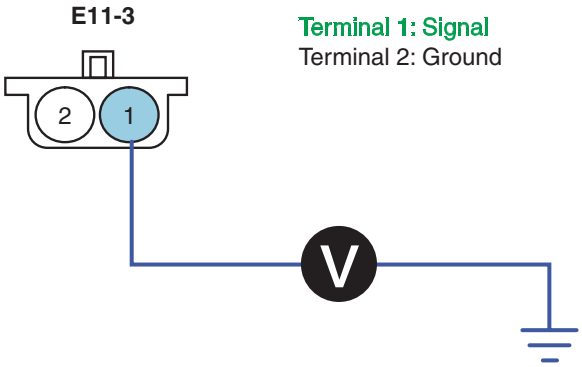
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

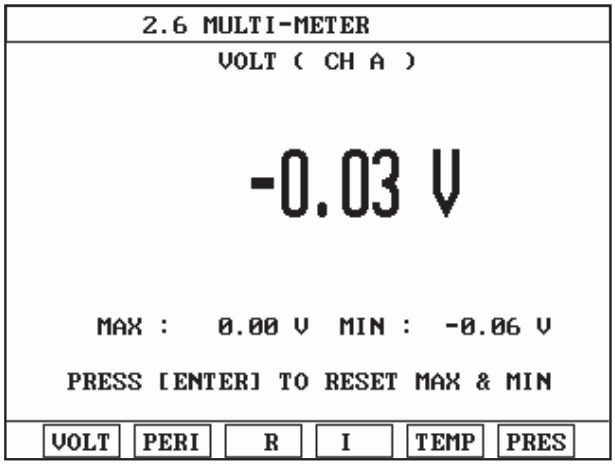
3. Power Supply Short to Power Inspection

1) Disconnect injector #3 connector(E11-3) and ECM connector(F39-1).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of injector #3 harness connector(E11-3) and chassis ground.





SUDFL8194L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

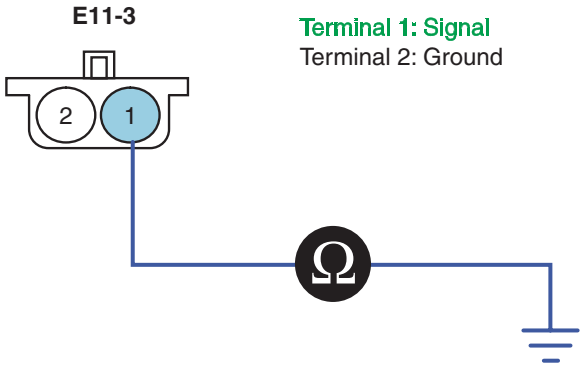
▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

4. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect injector #3 connector(E11-3) and ECM connector(F39-1).

3) Measure resistance between terminal 1 of injector #3 harness connector(E11-3) and chassis ground.



SUDFL8195L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

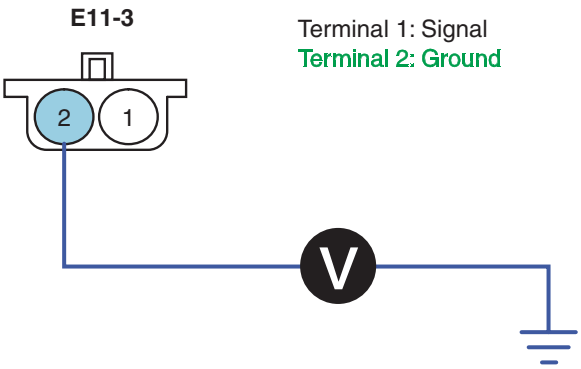
GROUND CIRCUIT INSPECTION E589C6DD

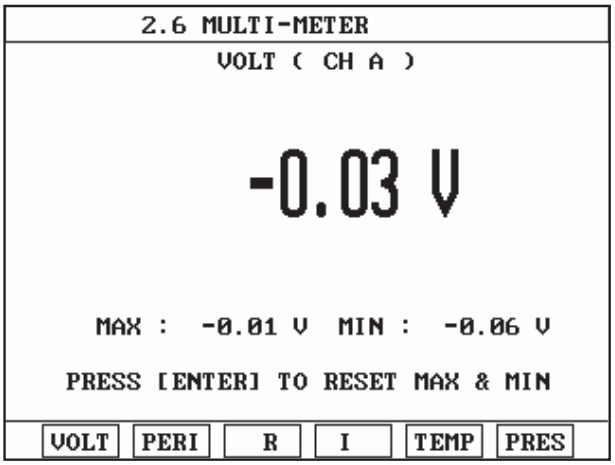
1. Ground Voltage Drop Inspection

1) Disconnect injector #3 connector(E11-3).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 2 of injector #3 harness connector(E11-3) and chassis ground.





SUDFL8196L

■ Specification: Ground voltage drop-Within 200mV

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

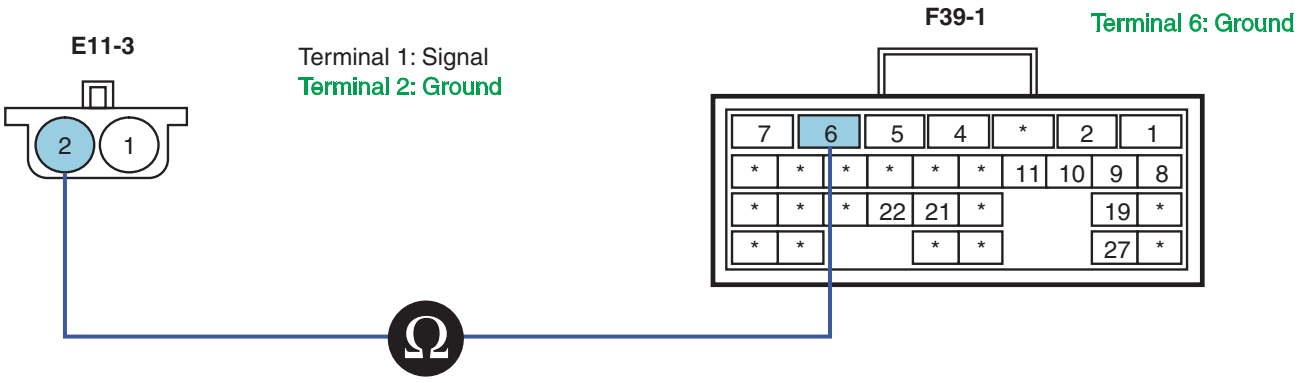
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect injector #3 connector(E11-3) and ECM connector(F39-1).

3) Measure resistance between terminal 2 of injector #3 harness connector(E11-3) and terminal 6 of ECM connector(F39-1).



SNBFL8085L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

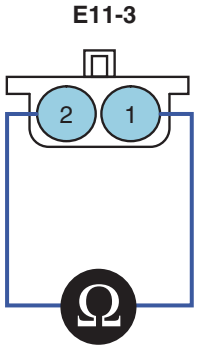
COMPONENT INSPECTION E745A0B9

1. Injector Component Inspection

1) Turn ignition OFF.

2) Disconnect injector#3 connector(E11-3).

3) Measure resistance between terminals 1 and 2 of injector#3 connector.



Terminal 1: Signal
Terminal 2: Ground

■ Specification

Item	Specification
Resistance	0.45Ω(At 20˚C)

SUDFL8198L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the injector and then go to "Verification of Vehicle Repair" procedure.

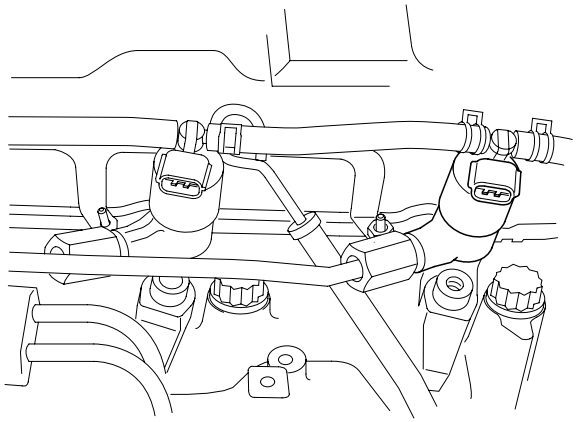
VERIFICATION OF VEHICLE REPAIR E66D6ECA

Refer to DTC P0112.

DTC P0304 CYLINDER 4 MISFIRE DETECTED

COMPONENT LOCATION EA8F988E

Injector



SUDFL8098L

DESCRIPTION EC6B4476

1. GENERAL DESCRIPTION
   Injector carries out function to inject fuel amount calculated by ECM by making diesel spread with small particles to combustion chamber compressed with high pressure. Fuel injected generates power through combustion process.
   Purpose to increase fuel pressure of common rail diesel engine up to Max. 1,600 bar is to make fuel into small particles, small particles of fuel are related to smoke reduction, high power of engine, fuel consumption improvement etc.
   Also, hydraulic servo type is used to control fuel pressure of 1,600 bar with solenoid, injector solenoid is driven by current after increasing solenoid driving voltage up to 135V.
   Multi injection is possible by applying fuel injection which is not mechanic injector but electric control injector.
   ECM injects fuel after dividing into two stages of pilot injection and main injection and it is possible to control Injection time and injection amount independently to each cylinder. Power, torque, exhaust gas, fuel consumption improvement etc. can be optimized by controlling engine to optimum fuel injection amount.

2. DTC DESCRIPTION
   If cylinder balance control fuel amount is detected above 9mm³/st for 30,033.2ms or more, ECM judges this as a fault and DTC is set. The possible causes are open circuit of terminal 3 of ECM connector(F39-2), short to injector coil etc. Check that 9mm³/st or more are displayed by confirming final value of cylinder correction amount with a scan tool if there are DTCs in the ECM.
   Not only the engine is unstable at idle but also the there will be damaged to the engine if the engine is operated for a long time with the injector malfunctioned.

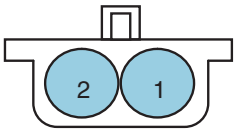
DTC DETECTING CONDITION EAE22355

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Open in terminal 3 of ECM connector(F39-2) • Short to injector coil • Check the injector.
Enable Conditions	• Running			
Threshold Value	• Cylinder balance control fuel amount>9mm³/st or more			
Diagnosis Time	• 30,033.2ms or more			
Fail Safe	Fuel Cut	No	• Unstable at idle	
	Fuel Limit	No		
	MIL	OFF		

SPECIFICATION E9460348

Item	Specification
Resistance	0.45Ω (At 20˚C)
Injector driving voltage	135V
Injector driving current	20A
Injector control type	Current control

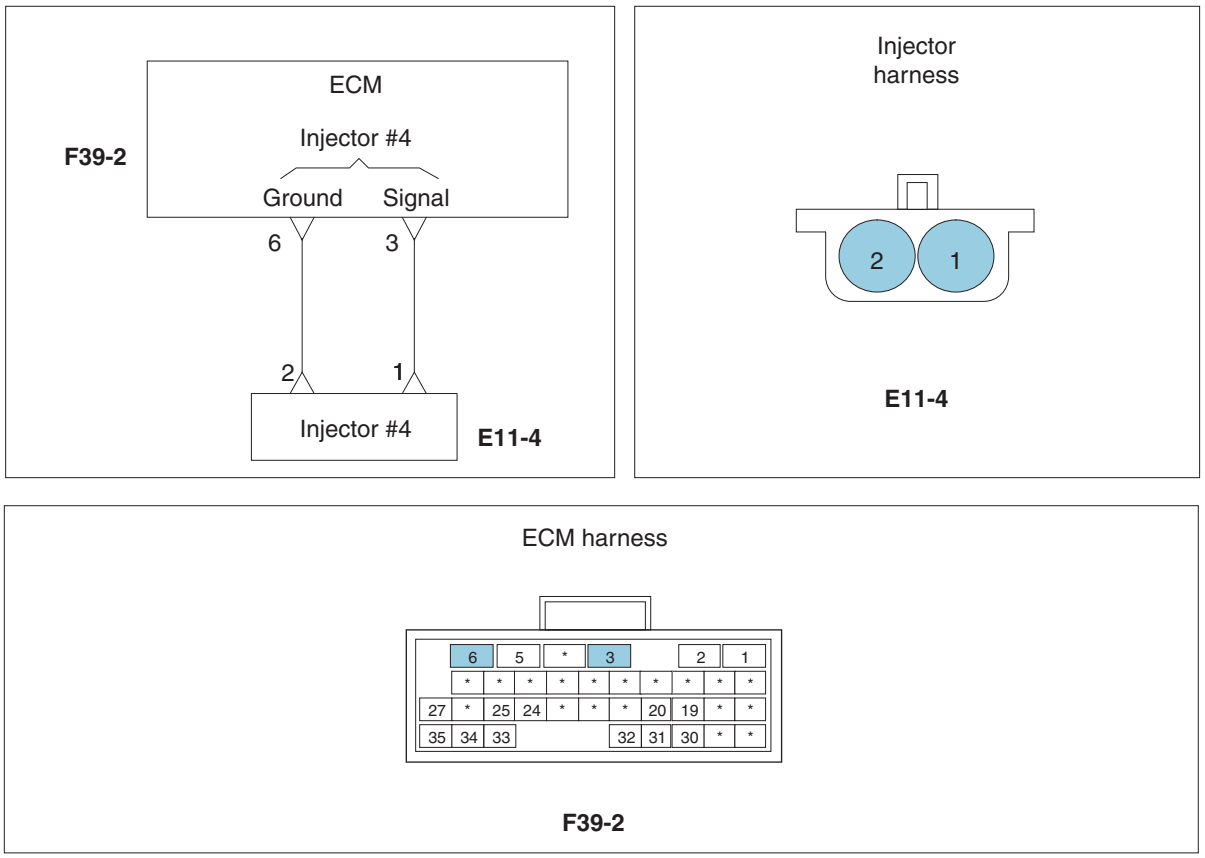
Terminal 1: Signal
Terminal 2: Ground



Sensor connector

SUDFL8099L

SCHEMATIC DIAGRAM EE5E3F37



SNBFL8054L

WAVEFORM AND DATA EC881E5C

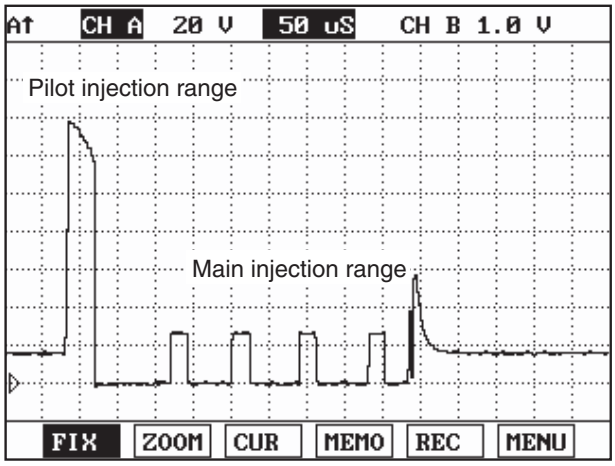


Fig. 1 Low side waveform when activating injector(Ground side)

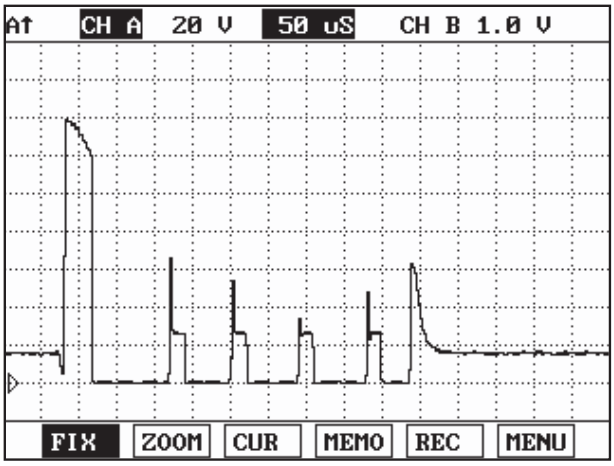


Fig. 2 High side injector power waveform(Signal side)

Fig.1) is divided into pilot injection range and main injection range as low side waveform when activating injector.
Fig.2) is high side injector power waveform.

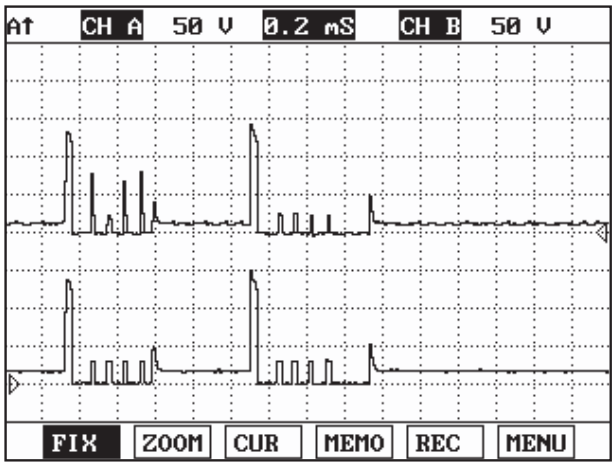


Fig. 3 Injector power waveform combined with High/Low side

SUDFL8101L

NOTE

Waveforms of Fig.1) and Fig.2) are displayed by turns in the course of checking injector waveform in LOW side. The reason that the waveform like a Fig.2) is displayed is used in LOW side in common the power of HIGH side of injector #1, #4 or injector #2, #3 which is not activated.

MONITOR SCAN TOOL DATA EE75B778

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Fuel injection amount" parameter on the scan tool.

■ Specification: Fuel amount - Approx. 9.0~10.5 mm³/st at idle

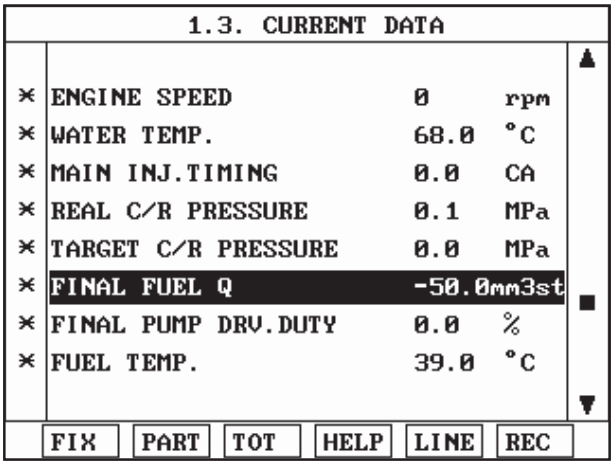


Fig. 1 Fuel injection amount data at ignition ON

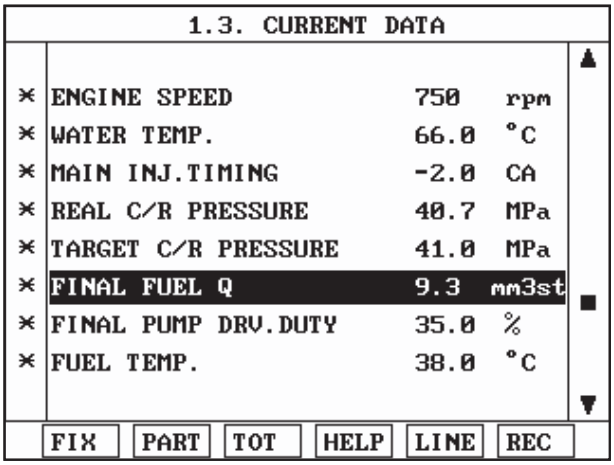


Fig. 2 Fuel injection amount data at idle

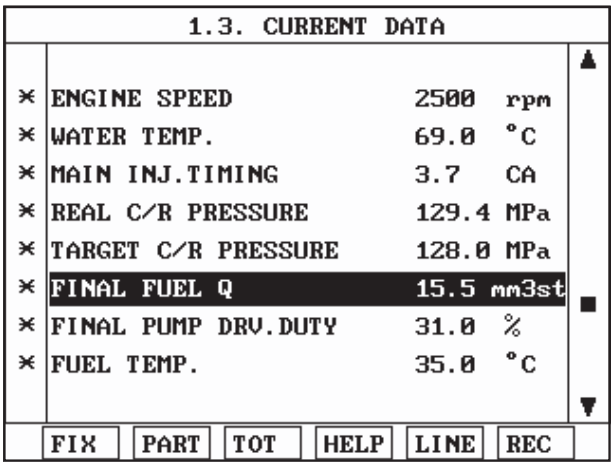


Fig. 3 Fuel injection amount data at 2,500rpm

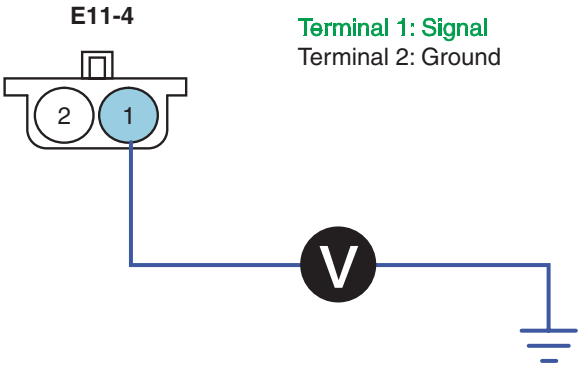
SUDFL8102L

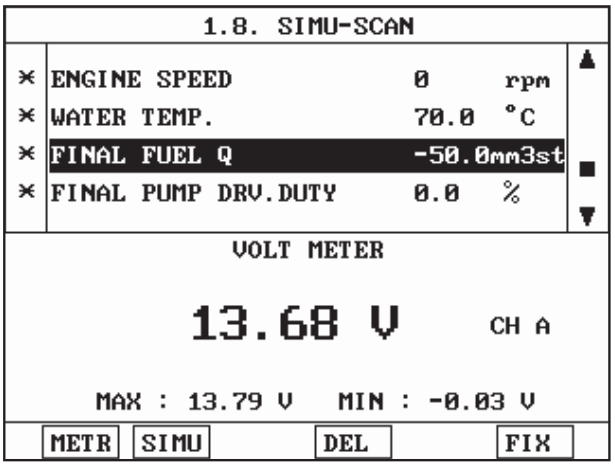
TERMINAL & CONNECTOR INSPECTION ECFF08F8

Refer to DTC P0112.

POWER SUPPLY INSPECTION E5AFBB00

1. Power Supply Voltage Inspection
   1) Leave injector #4 connector(E11-4) connected.
   2) Turn the ignition ON. The engine stops.
   3) Measure voltage between terminal 1 of the injector #4 and chassis ground.





▶ With injector #4 connector disconnected/connected (At IG ON)

SUDFL8199L

■ Specification: Injector #4 signal power approx. 13.57 V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

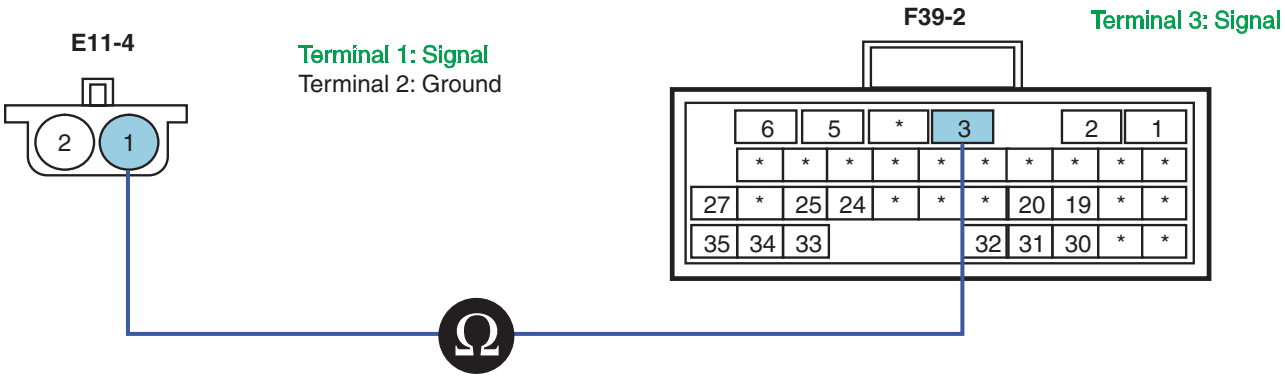
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn the ignition OFF.

2) Disconnect injector #4 connector(E11-4) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of injector #4 harness connector(E11-4) and terminal 3 of ECM connector(F39-2).



SNBFL8086L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

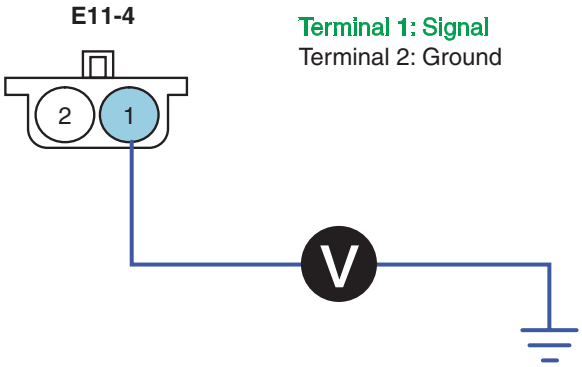
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

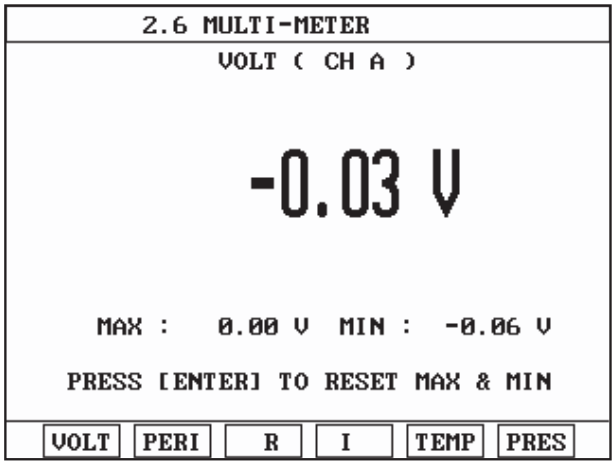
3. Power Supply Short to Power Inspection

1) Disconnect injector #4 connector(E11-4) and ECM connector(F39-2).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of injector #4 harness connector(E11-4) and chassis ground.





SUDFL8201L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

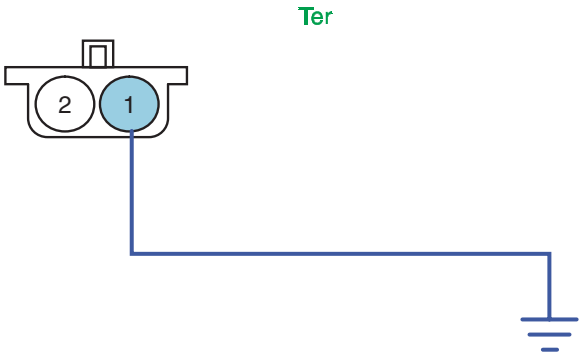
▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

4. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect injector #4 connector(E11-4) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of injector #4 harness connector(E11-4) and chassis ground.


Ter
2
1

■ Specification: Ground voltage drop - Within 200mV

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

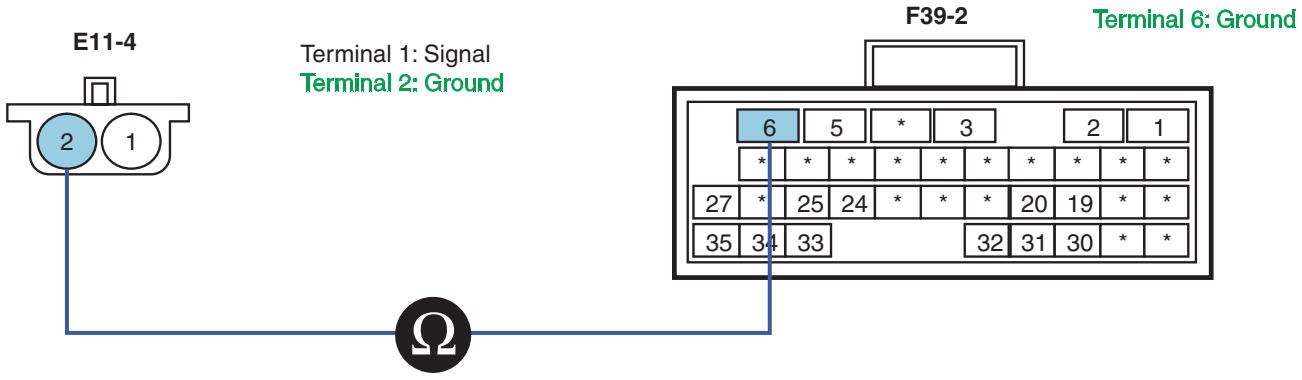
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect injector #4 connector(E11-4) and ECM connector(F39-2).

3) Measure resistance between terminal 2 of injector #4 harness connector(E11-4) and terminal 6 of ECM connector(F39-2).



SNBFL8087L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

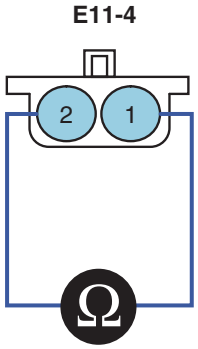
COMPONENT INSPECTION E1906D89

1. Injector Component Inspection

1) Turn ignition OFF.

2) Disconnect injector#4 connector(E11-4).

3) Measure resistance between terminals 1 and 2 of injector#4 connector.



■ Specification

Item	Specification
Resistance	0.45Ω(At 20˚C)

SUDFL8205L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the injector and then go to "Verification of Vehicle Repair" procedure.

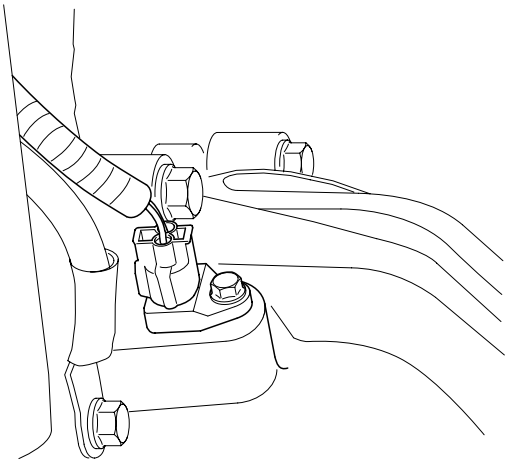
VERIFICATION OF VEHICLE REPAIR EAF12D5A

Refer to DTC P0112.

DTC P0335 CRANK SENSOR NO PULSE

COMPONENT LOCATION E0AB4701

Crankshaft position sensor



SUDFL8136L

DESCRIPTION E4F05FA5

1. GENERAL DESCRIPTION
   The engine piston position is used for determining fuel injection timing, all pistons are connected to crankshaft via connecting rod. After the crankshaft position sensor detects piston position, it sends signal to the ECM to determine fuel injection timing and engine speed. The camshaft position sensor is used to detect the top dead center of compression stroke of each cylinder. Based on these signals, the ECM determines fuel injection timing and injection order of each cylinder.

2. DTC DESCRIPTION
   If the number of NE pulse is detected below one time per engine one revolution(360˚ CA) for 1,800.1CA or more, the ECM judges this as a fault and DTC is set. The probable causes are crankshaft sensor malfunction, open or short to terminals 6 and 7 of ECM connector(F39-3). The vehicle is possible to drive normally, but starting-ability is bad and exhaust brake operation to protect engine system will be stopped due to starting time delay since ECM receives signal only from pulse of camshaft position sensor(G).

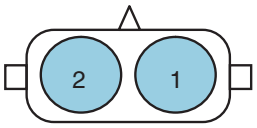
DTC DETECTING CONDITION E46B5AE3

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="5">• Crankshaft sensor malfunction
• Open or short to terminals 6 and 7 of ECM connector(F39-3)</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• The number of pulse is below one time each 360˚ CA(engine one revolution)</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 1,800.1 CA or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• The system is controlled only by the pulse of camshaft position sensor.
• Starting time delay
• Exhaust brake operation is stopped.</td></tr>
<tr><td>Fuel Limit</td><td>No</td></tr>
<tr><td>MIL</td><td>ON</td></tr>
</table>

SPECIFICATION EE38259B

Temp.(℃)	Resistance(Ω) between terminals 1 and 2
20	175 ± 17

Air gap	1.50 ± 0.5mm

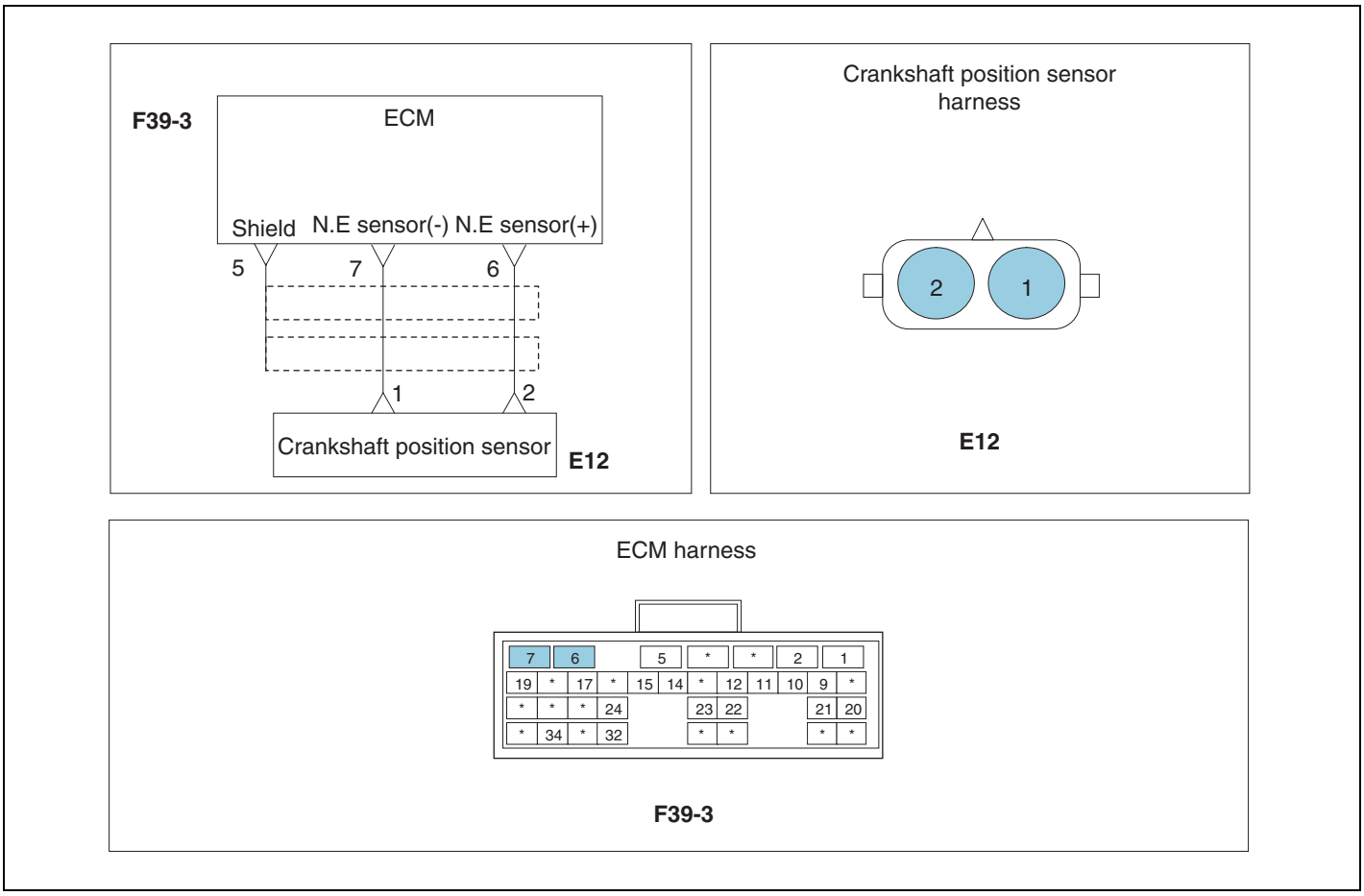


Terminal 1: N.E sensor(-)
Terminal 2: N.E sensor(+)

Sensor connector

SUDFL8339L

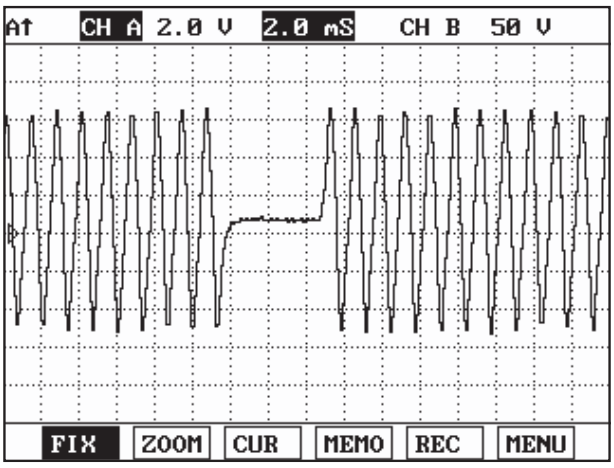
SCHEMATIC DIAGRAM E6B54604



SNBFL8088L

SIGNAL WAVEFORM E5F7C091

Crankshaft position sensor (At idle)



SUDFL8139L

MONITOR SCAN TOOL DATA E5C0116D

1. Connect scan tool to the self-diagnosis connector.

2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Engine Rev." parameter on the scan tool.

NOTE

The value of "Engine revolution" depending on engine operation conditions will change. Compare "Fuel injection amount" between 4,000rpm or more and 3,500rpm or less of engine rpm in case of fail safe.

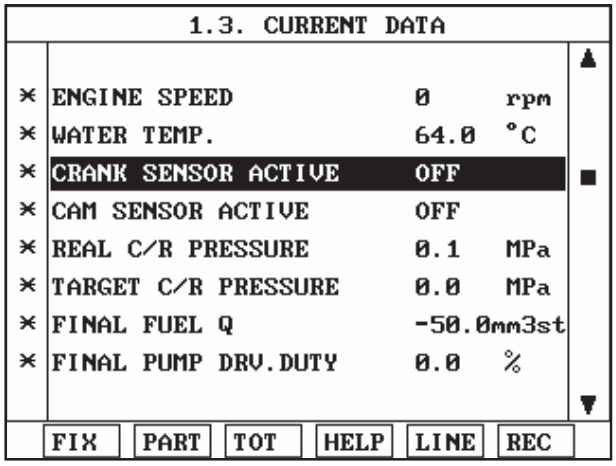


Fig. 1 Engine rpm data at ignition ON

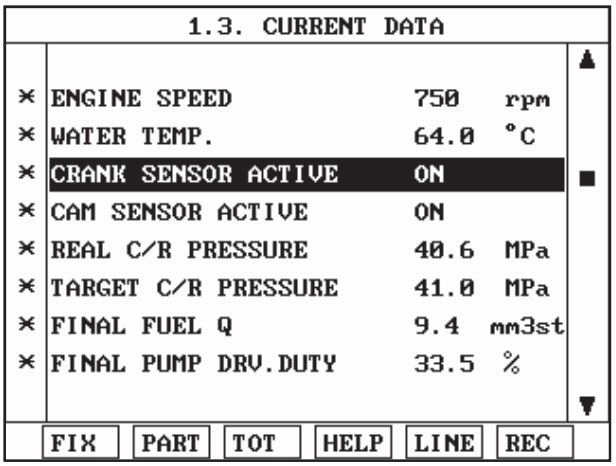


Fig. 2 Engine rpm data at idle

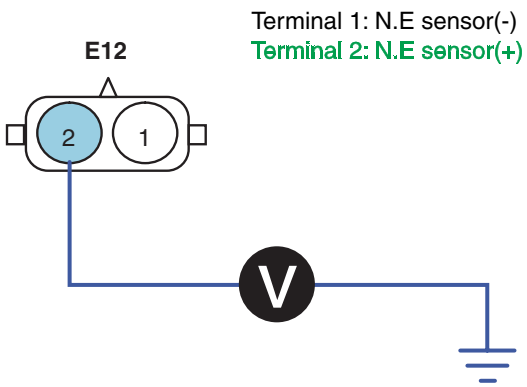
SUDFL8140L

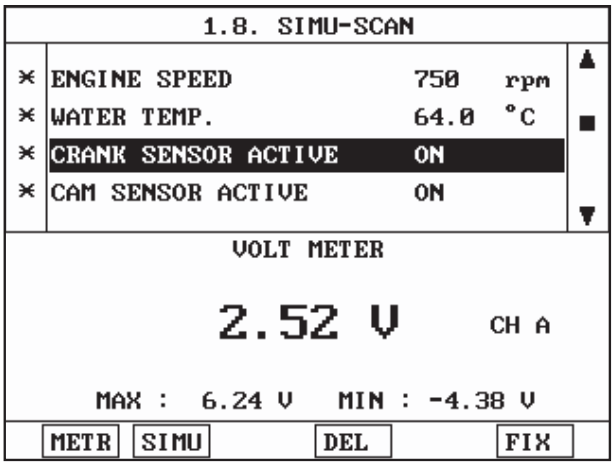
TERMINAL & CONNECTOR INSPECTION E01D8A40

Refer to DTC P0112.

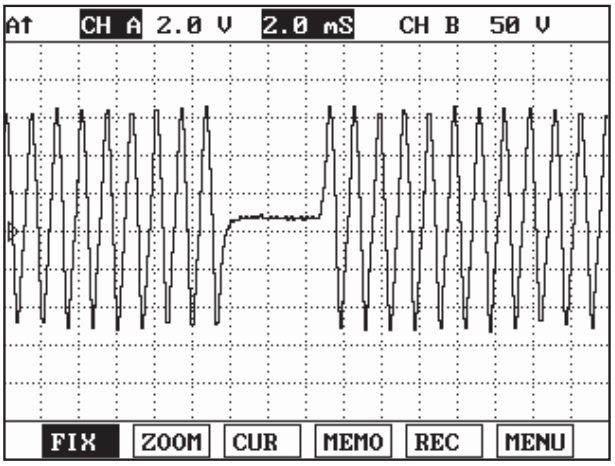
SIGNAL CIRCUIT INSPECTION E8E4D79E

1. N.E sensor(+) Voltage Inspection
   1) Leave the crankshaft position sensor connector(E12) connected.
   2) Turn the ignition ON. The engine stops.
   3) Measure voltage between terminal 2 of the crankshaft position sensor harness connector and chassis ground.





▶ With crankshaft position sensor connector connected (Power at idle)



▶ With crankshaft position sensor connector connected (Waveform at idle)

SUDFL8141L

■ Specification: ETC control module output power approx. 5.97 V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

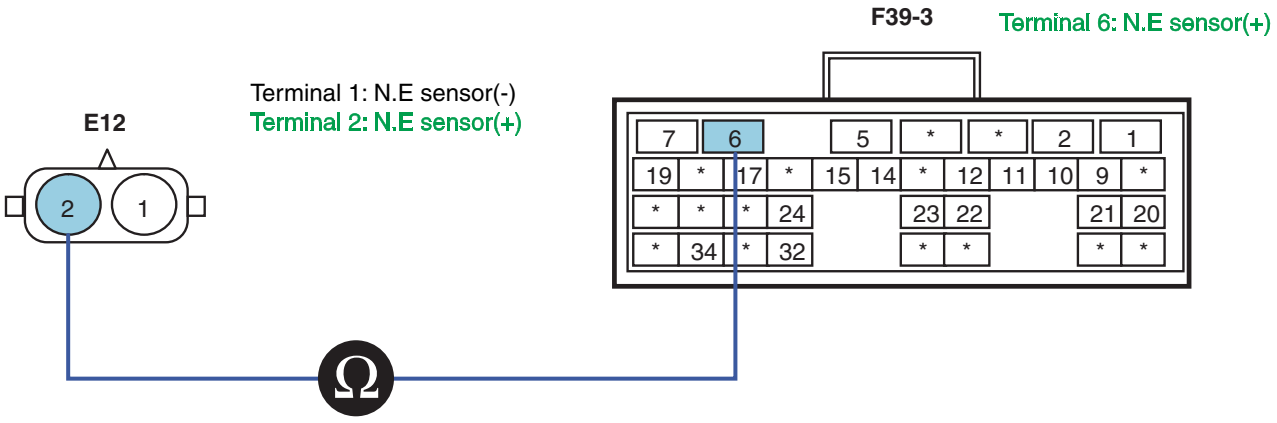
▶ Go to "N.E Sensor(+) Open Inspection" procedure.

2. N.E Sensor(+) Open Inspection

1) Turn ignition OFF.

2) Disconnect crankshaft position sensor connector(E12) and ECM connector(F39-3).

3) Measure resistance between terminal 2 of crankshaft position sensor harness connector and terminal 6 of ECM connector(F39-3).



SNBFL8059L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "N.E Sensor(+) Short to Power Inspection" procedure.

NO

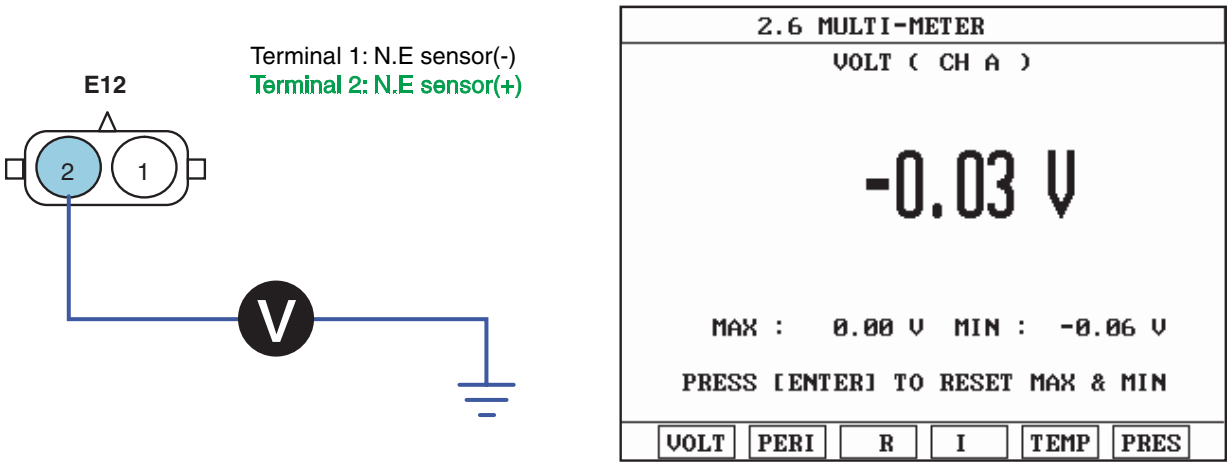
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. N.E Sensor(+) Short to Power Inspection

1) Disconnect crankshaft position sensor connector(E12) and ECM connector(F39-3).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 2 of crankshaft position sensor harness connector and chassis ground.



SUDFL8143L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

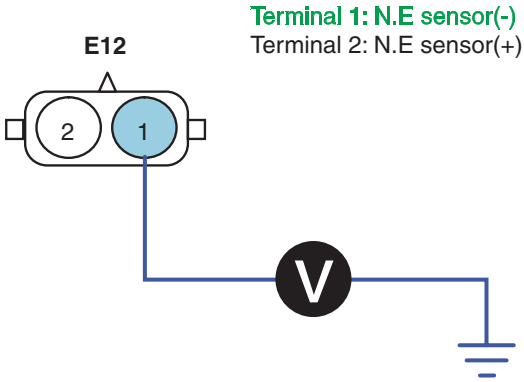
GROUND CIRCUIT INSPECTION E61B7F88

1. N.E Sensor(+) Voltage Inspection

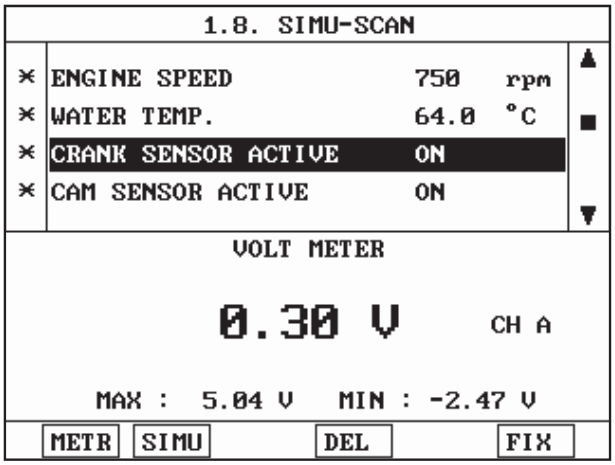
1) Leave crankshaft position sensor connector(E12) connected.

2) Turn the ignition ON. Start the engine.

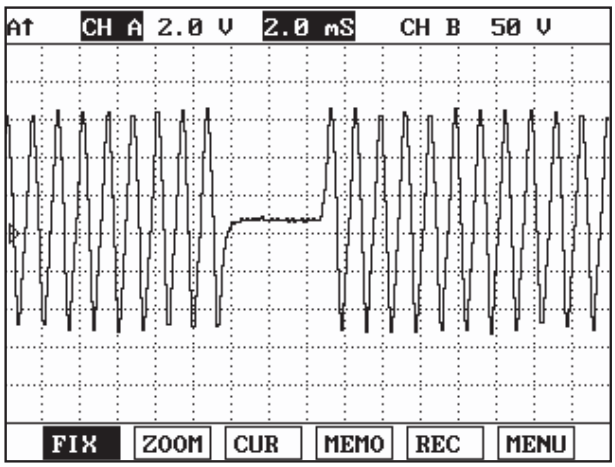
3) Measure voltage between terminal 1 of crankshaft position sensor harness connector and chassis ground.



Terminal 1: N.E sensor(-)
Terminal 2: N.E sensor(+)



▶ With crankshaft position sensor connector connected at idle



▶ With crankshaft position sensor connector connected (Waveform at idle)

SUDFL8144L

■ Specification: ETC control module output power approx. 5.97 V

4) Is the voltage measured within specification?

YES

▶ Go to "Shield Circuit Inspection" procedure.

NO

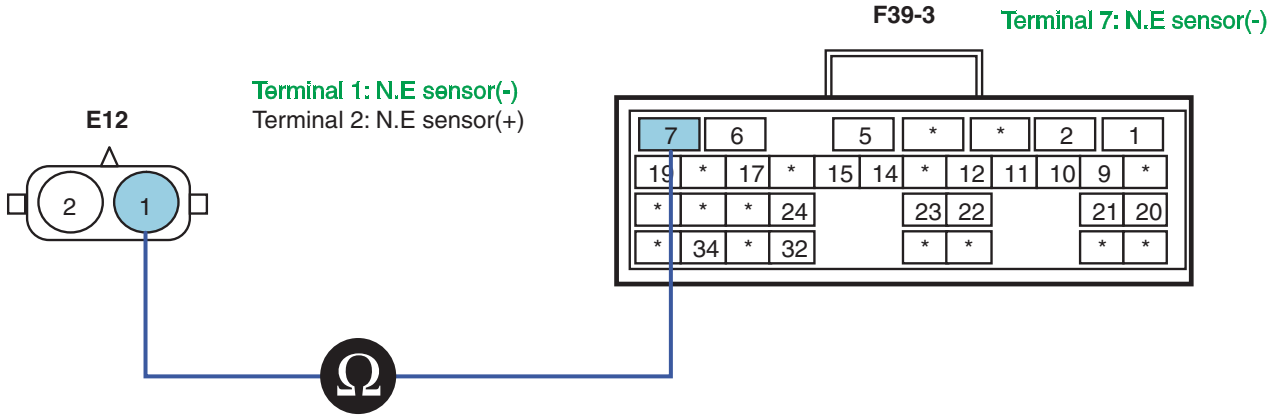
▶ Go to "N.E Sensor(-) Open Inspection" procedure.

2. N.E Sensor(-) Open Inspection

1) Turn the ignition OFF.

2) Disconnect crankshaft position sensor connector(E12) and ECM connector(F39-3).

3) Measure resistance between terminal 1 of crankshaft position sensor harness connector and terminal 7 of ECM connector(F39-3).



SNBFL8089L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "N.E Sensor(-) Short to Power Inspection" procedure.

NO

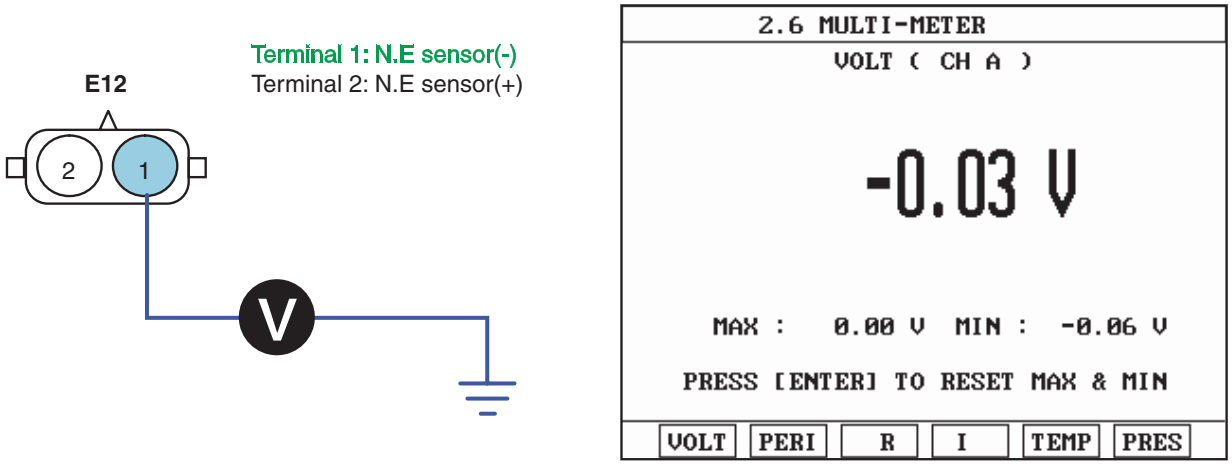
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. N.E Sensor(-) Short to Power Inspection

1) Disconnect crankshaft position sensor connector(E12) and ECM connector(F39-3).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of crankshaft position sensor harness connector and chassis ground.



SUDFL8146L

■ Specification: Below 0~0.1V

4) Is the resistance measured within specification?

YES

▶ Go to "Shield Circuit Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

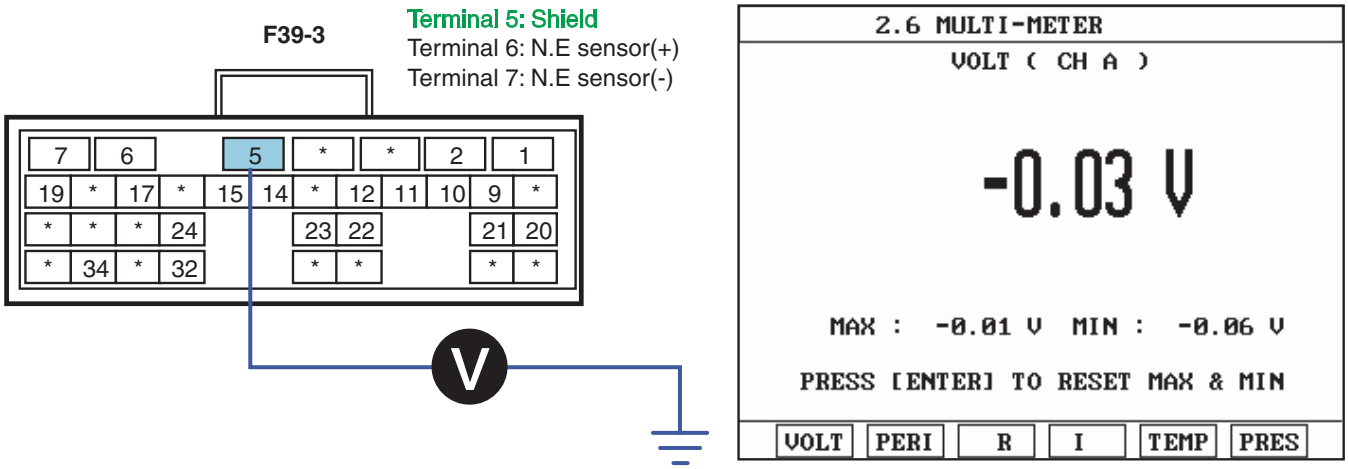
SHIELD CIRCUIT INSPECTION ED054CAB

1. Shield Short to Power Inspection

1) Disconnect ECM connector(F39-3).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 5 of ECM harness connector and chassis ground.



SNBFL8061L

■ Specification: Shield ground power approx. 0V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

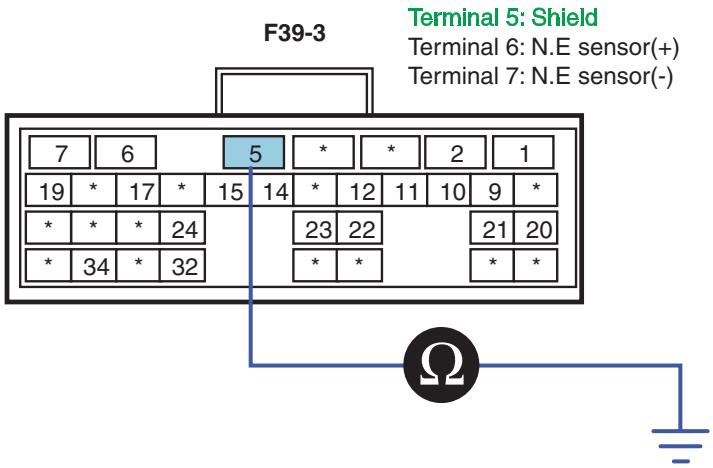
▶ Go to "Shield Short to Ground Inspection" procedure.

2. Shield Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect ECM connector(F39-3).

3) Measure resistance between terminal 5 of ECM harness connector(F39-3) and chassis ground.



SNBFL8062L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EA963A78

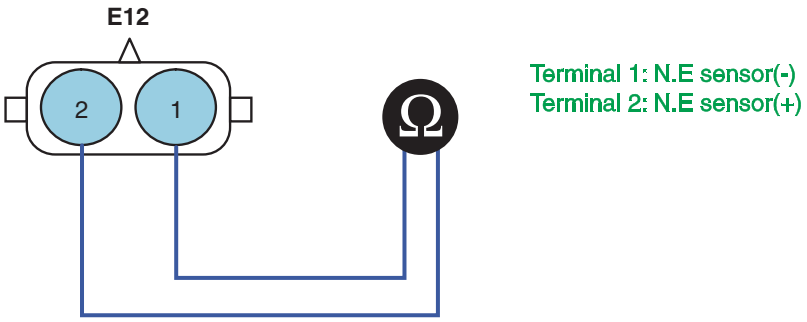
1. Crankshaft position Sensor Resistance Inspection

1) Turn ignition OFF.

2) Disconnect crankshaft position sensor connector(E12).

3) Measure resistance between terminals 1 and 2 of crankshaft position sensor connector.

Temperature(℃)	Resistance(Ω)
20	125±17



SUDFL8149L

4) Is the resistance measured within specification?

YES

▶ Go to "Crankshaft position Sensor Waveform Inspection" procedure.

NO

▶ Replace the crankshaft position sensor and then go to "Verification of Vehicle Repair" procedure.

2. Crankshaft position Sensor Waveform Inspection

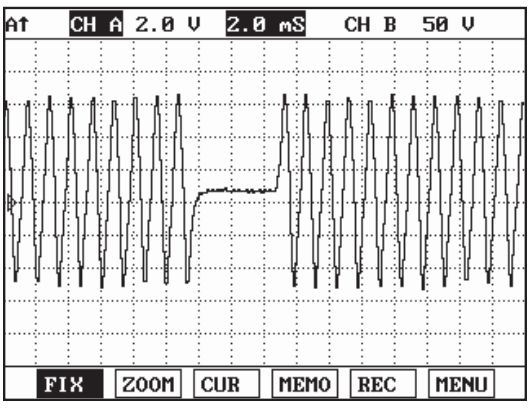
1) Turn ignition OFF.

2) Connect crankshaft position sensor connector(E12).

3) Connect oscilloscope to terminal 2 of crankshaft position sensor.

4) Check crankshaft position waveform for normal operation at idle state.

Crankshaft position sensor waveform
(at idle)



SUDFL8150L

5) Is the crankshaft position sensor waveform normal?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the crankshaft position sensor and then go to "Verification of Vehicle Repair" procedure.

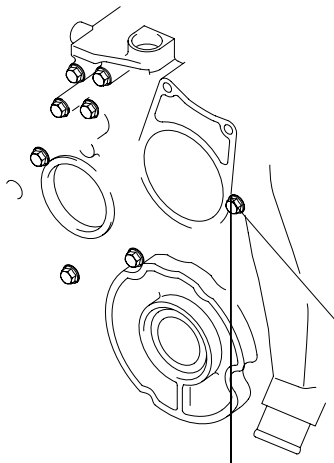
VERIFICATION OF VEHICLE REPAIR ECA4ED6A

Refer to DTC P0112.

DTC P0340 CAM SENSOR NO PULSE

COMPONENT LOCATION EF2B1987

Camshaft position sensor

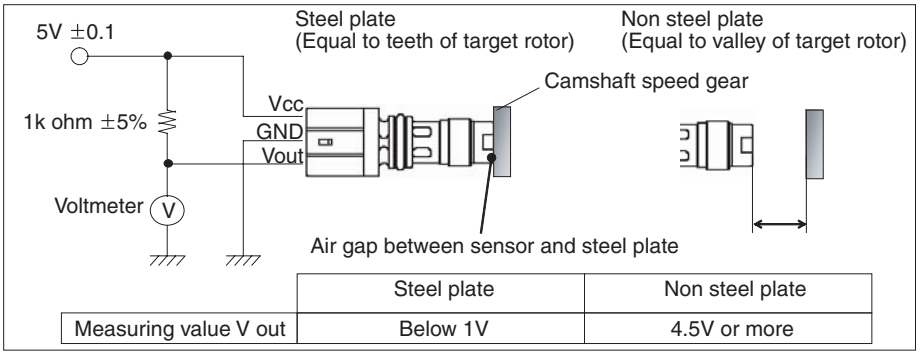


DTC DETECTING CONDITION E427E1A9

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Camshaft sensor malfunction • Open or short to terminals 19, 30 and 32 of ECM connector(F39-2)
Enable Conditions	• Running			
Threshold Value	• The number of pulse is below one time each 360˚ CA(engine one revolution)			
Diagnosis Time	• 1,800.1 CA or more			
Fail Safe	Fuel Cut	No	• The system is controlled only by the pulse of crankshaft position sensor. • Starting time delay • Exhaust brake operation is stopped.	
	Fuel Limit	No		
	MIL	ON		

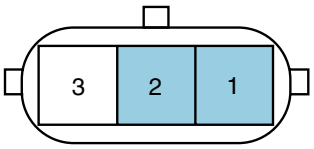
SPECIFICATION ED330C0E

Air gap	1.0 ± 0.5mm



	Steel plate	Non steel plate
Measuring value V out	Below 1V	4.5V or more

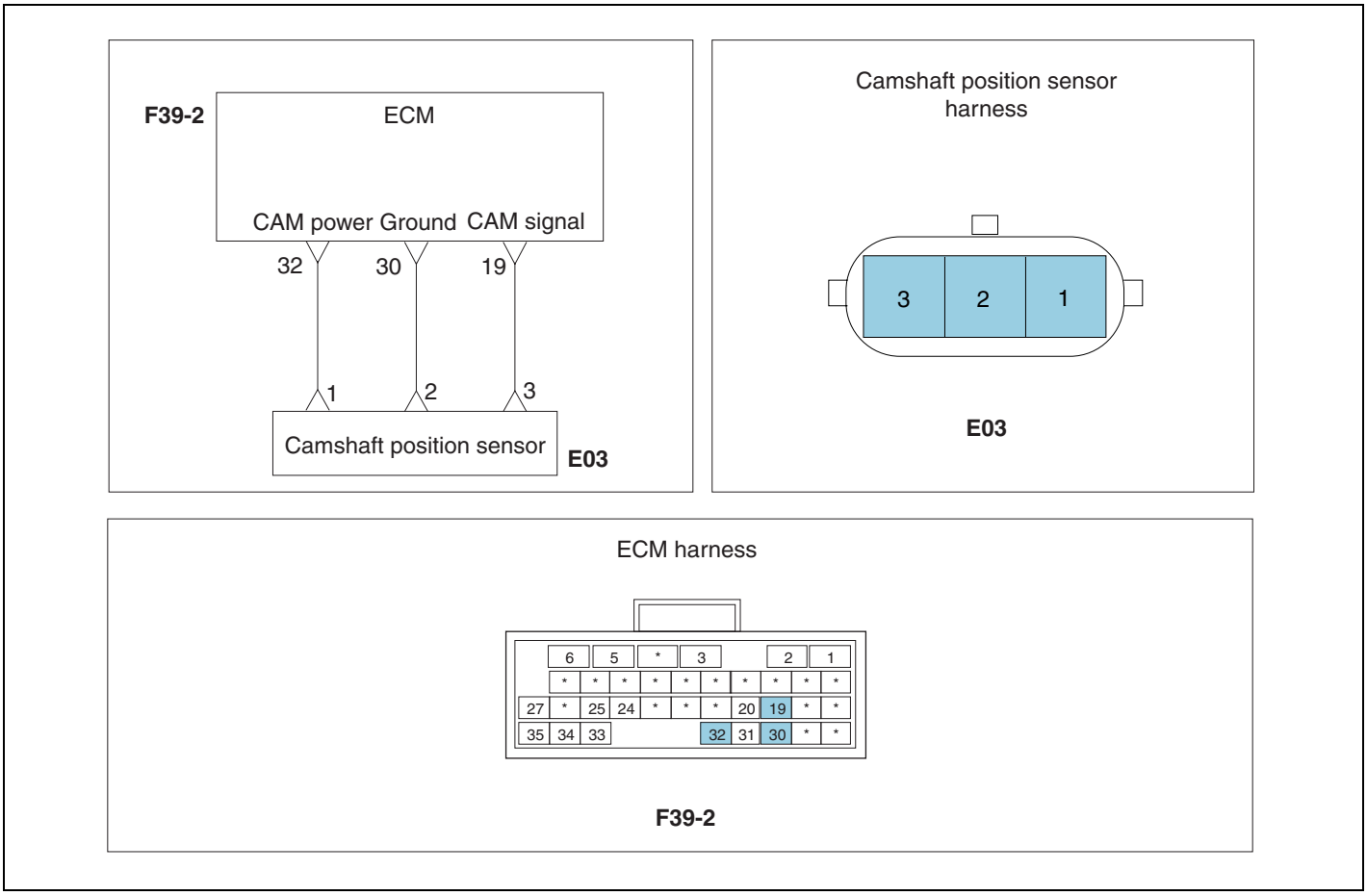
Terminal 1: CAM power
Terminal 2: Ground
Terminal 3: CAM signal



Sensor connector

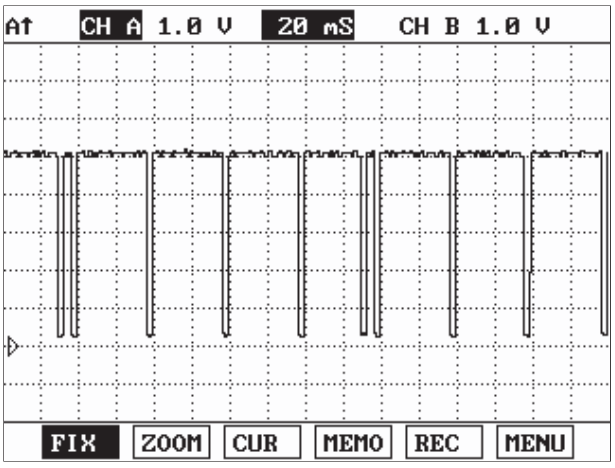
SUDFL8208L

SCHEMATIC DIAGRAM E9C238D0



SNBFL8090L

SIGNAL WAVEFORM E6195159



SUDFL8210L

MONITOR SCAN TOOL DATA E74F45FE

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.

3. Turn the electric equipment and air conditioner OFF.

4. Monitor "Engine Rev." parameter on the scan tool.

NOTE

The value of "Engine revolution" depending on engine operation conditions will change. Compare "Fuel injection amount" between 4,000rpm or more and 3,500rpm or less of engine rpm in case of fail safe.

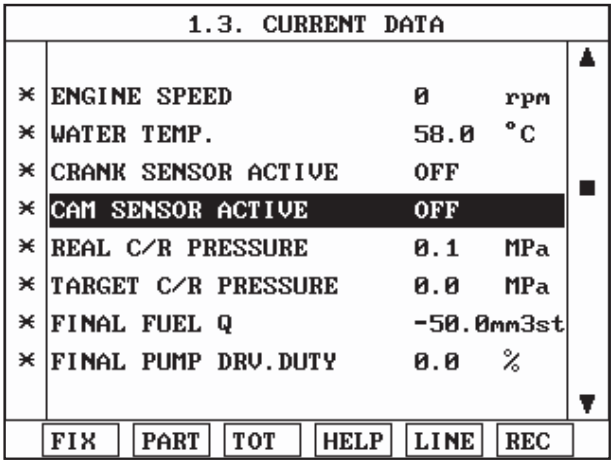


Fig. 1 Engine rpm data at ignition ON

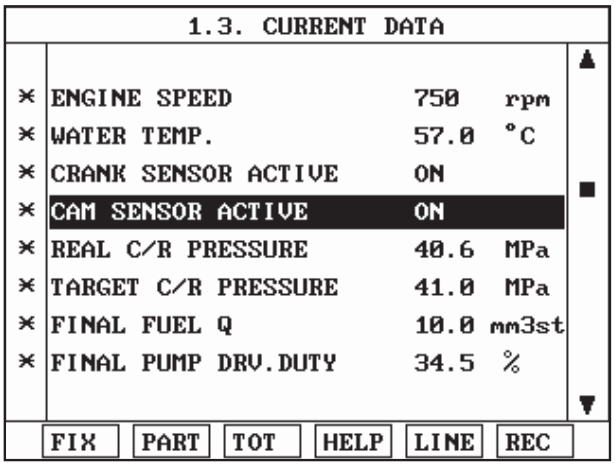


Fig. 2 Engine rpm data at idle

SUDFL8211L

TERMINAL & CONNECTOR INSPECTION EF064184

Refer to DTC P0112.

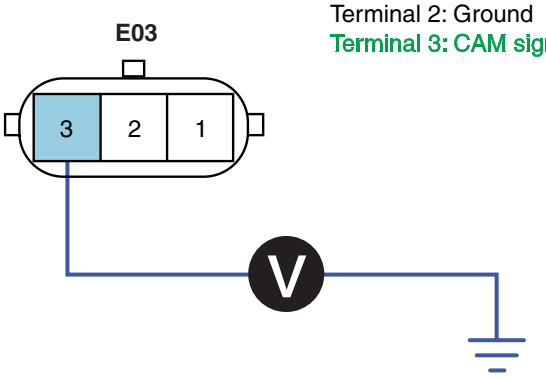
SIGNAL CIRCUIT INSPECTION E9F846A0

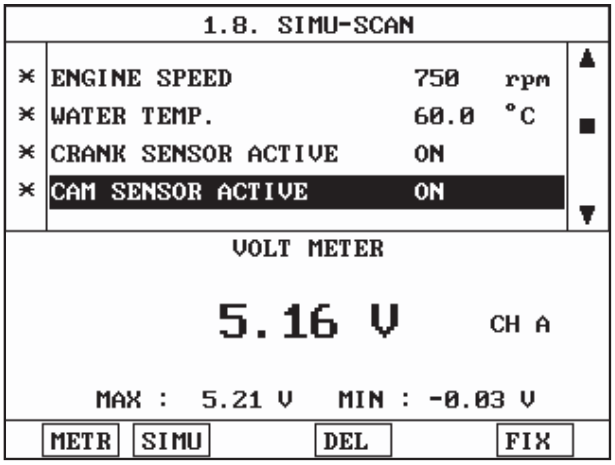
1. Signal Voltage Inspection

   1) Leave the camshaft position sensor connector(E03) connected.

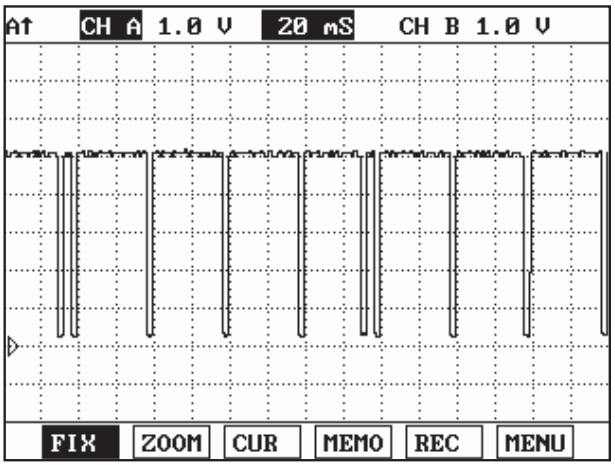
   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 3 of the camshaft position sensor harness connector and chassis ground.





▶ With camshaft position sensor connector connected (Power at idle)



▶ With camshaft position sensor connector connected (Waveform at idle)

SUDFL8212L

■ Specification: ETC control module output power approx. 5.16 V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

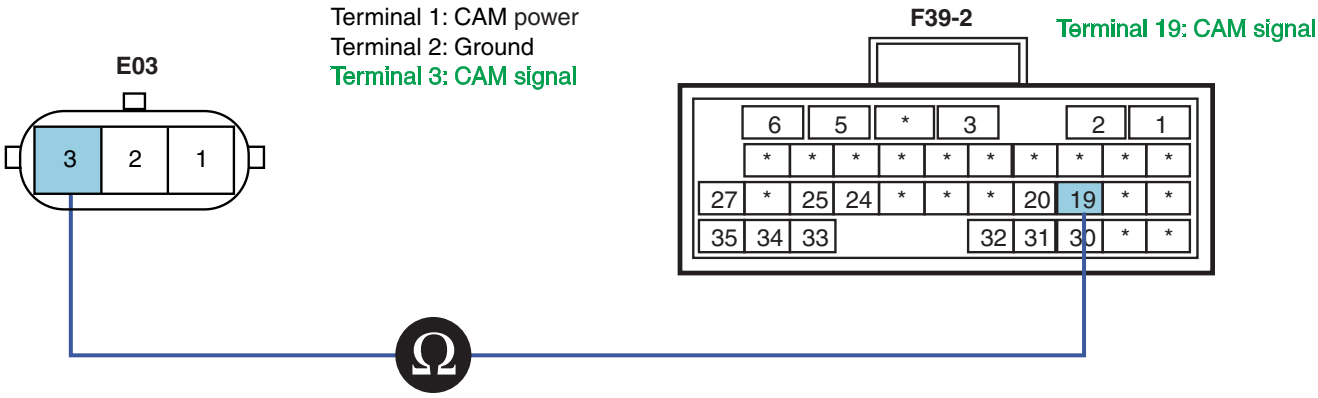
▶ Go to "Signal Open Inspection" procedure.

2. Signal Open Inspection

1) Turn ignition OFF.

2) Disconnect camshaft position sensor connector(E03) and ECM connector(F39-2).

3) Measure resistance between terminal 3 of camshaft position sensor harness connector and terminal 19 of ECM connector(F39-2).



SNBFL8091L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Power Inspection" procedure.

NO

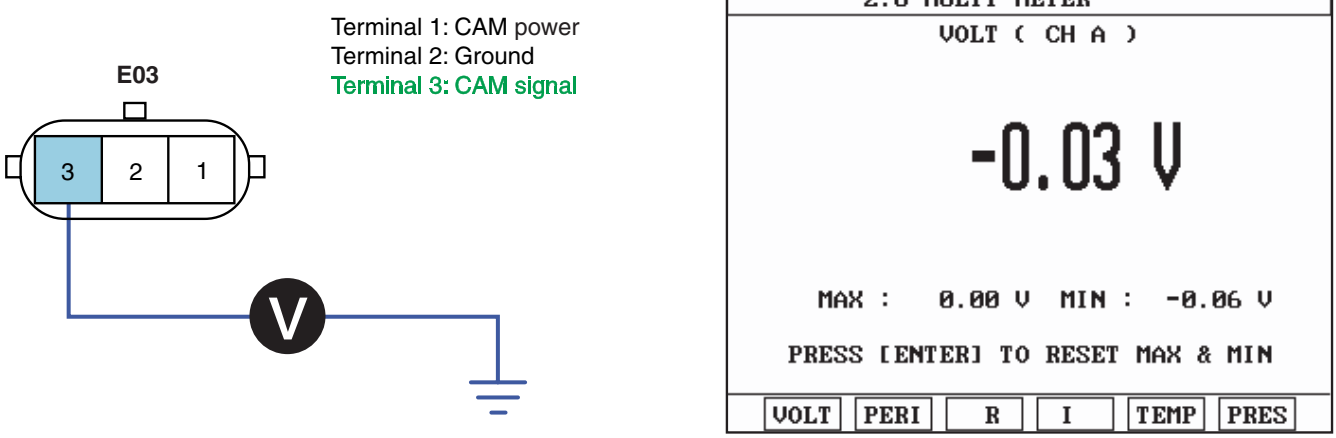
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. Signal Short to Power Inspection

1) Disconnect camshaft position sensor connector(E03) and ECM connector(F39-2).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 3 of camshaft position sensor harness connector and chassis ground.



SUDFL8214L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

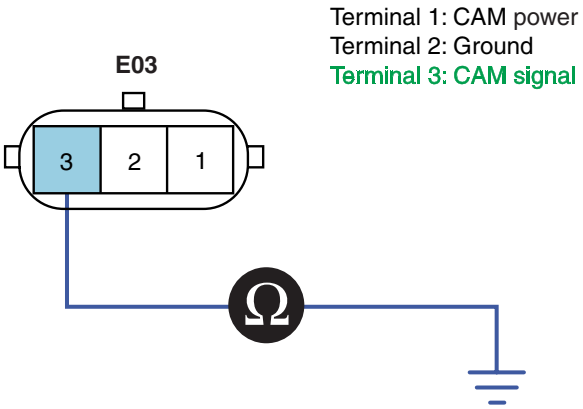
▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

4. Signal Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect camshaft position sensor connector(E03) and ECM connector(F39-2).

3) Measure resistance between terminal 3 of camshaft position sensor harness connector and chassis ground.



SUDFL8215L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

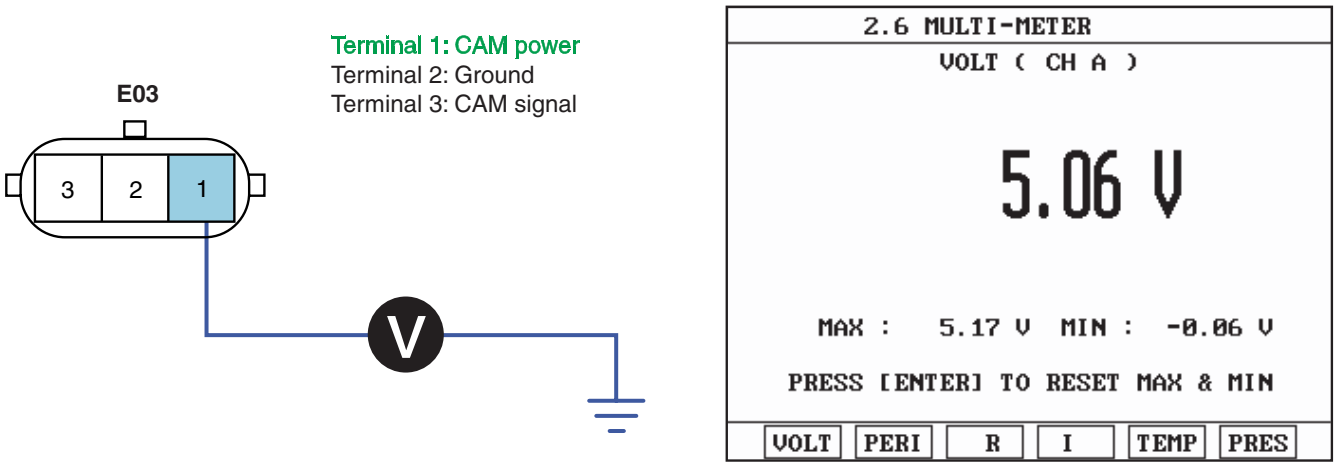
POWER SUPPLY INSPECTION EC796007

1. Power Supply Voltage Inspection

1) Disconnect camshaft position sensor connector(E03).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of camshaft position sensor harness connector and chassis ground.



SUDFL8216L

■ Specification: Camshaft position sensor supply power approx. 5.16 V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

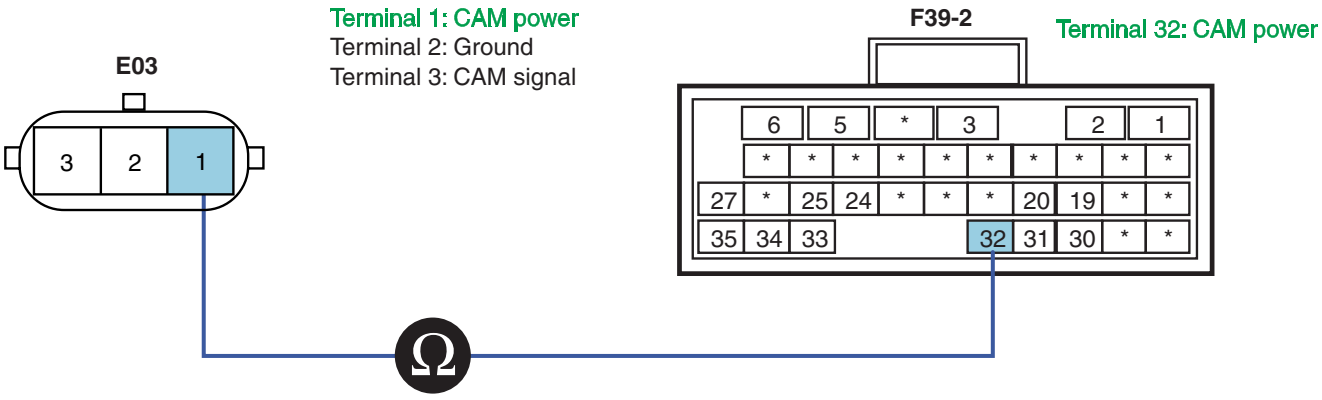
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn the ignition OFF.

2) Disconnect camshaft position sensor connector(E03) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of camshaft position sensor harness connector and terminal 32 of ECM connector(F39-2).



SNBFL8092L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

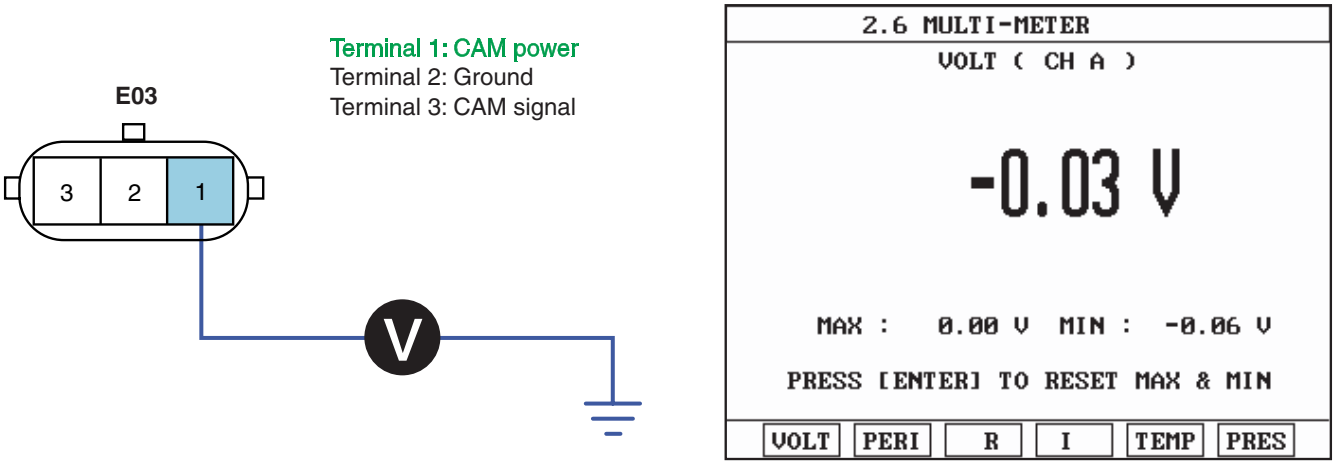
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. Power Supply Short to Power Inspection

1) Disconnect camshaft position sensor connector(E03) and ECM connector(F39-2).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of camshaft position sensor harness connector and chassis ground.



SUDFL8218L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

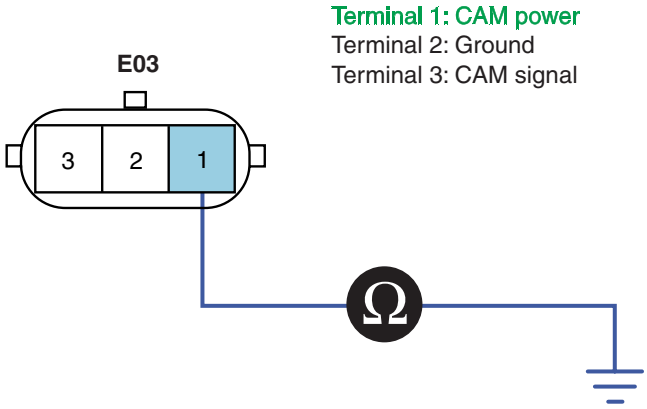
▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

4. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect camshaft position sensor connector(E03) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of camshaft position sensor connector(E03) and chassis ground.



SUDFL8219L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

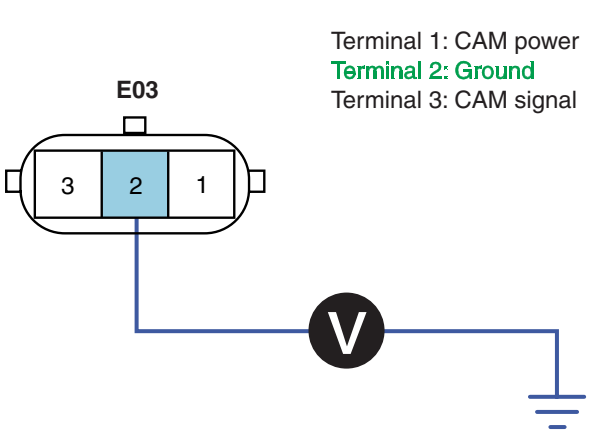
GROUND CIRCUIT INSPECTION EE738F81

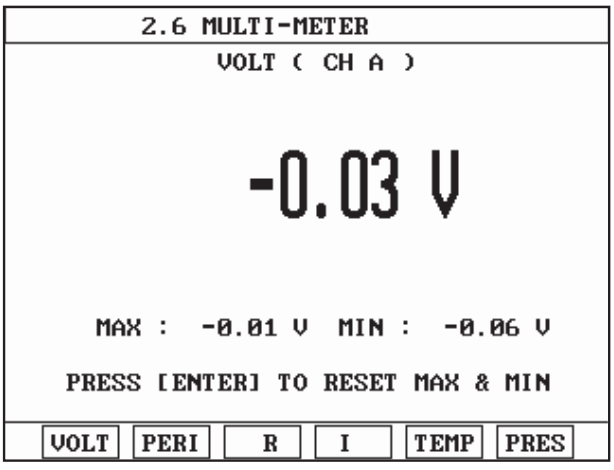
1. Ground Voltage Drop Inspection

1) Disconnect camshaft position sensor connector(E03).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 2 of camshaft position sensor connector(E03) and chassis ground.





SUDFL8220L

■ Specification: Ground voltage drop- within 200mV

4) Is the voltage drop measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

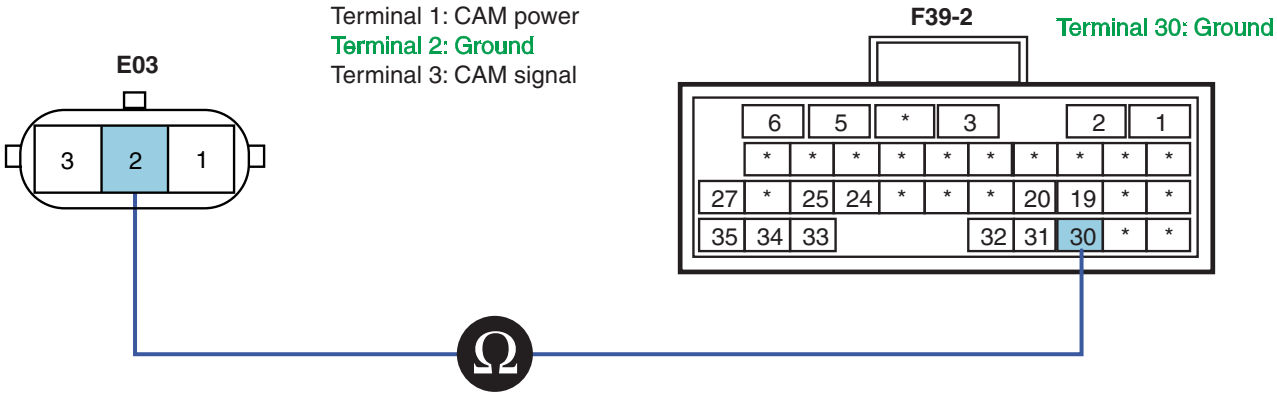
▶ Repair the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn ignition OFF.

2) Disconnect camshaft position sensor connector(E03) and ECM connector(F39-2).

3) Measure resistance between terminal 2 of camshaft position sensor harness connector and terminal 30 of ECM connector(F39-2).



SNBFL8093L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

COMPONENT INSPECTION E6A07492

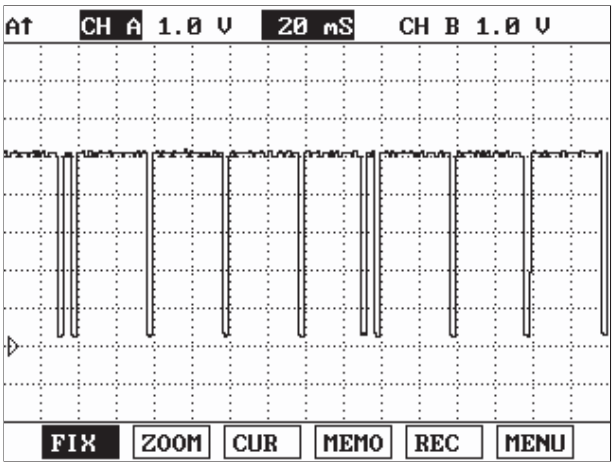
1. Camshaft position Sensor Waveform Inspection

1) Turn ignition OFF.

2) Connect camshaft position sensor connector(E03).

3) Connect oscilloscope to terminal 1 of camshaft position sensor connector.

4) Check camshaft position sensor waveform for normal operation at idle state.
■ Specification



SUDFL8210L

5) Is the crankshaft position sensor waveform normal?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the camshaft position sensor and then go to "Verification of Vehicle Repair" procedure.

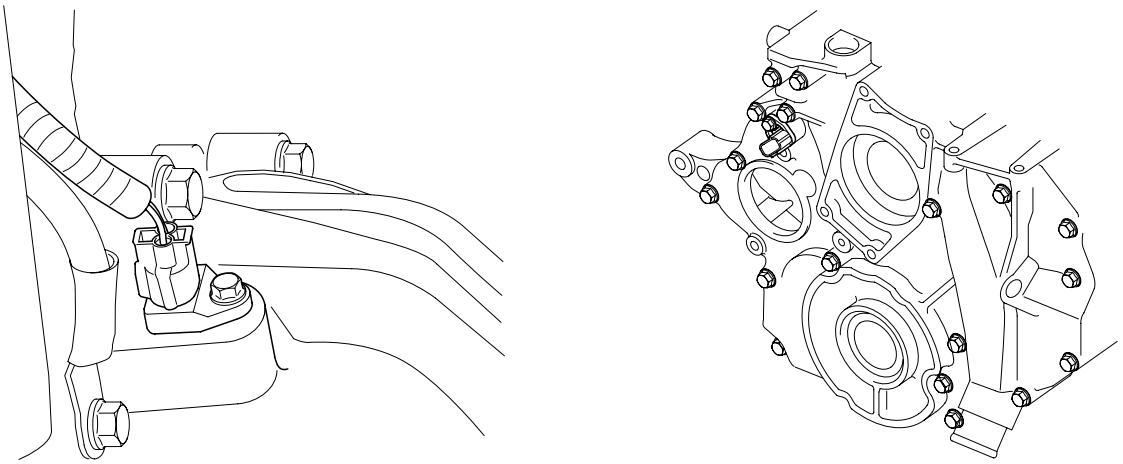
VERIFICATION OF VEHICLE REPAIR E62F8082

Refer to DTC P0112.

DTC P0385 CRANK & CAM SENSOR NO PULSE

COMPONENT LOCATION E061957C

Crankshaft & Camshaft position sensor



Crankshaft position sensor

Camshaft position sensor

SUDFL8222L

DESCRIPTION E2DD37A8

1. GENERAL DESCRIPTION
   The engine piston position is used for determining fuel injection timing, all pistons are connected to camshaft via connecting rod. After the crankshaft position sensor detects piston position, it sends signal to the ECM to determine fuel injection timing and engine speed. The camshaft position sensor is used to detect the top dead center of compression stroke of each cylinder. Based on these signals, the ECM determines fuel injection timing and injection order of each cylinder.

2. DTC DESCRIPTION
   If the engine stall at starting is detected for 1,048.6ms or more, the ECM judges this as a fault and DTC is set. The probable causes are camshaft sensor malfunction, crankshaft position sensor malfunction, open or short to terminals 6 and 7 of ECM connector(F39-3) and terminals 19,30 and 32 of ECM connector(F39-2). In case of fail safe, there may be the vehicle stop and impossible starting, PTO(if equipped) operation stop, cylinder balancing stop, exhaust brake operation stop etc.

DTC DETECTING CONDITION E45939CE

Item	Detecting Condition			Possible Cause
DTC Strategy	• Signal monitoring			• Crankshaft position sensor malfunction • Open or short to terminals 6 and 7 of ECM connector(F39-3) • Camshaft position sensor malfunction • Open or short to terminals 19,30 and 32 of ECM connector(F39-2)
Enable Conditions	• Cranking/Running			
Threshold Value	• At engine starting, engine stalling			
Diagnosis Time	• 1,048.6ms or more			
Fail Safe	Fuel Cut	No	• Lack of engine power while driving/ impossible starting • PTO operation stop • Cylinder balancing stop.Exhaust brake operation stop	
	Fuel Limit	No		
	MIL	OFF		

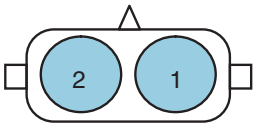
SPECIFICATION E2BAA58D

1. Crankshaft position sensor

Injector resistance(terminal-to-terminal)

Temperature(℃)	Resistance between terminals 1 and 2(Ω)
20	125 ± 17

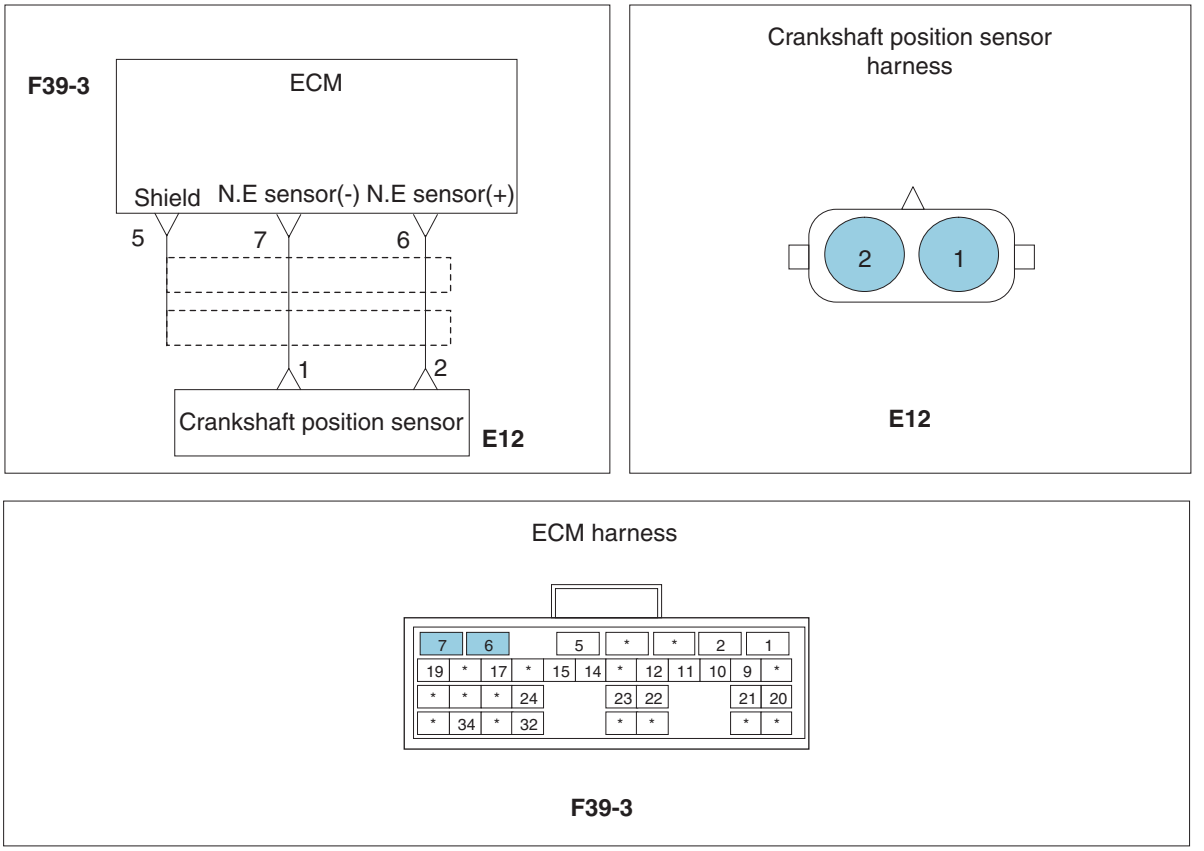
Air gap	1.50 ± 0.5 mm



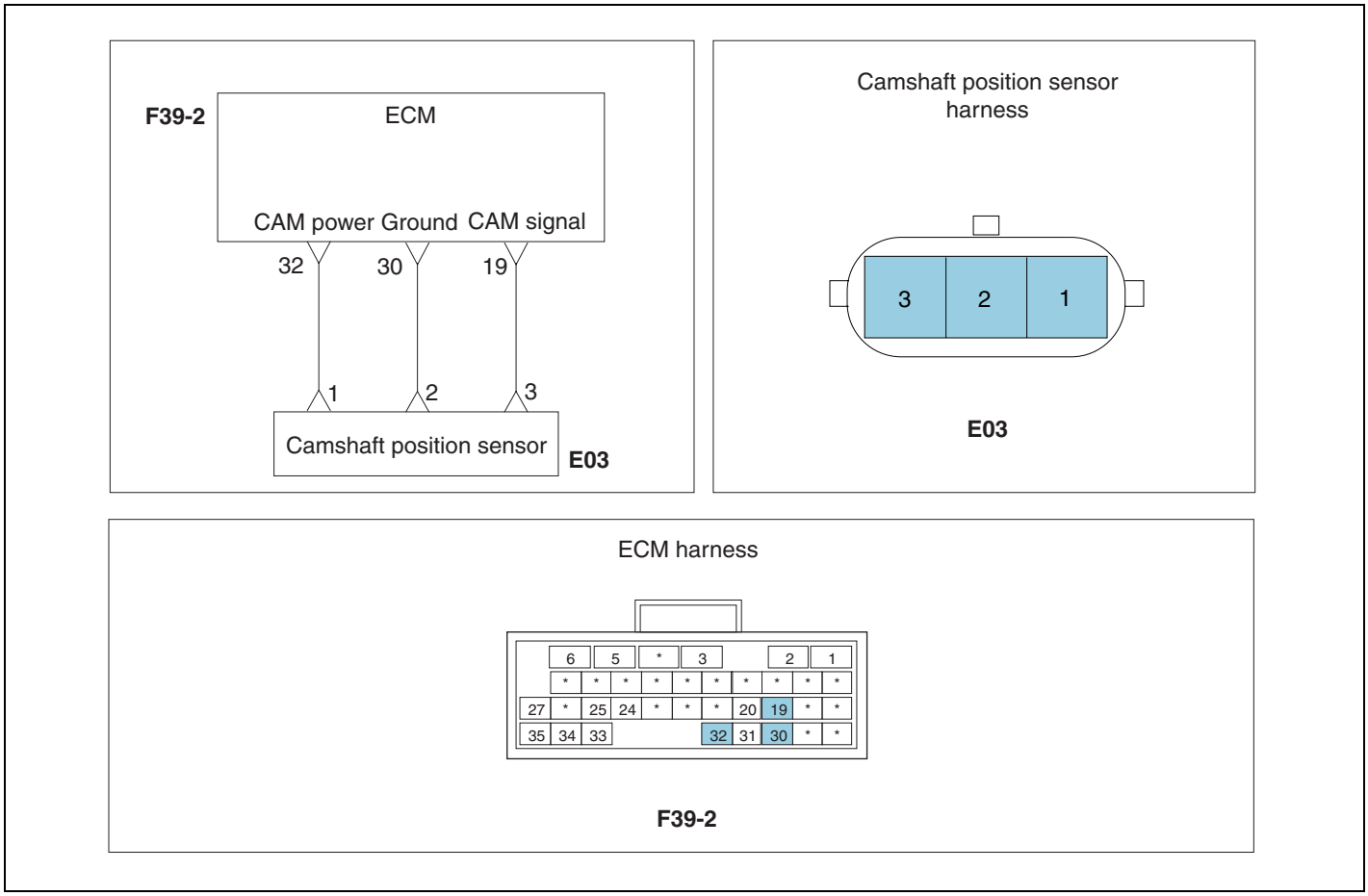
Terminal 1: N.E sensor(-)
Terminal 2: N.E sensor(+)

Sensor side connector

SCHEMATIC DIAGRAM E8C5FD1B

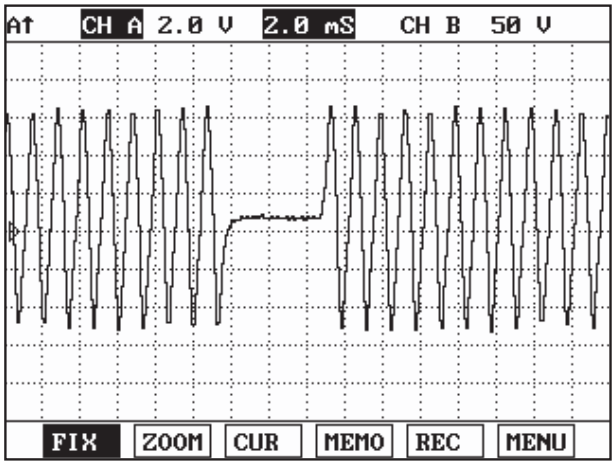


SNBFL8094L

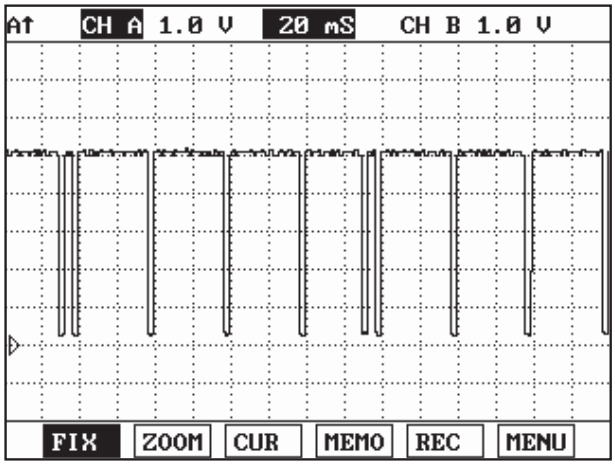


SNBFL8090L

SIGNAL WAVEFORM ECBD070F



Crankshaft position sensor



Camshaft position sensor

SUDFL8224L

MONITOR SCAN TOOL DATA E0813886

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.

4. Monitor "Engine Rev." parameter on the scan tool.

NOTE

The value of "Engine revolution" depending on engine operation conditions will change. Compare "Fuel injection amount" between 4,000rpm or more and 3,500rpm or less of engine rpm in case of fail safe.

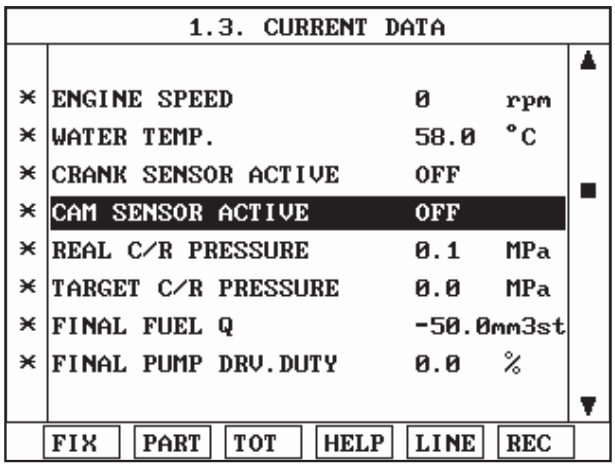


Fig. 1 Engine rpm data at ignition ON

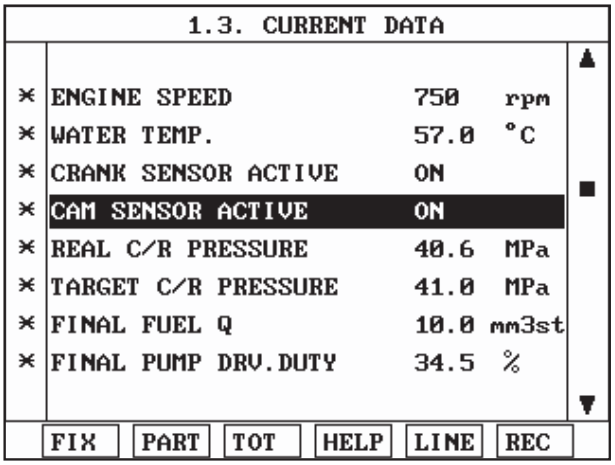


Fig. 2 Engine rpm data at idle

SUDFL8211L

TERMINAL & CONNECTOR INSPECTION E752D9FC

Refer to DTC P0112.

SIGNAL CIRCUIT INSPECTION EB48BAAE

Refer to DTC P0335 and P0340 procedure.

POWER SUPPLY INSPECTION E754387B

Refer to DTC P0340 procedure.

GROUND CIRCUIT INSPECTION E83385FC

Refer to DTC P0340 procedure.

SHIELD CIRCUIT INSPECTION EC611AE2

Refer to DTC P0335 and P0340 procedure.

COMPONENT INSPECTION E0745EB4

Refer to DTC P0335 and P0340 procedure.

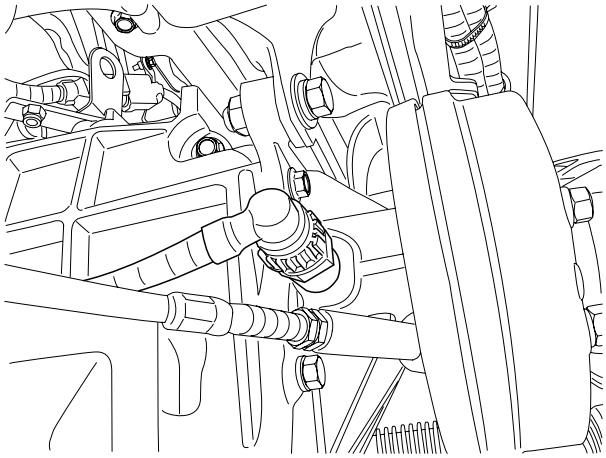
VERIFICATION OF VEHICLE REPAIR E24D6F64

Refer to DTC P0112.

DTC P0501 VEHICLE SPEED SENSOR(VSS) SIGNAL INVALID

COMPONENT LOCATION E122AED1

Vehicle speed sensor



SUDFL8501L

DESCRIPTION E8EDFC12

1. GENERAL DESCRIPTION
   Vehicle speed sensor which is hall sensor type detects vehicle speed by sensing the revolution of transmission output shaft. If the vehicle speed sensor sends signal to ECM, the signal is used not only for correction signal to calculate optimum fuel amount by comparing current engine revolution and vehicle speed but also for vehicle gauge signal and vehicle information to ETACS.

2. DTC DESCRIPTION
   If the sudden vehicle speed signal change is detected above 100km/h for 524.3ms or more, the ECM judges this as a fault and DTC is set. The possible cause may be vehicle speed sensor malfunction or entry of noise to terminal 27 of ECM connector(F39-4). The vehicle speed will change rapidly and it is impossible for the ECM to detect gear range. It is impossible to control PTO, if equipped.

DTC DETECTING CONDITION E2D18ECE

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• Vehicle speed sensor malfunction
• Noise entry to terminal 27 of ECM(F39-4)</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• 100km/h or more of sudden vehicle speed change due to surge entry are detected</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 524.3ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• Sudden vehicle speed change
• Impossible to detect gear range
• Impossible to control PTO(if equipped)</td></tr>
<tr><td>Fuel Limit</td><td>No</td></tr>
<tr><td>MIL</td><td>OFF</td></tr>
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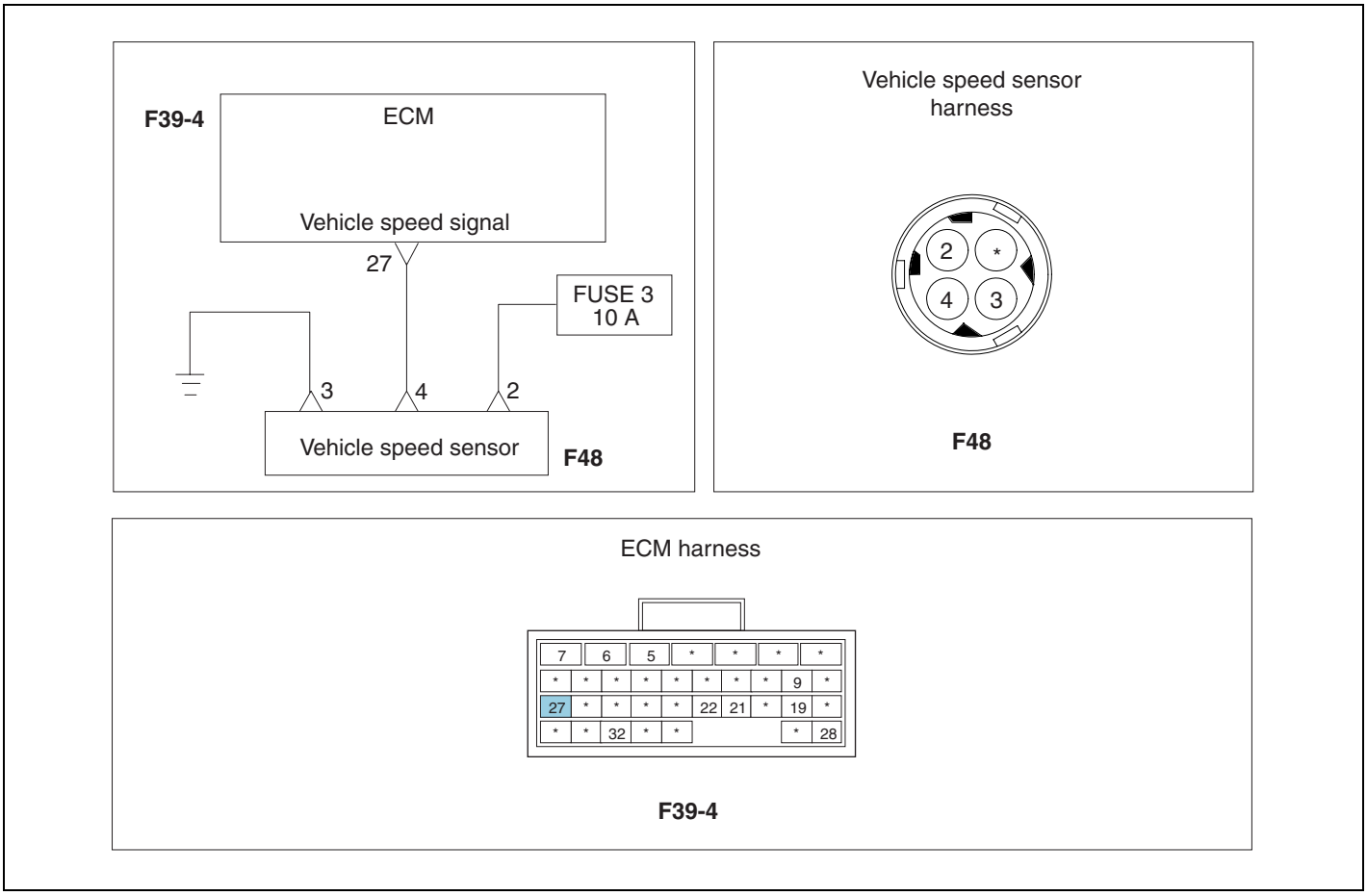
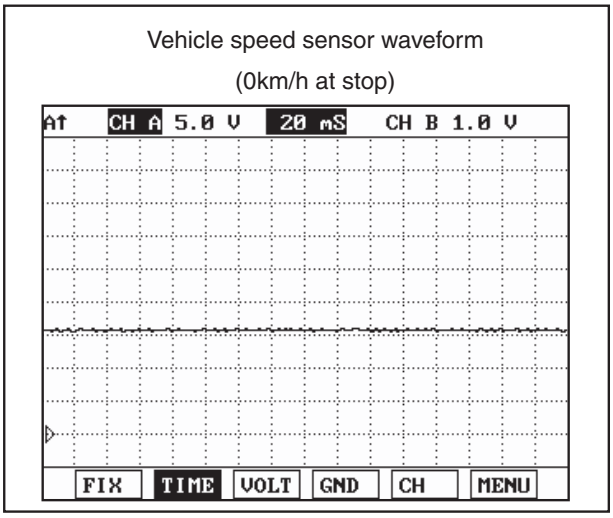
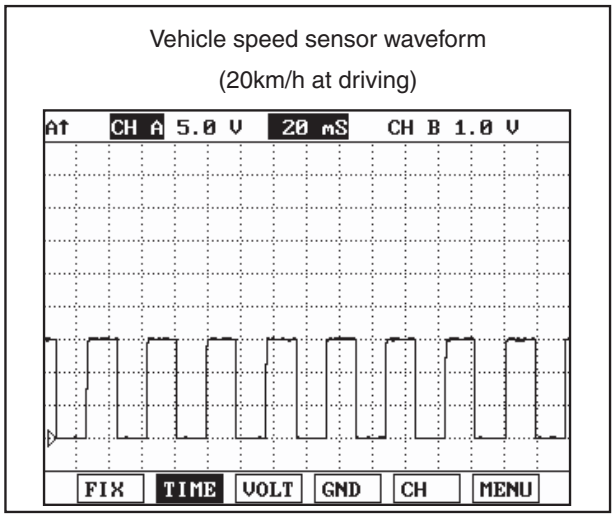
SCHEMATIC DIAGRAM E1E8C47C



SNBFL8095L

SIGNAL WAVEFORM E6CBA0FF





SUDFL8226L

MONITOR SCAN TOOL DATA E6C79B81

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.

3. Turn the electric equipment and air conditioner OFF.

4. Monitor "Vehicle speed" parameter on the scan tool.

NOTE

The information on stopping and driving of "Vehicle speed" depending on engine operation conditions will be displayed. (Refer to voltage change from "Control information and simulation".)

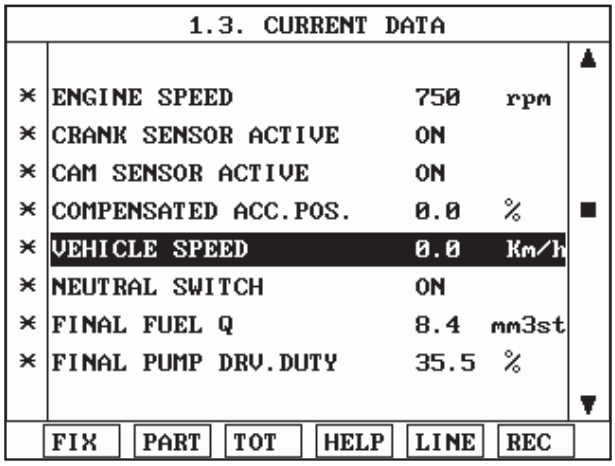


Fig. 1 "Vehicle speed" data at idle

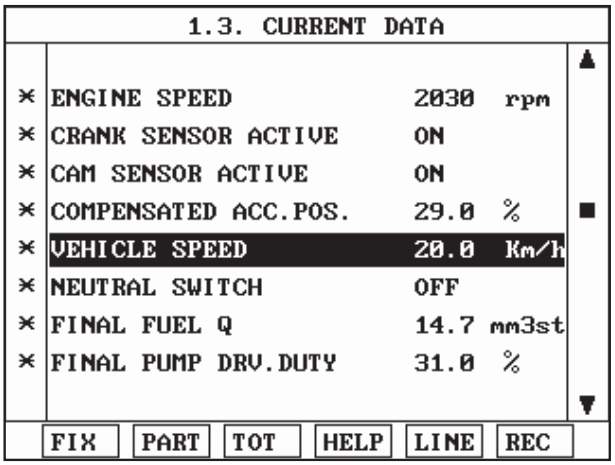


Fig. 2 "Vehicle speed" at 20km/h

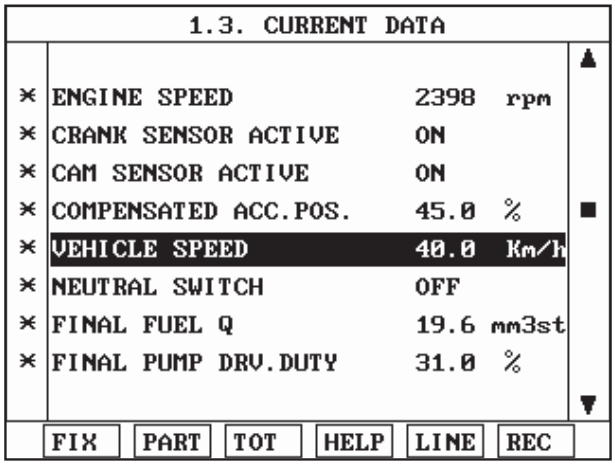


Fig. 3 "Vehicle speed" at 40km/h

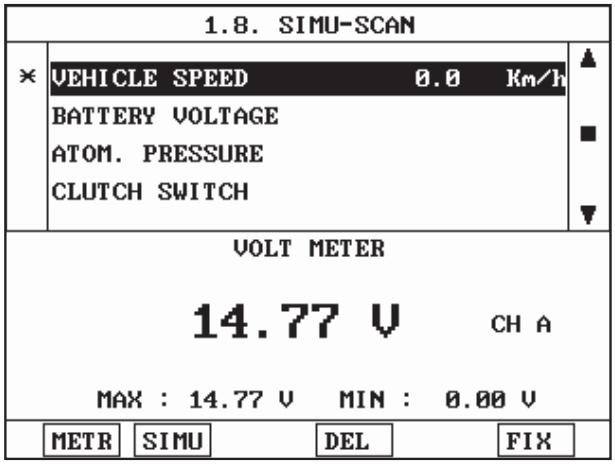


Fig. 4 "Vehicle speed" control information at 0km/h

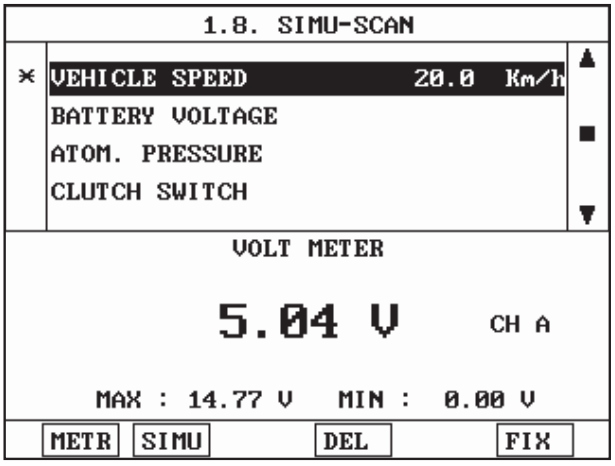


Fig. 5 "Vehicle speed" control information at 20km/h

SUDFL8227L

TERMINAL & CONNECTOR INSPECTION E8B75DE3

Refer to DTC P0112.

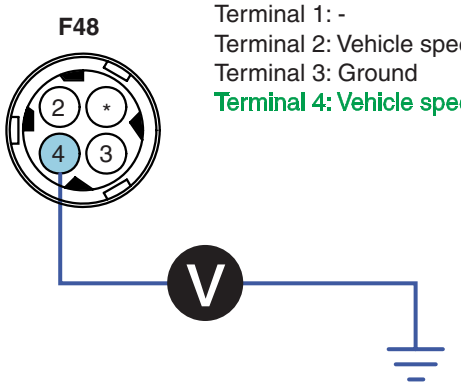
SIGNAL CIRCUIT INSPECTION EA7819D1

1. Signal Voltage Inspection

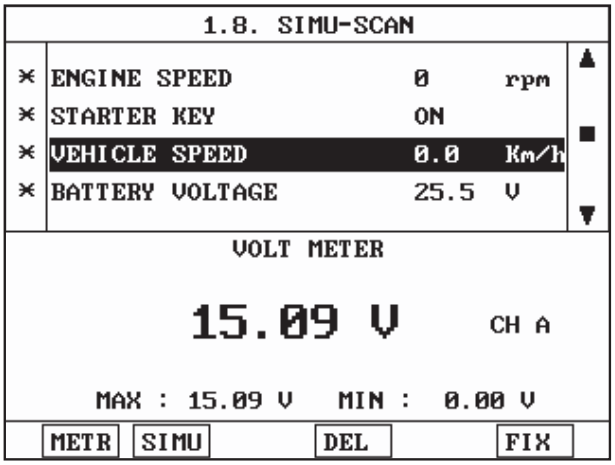
   1) Leave the vehicle speed sensor connector(F48) connected.

   2) Turn the ignition ON. Start the engine.

   3) Measure voltage between terminal 4 of the vehicle speed sensor harness connector and chassis ground.



Terminal 1: -
Terminal 2: Vehicle speed B+
Terminal 3: Ground
Terminal 4: Vehicle speed signal



▶ With vehicle speed sensor connector connected (At ignition ON)

SNBFL8096L

■ Specification: Vehicle speed sensor signal power approx. 16.39 V

   4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

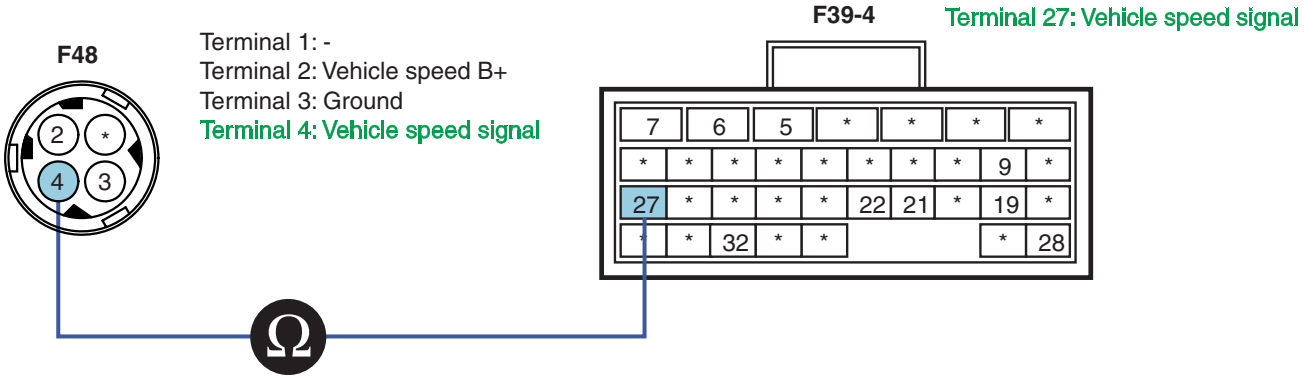
▶ Go to "Signal Open Inspection" procedure.

2. Signal Open Inspection

   1) Turn ignition OFF.

   2) Disconnect vehicle speed sensor connector(F48) and ECM connector(F39-4).

   3) Measure resistance between terminal 4 of vehicle speed sensor harness connector and terminal 27 of ECM connector(F39-4).



SNBFL8097L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Power Inspection" procedure.

NO

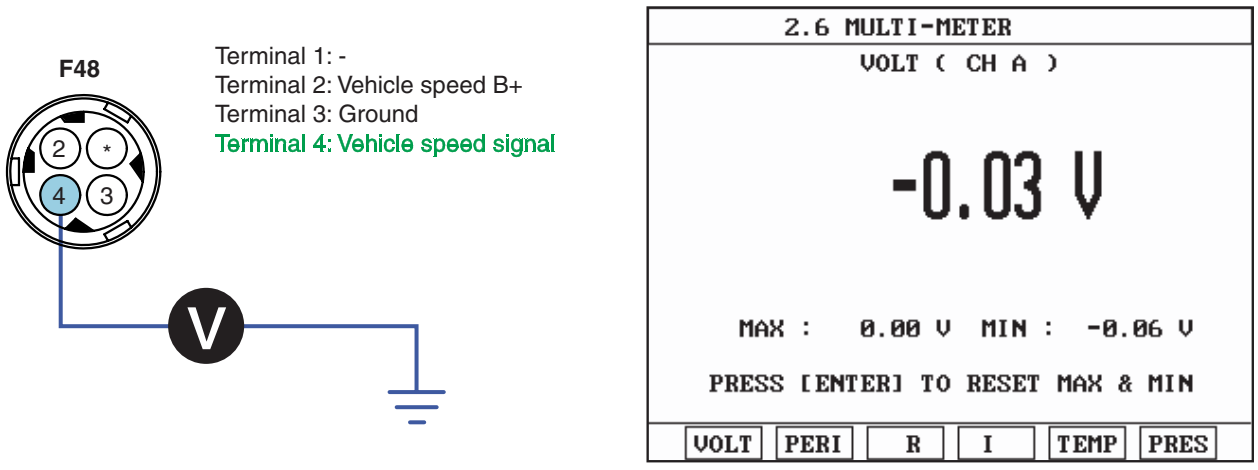
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. Signal Short to Power Inspection

1) Disconnect vehicle speed sensor connector(F48) and ECM connector(F39-4).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 4 of vehicle speed sensor harness connector and chassis ground.



SNBFL8098L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Signal Short to Ground Inspection" procedure.

NO

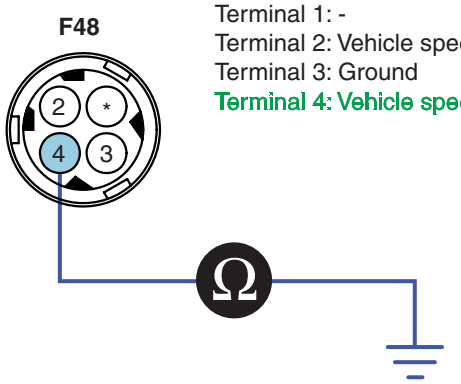
▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

4. Signal Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect vehicle speed sensor connector(F48) and ECM connector(F39-4).

3) Measure resistance between terminal 4 of vehicle speed sensor harness connector and chassis ground.



Terminal 1: -
Terminal 2: Vehicle speed B+
Terminal 3: Ground
Terminal 4: Vehicle speed signal

SNBFL8099L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

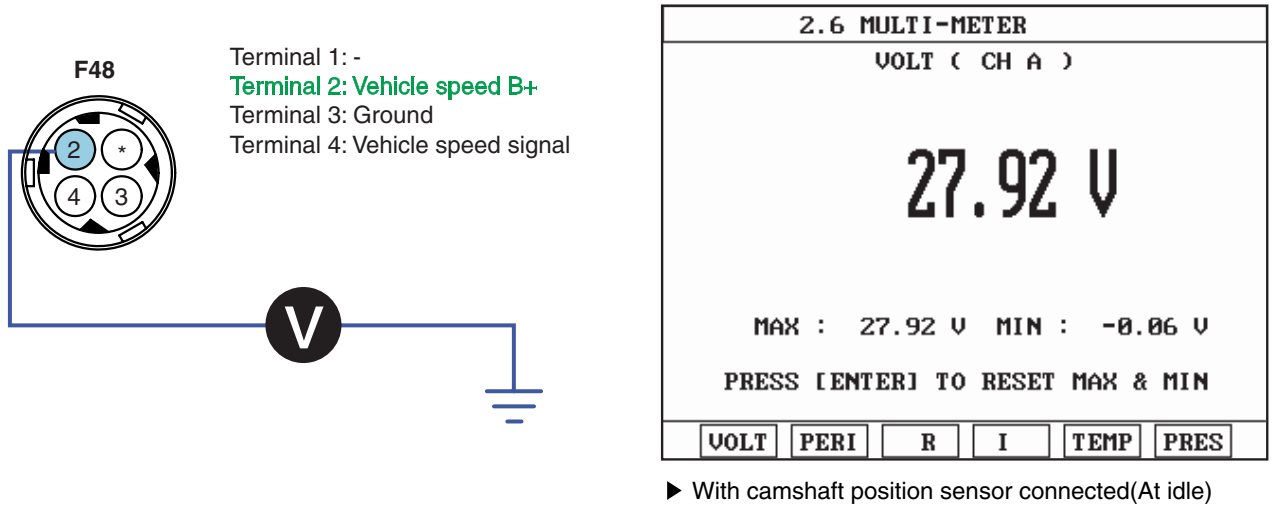
POWER SUPPLY INSPECTION E4A20CFF

1. Power Supply Voltage Inspection

1) Leave vehicle speed sensor connector(F48) connected.

2) Turn the ignition ON. Start the engine.

3) Measure voltage between terminal 2 of vehicle speed sensor harness connector and chassis ground.



▶ With camshaft position sensor connected(At idle)

SNBFL8100L

■ Specification: Vehicle speed sensor supply power B+ V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

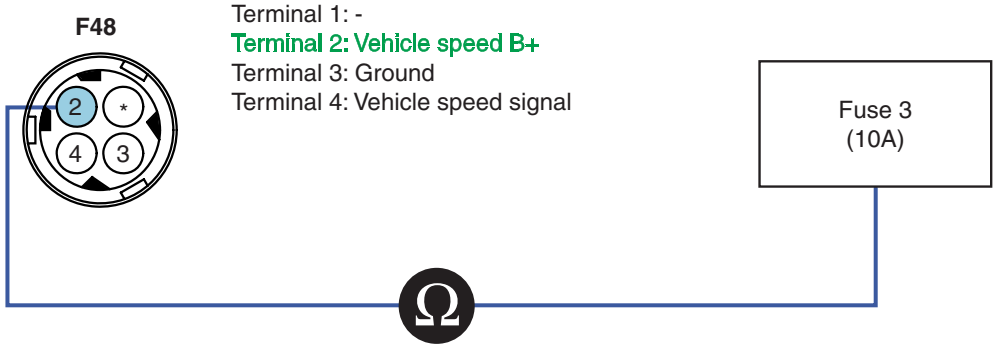
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn the ignition OFF.

2) Disconnect vehicle speed sensor connector(F48) and ECM connector(F39-4).

3) Measure resistance between terminal 2 of vehicle speed sensor harness connector and fuse 11(10A).



SNBFL8101L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

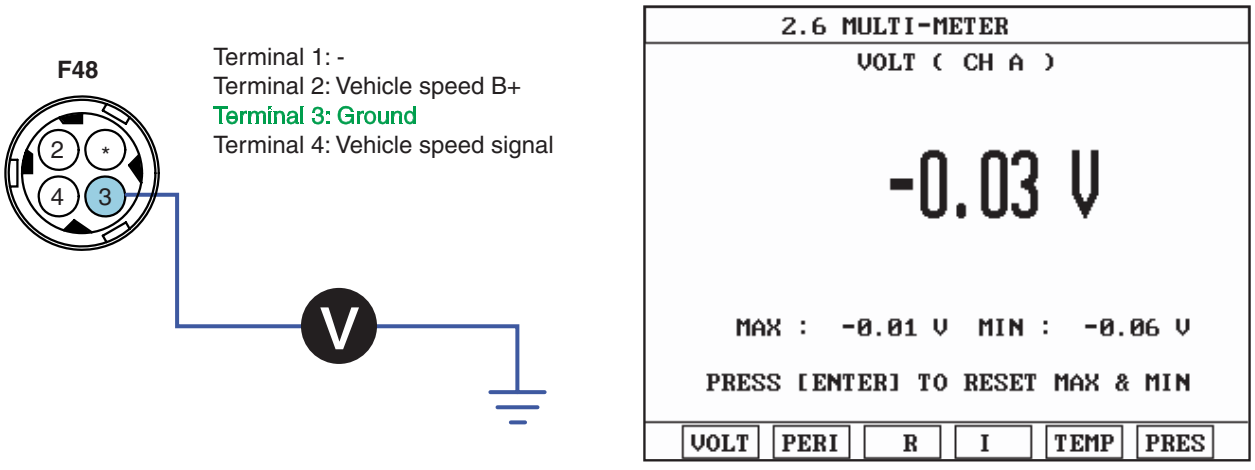
GROUND CIRCUIT INSPECTION E85379CE

1. Ground Voltage Drop Inspection

   1) Disconnect vehicle speed sensor connector(F48) and ECM connector(F39-4).

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage drop between terminal 3 of vehicle speed sensor connector(F48) and chassis ground.



SNBFL8102L

■ Specification: Ground voltage drop- within 200mV

   4) Is the voltage drop measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

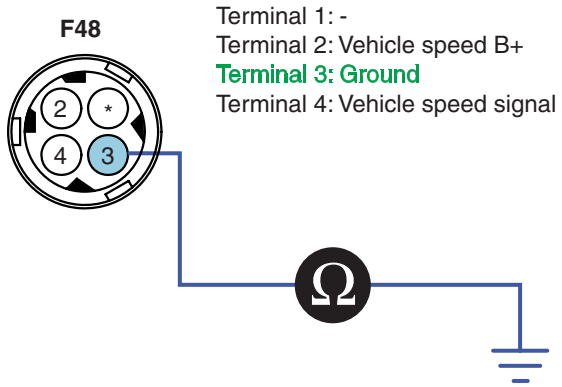
▶ Repair the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

   1) Turn ignition OFF.

   2) Disconnect vehicle speed sensor connector(F48) and ECM connector(F39-4).

   3) Measure resistance between terminal 3 of vehicle speed sensor harness connector and ground part.



SNBFL8103L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

COMPONENT INSPECTION EDFB3EE9

1. Vehicle Speed Sensor Waveform Inspection

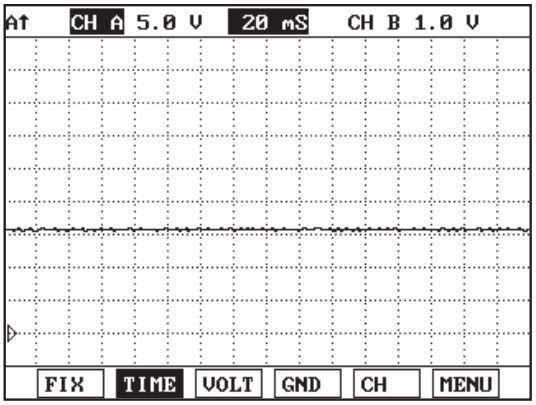
1) Turn ignition ON. The engine stops.

2) Connect vehicle speed sensor connector(F48) and ECM connector(F39-4).

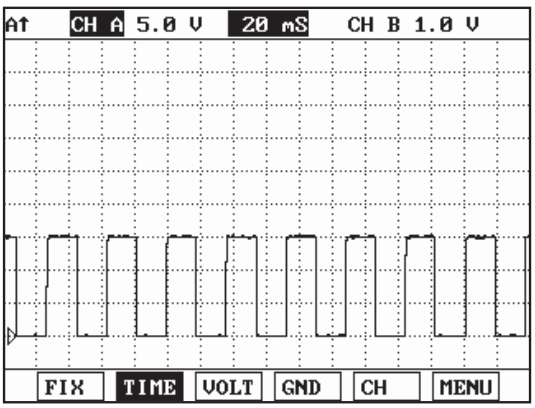
3) Connect oscilloscope to terminal 4 of vehicle speed sensor connector.

4) Check vehicle speed sensor waveform for normal operation while driving.
■ Specification

Vehicle speed sensor waveform
(0km/h at stop)



Vehicle speed sensor waveform
(20km/h at driving)



SUDFL8226L

5) Is the crankshaft position sensor waveform normal?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the vehicle speed sensor and then go to "Verification of Vehicle Repair" procedure.

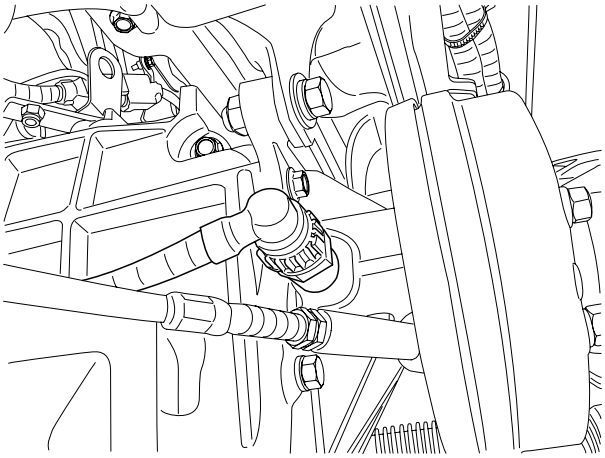
VERIFICATION OF VEHICLE REPAIR ECE1C8D2

Refer to DTC P0112.

DTC P0502 VEHICLE SPEED SENSOR(VSS) INPUT OPEN / SHORT

COMPONENT LOCATION EB2F1996

Vehicle speed sensor



SUDFL8501L

DESCRIPTION EA2DCE6F

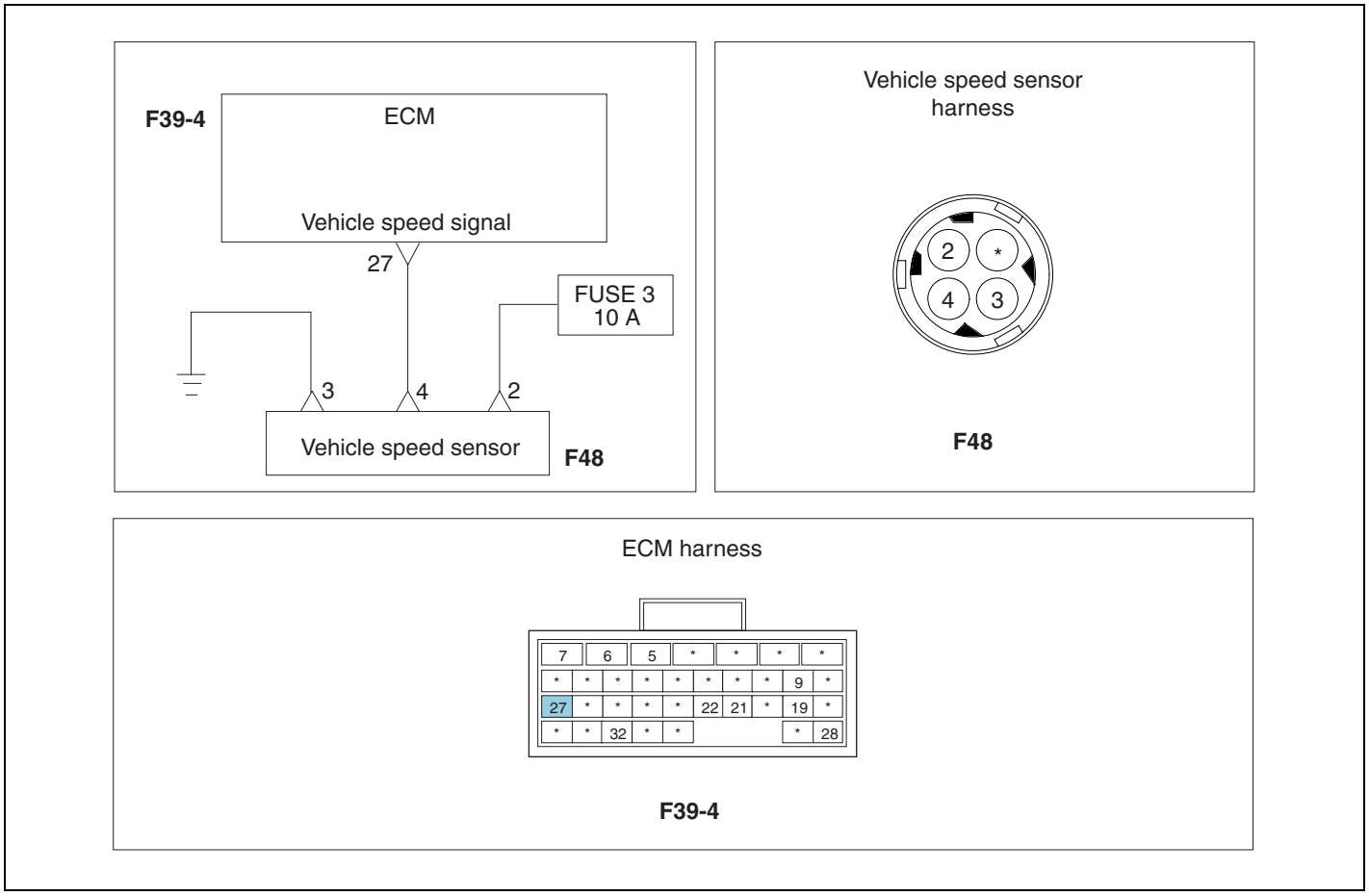
1. GENERAL DESCRIPTION
   Vehicle speed sensor which is hall sensor type detects vehicle speed by sensing the revolution of transmission output shaft. If the vehicle speed sensor sends signal to ECM, the signal is used not only for correction signal to calculate optimum fuel amount by comparing current engine revolution and vehicle speed but also for vehicle gauge signal and vehicle information to ETACS.

2. DTC DESCRIPTION
   If the vehicle speed sensor signal while driving is detected below 0.1km/h for 1,200ms or more to ECM, the ECM judges this as a fault and DTC is set. At this moment the following conditions should be satisfied: 1,200rpm or more of engine speed, 20℃ or more of engine coolant temperature, not neutral position of gear range, 60㎣/st or more of fuel amount. The possible cause may be open or short to vehicle speed sensor or vehicle speed sensor malfunction etc. As vehicle speed signal is not input, it is impossible for ECM to detect gear range. And also it is impossible to control PTO, if equipped.

DTC DETECTING CONDITION EF76788F

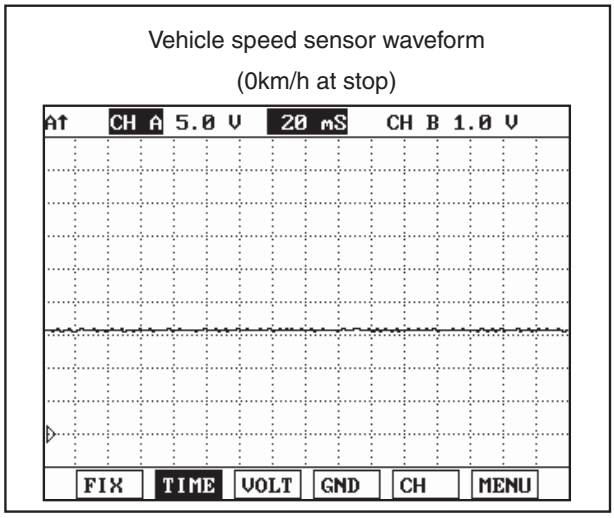
<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="6">• Vehicle speed sensor malfunction
• Open or short to wiring</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• When vehicle speed is detected as 0.1km/h while driving after satisfying condition.</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 1,200ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• Impossible to detect gear range
• Impossible to control PTO(if equipped)</td></tr>
<tr><td>Fuel Limit</td><td>No</td></tr>
<tr><td>MIL</td><td>OFF</td></tr>
</table>

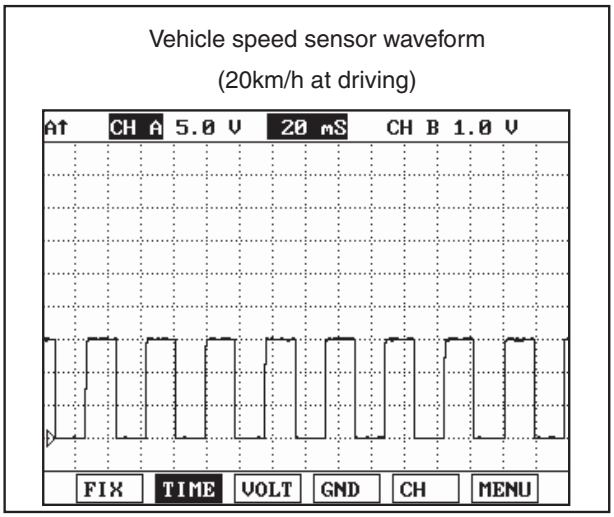
SCHEMATIC DIAGRAM E1BB00D9



SNBFL8095L

SIGNAL WAVEFORM E62B5725





SUDFL8226L

MONITOR SCAN TOOL DATA E09CB9D1

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.

3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Vehicle speed" parameter on the scan tool.

NOTE

The information on stopping and driving of "Vehicle speed" depending on engine operation conditions will be displayed. (Refer to voltage change from "Control information and simulation".)

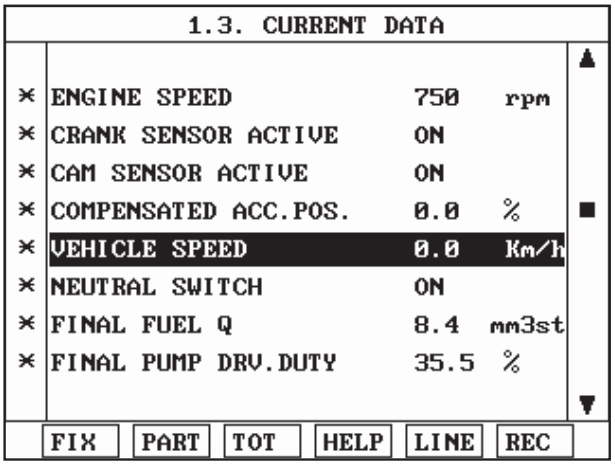


Fig. 1 "Vehicle speed" data at idle

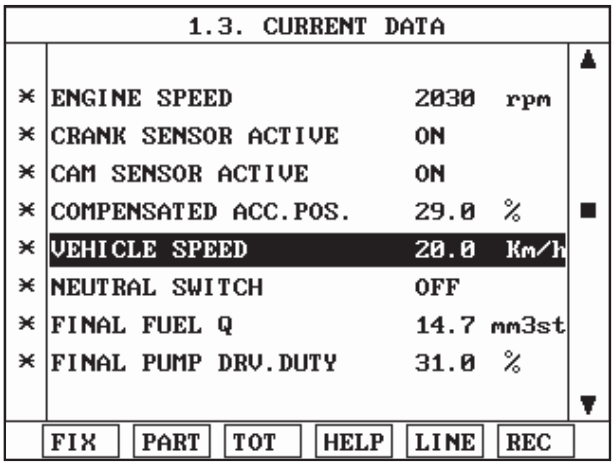


Fig. 2 "Vehicle speed" at 20km/h

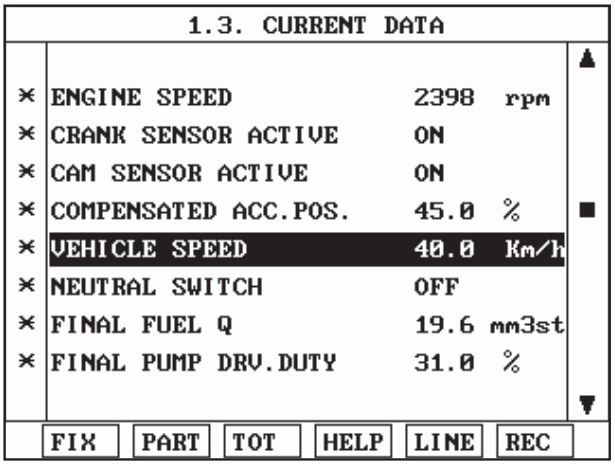


Fig. 3 "Vehicle speed" at 40km/h

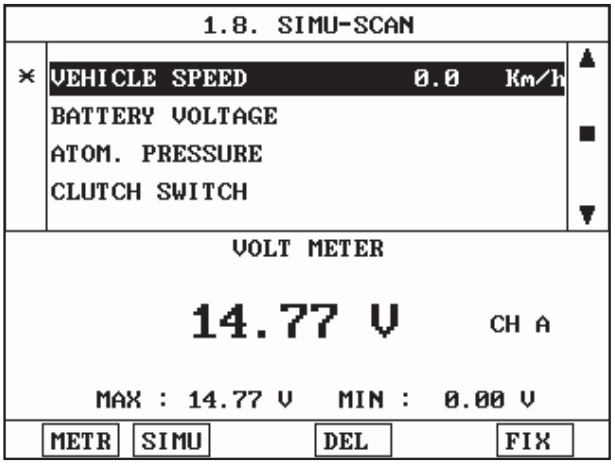


Fig. 4 "Vehicle speed" control information at 0km/h

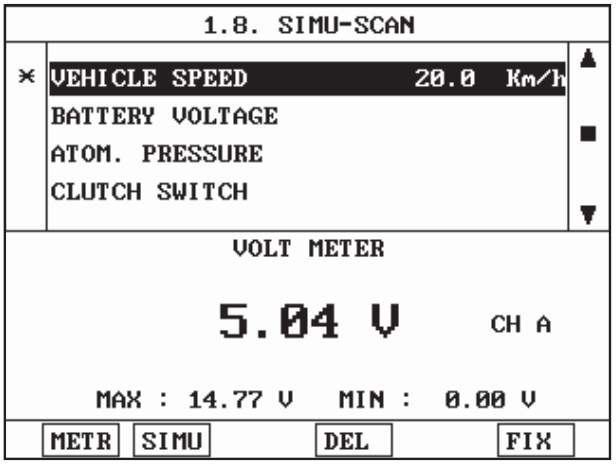


Fig. 5 "Vehicle speed" control information at 20km/h

SUDFL8227L

TERMINAL & CONNECTOR INSPECTION E15B8FA0

Refer to DTC P0112.

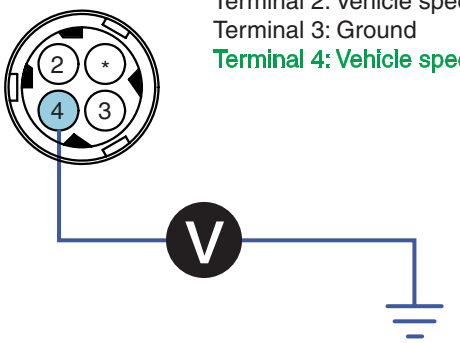
SIGNAL CIRCUIT INSPECTION E3871B46

1. Signal Voltage Inspection

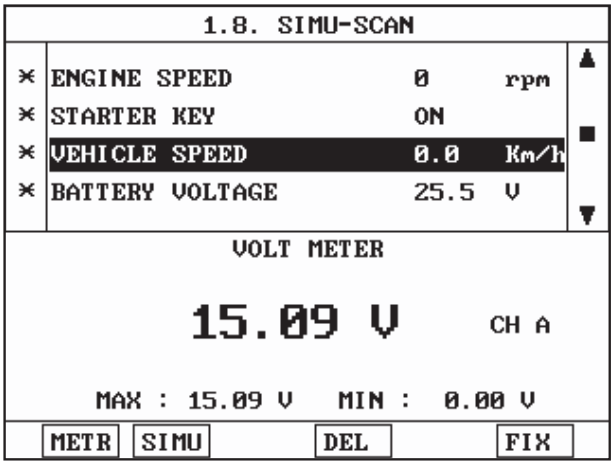
   1) Leave the vehicle speed sensor connector(F48) connected.

   2) Turn the ignition ON. Start the engine.

   3) Measure voltage between terminal 4 of the vehicle speed sensor harness connector and chassis ground.



Terminal 1: -
Terminal 2: Vehicle speed B+
Terminal 3: Ground
Terminal 4: Vehicle speed signal



▶ With vehicle speed sensor connector connected (At ignition ON)

SNBFL8096L

■ Specification: Vehicle speed sensor signal power approx. 16.39 V

   4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

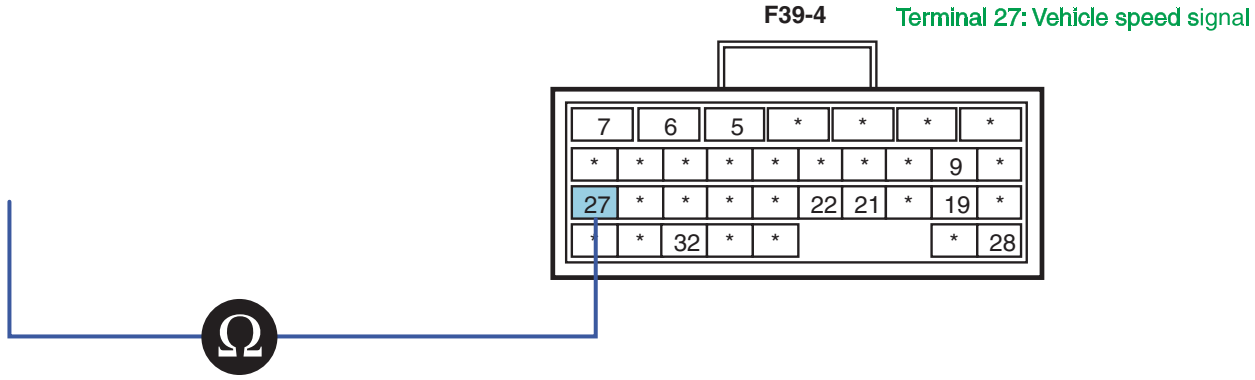
▶ Go to "Signal Open Inspection" procedure.

2. Signal Open Inspection

   1) Turn ignition OFF.

   2) Disconnect vehicle speed sensor connector(F48) and ECM connector(F39-4).

   3) Measure resistance between terminal 4 of vehicle speed sensor harness connector and terminal 27 of ECM connector(F39-4).


F39-4
Terminal 27: Vehicle speed signal
7
6
5
9
27
22
21
19
32
28
Ω

▶ Go to "Signal Short to Ground Inspection" procedure.

NO

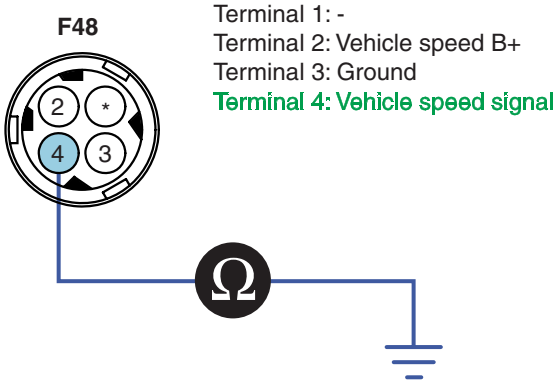
▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

4. Signal Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect vehicle speed sensor connector(F48) and ECM connector(F39-4).

3) Measure resistance between terminal 4 of vehicle speed sensor harness connector and chassis ground.



SNBFL8099L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

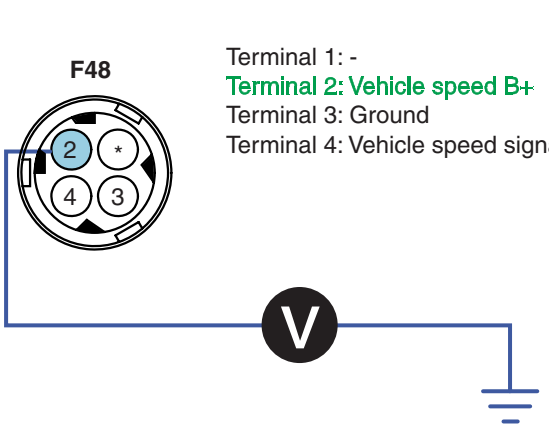
POWER SUPPLY INSPECTION EB219A0F

1. Power Supply Voltage Inspection

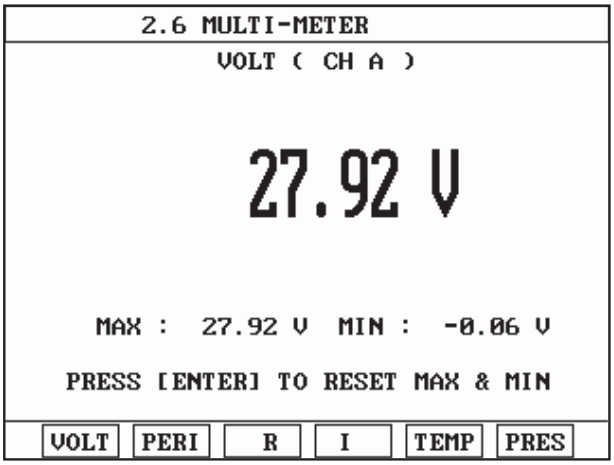
1) Leave vehicle speed sensor connector(F48) connected.

2) Turn the ignition ON. Start the engine.

3) Measure voltage between terminal 2 of vehicle speed sensor harness connector and chassis ground.



Terminal 1: -
Terminal 2: Vehicle speed B+
Terminal 3: Ground
Terminal 4: Vehicle speed signal



▶ With camshaft position sensor connected(At idle)

SNBFL8100L

■ Specification: Vehicle speed sensor supply power B+ V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

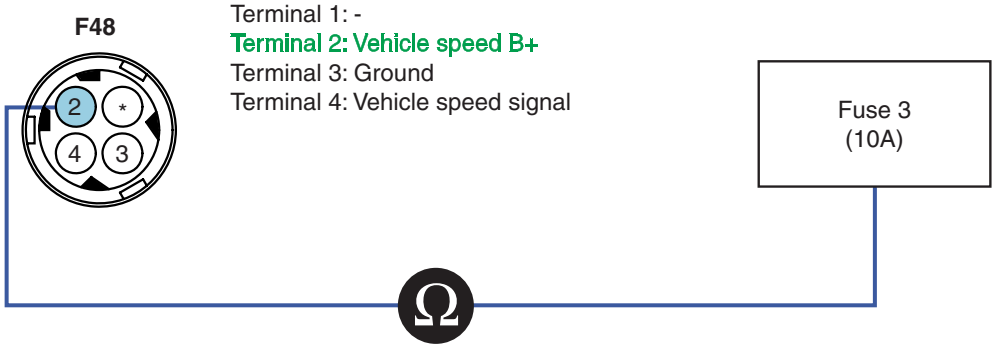
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn the ignition OFF.

2) Disconnect vehicle speed sensor connector(F48) and ECM connector(F39-4).

3) Measure resistance between terminal 2 of vehicle speed sensor harness connector and fuse 11(10A).



Terminal 1: -
Terminal 2: Vehicle speed B+
Terminal 3: Ground
Terminal 4: Vehicle speed signal

SNBFL8101L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

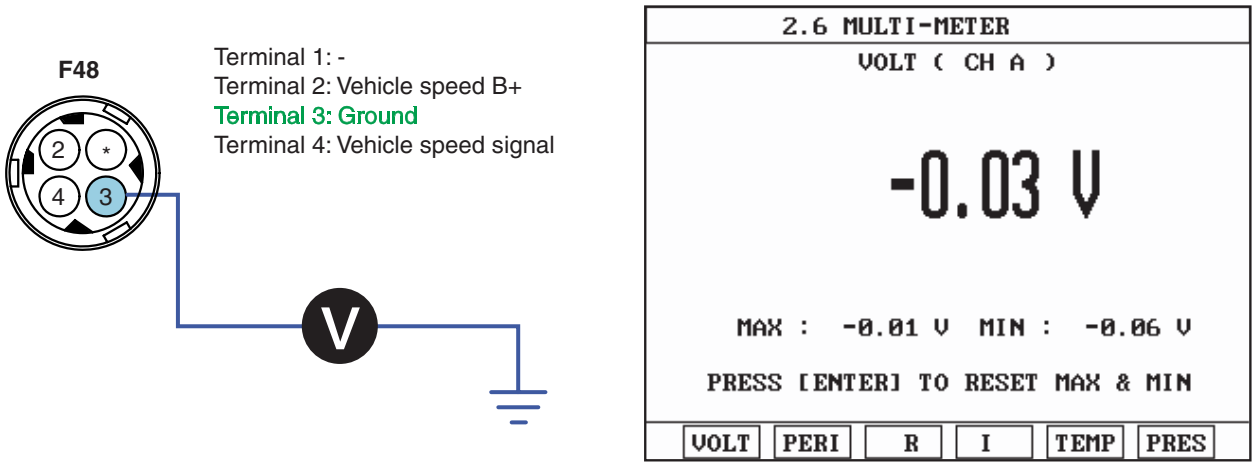
GROUND CIRCUIT INSPECTION EB1BA578

1. Ground Voltage Drop Inspection

   1) Disconnect vehicle speed sensor connector(F48) and ECM connector(F39-4).

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage drop between terminal 3 of vehicle speed sensor connector(F48) and chassis ground.



SNBFL8102L

■ Specification: Ground voltage drop- within 200mV

   4) Is the voltage drop measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

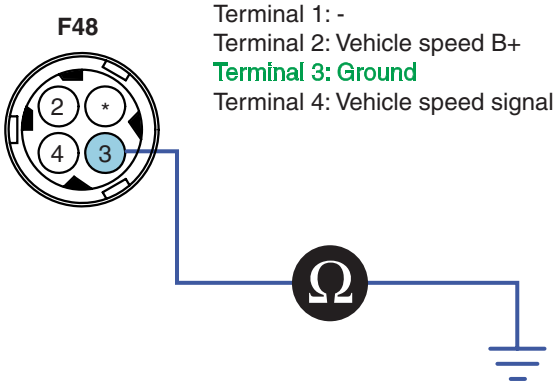
▶ Repair the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

   1) Turn ignition OFF.

   2) Disconnect vehicle speed sensor connector(F48) and ECM connector(F39-4).

   3) Measure resistance between terminal 3 of vehicle speed sensor harness connector and ground part.



SNBFL8103L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

COMPONENT INSPECTION ECD49288

1. Vehicle Speed Sensor Waveform Inspection

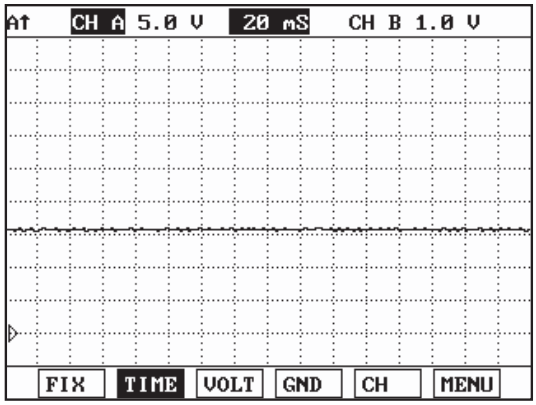
1) Turn ignition ON. The engine stops.

2) Connect vehicle speed sensor connector(F48) and ECM connector(F39-4).

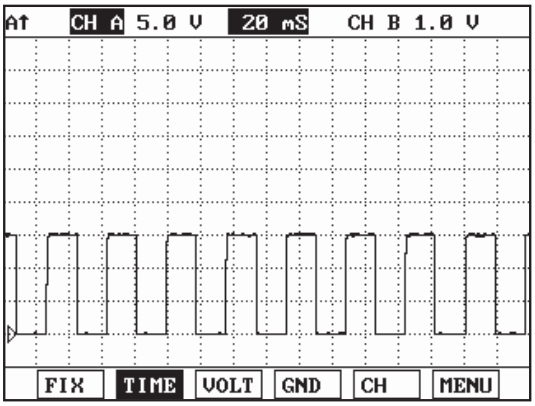
3) Connect oscilloscope to terminal 4 of vehicle speed sensor connector.

4) Check vehicle speed sensor waveform for normal operation while driving.
■ Specification

Vehicle speed sensor waveform
(0km/h at stop)



Vehicle speed sensor waveform
(20km/h at driving)



SUDFL8226L

5) Is the crankshaft position sensor waveform normal?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the vehicle speed sensor and then go to "Verification of Vehicle Repair" procedure.

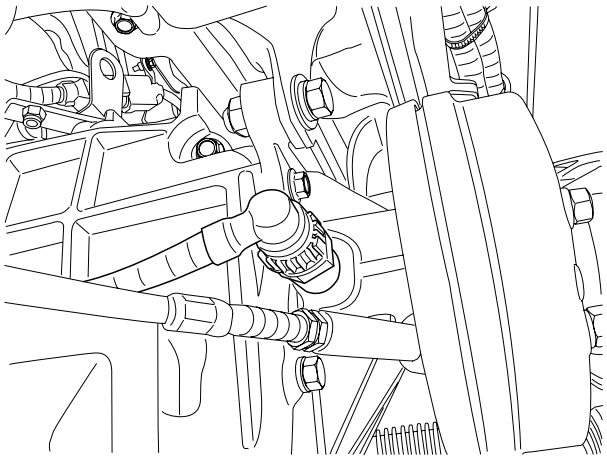
VERIFICATION OF VEHICLE REPAIR EF4C731F

Refer to DTC P0112.

DTC P0503 VEHICLE SPEED SENSOR(VSS) FREQUENCY TOO HIGH

COMPONENT LOCATION E82EE924

Vehicle speed sensor



SUDFL8501L

DESCRIPTION E610CA16

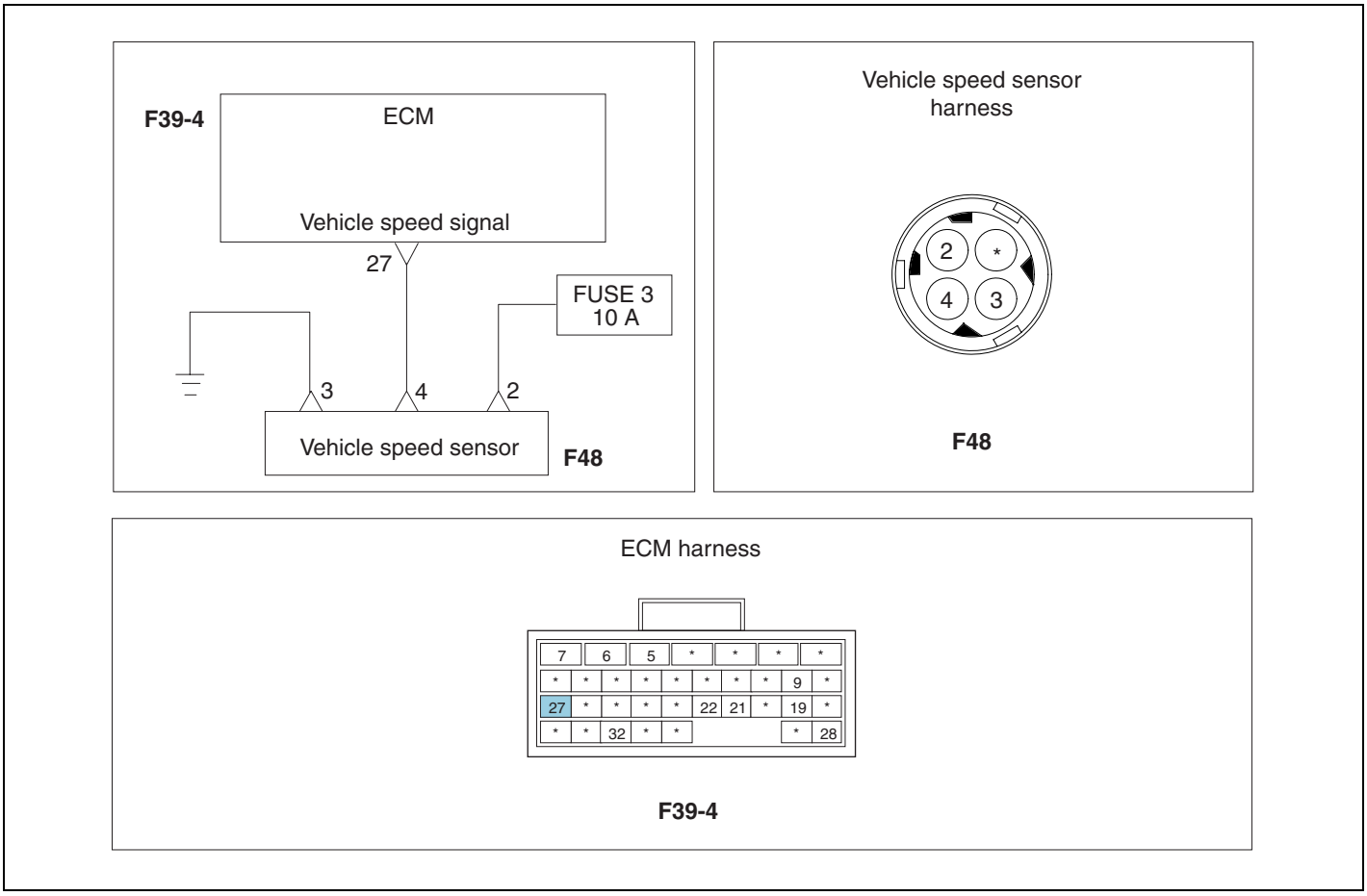
1. GENERAL DESCRIPTION
   Vehicle speed sensor which is hall sensor type detects vehicle speed by sensing the revolution of transmission output shaft. If the vehicle speed sensor sends signal to ECM, the signal is used not only for correction signal to calculate optimum fuel amount by comparing current engine revolution and vehicle speed but also for vehicle gauge signal and vehicle information to ETACS.

2. DTC DESCRIPTION
   If the vehicle speed sensor signal while driving is detected above 200km/h for 524.3ms or more, the ECM judges this as a fault and DTC is set. The possible cause may be vehicle speed sensor malfunction or entry of noise. It is impossible for the ECM to detect gear range and to control PTO(if equipped) when vehicle speed sensor signal is detected above 200km/h.

DTC DETECTING CONDITION E7809A19

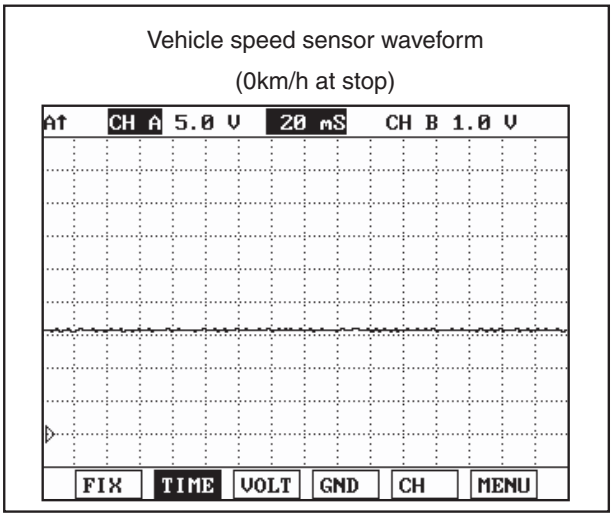
<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="5">• Vehicle speed sensor malfunction
• Noise entry to terminal 27 circuit of ECM connector(F39-4)</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• When vehicle speed is detected above 200km/h while driving</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 524.3ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• Impossible to detect gear range
• Impossible to control PTO(if equipped)</td></tr>
<tr><td>Fuel Limit</td><td>No</td></tr>
<tr><td>MIL</td><td>OFF</td></tr>
</table>

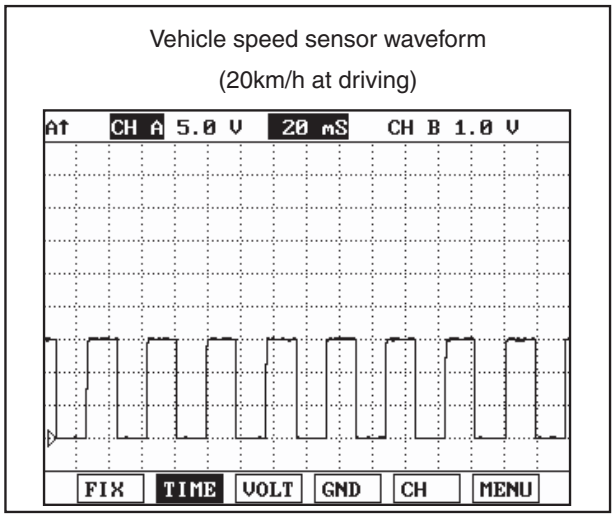
SCHEMATIC DIAGRAM E231D5CD



SNBFL8095L

SIGNAL WAVEFORM E7B151D1





SUDFL8226L

MONITOR SCAN TOOL DATA E312197E

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.

3. Turn the electric equipment and air conditioner OFF.

4. Monitor "Vehicle speed" parameter on the scan tool.

NOTE

The information on stopping and driving of "Vehicle speed" depending on engine operation conditions will be displayed. (Refer to voltage change from "Control information and simulation".)

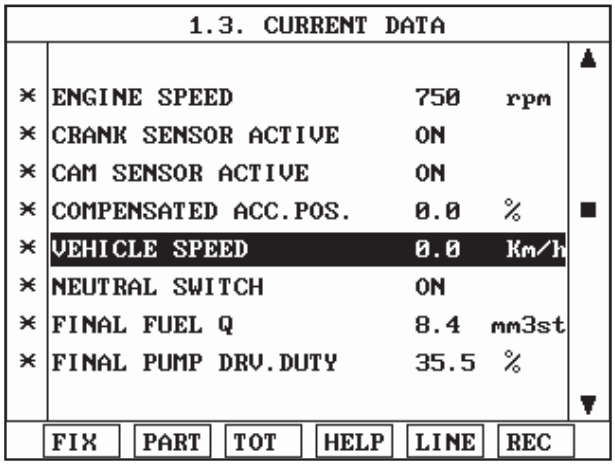


Fig. 1 "Vehicle speed" data at idle

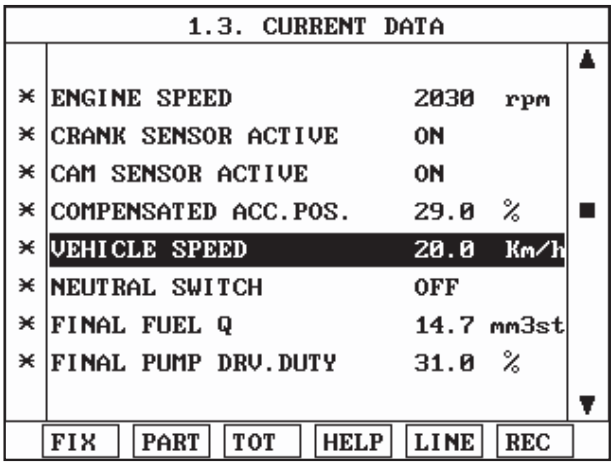


Fig. 2 "Vehicle speed" at 20km/h

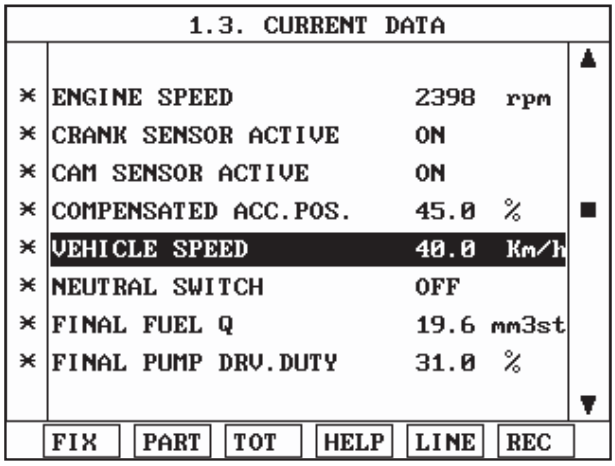


Fig. 3 "Vehicle speed" at 40km/h

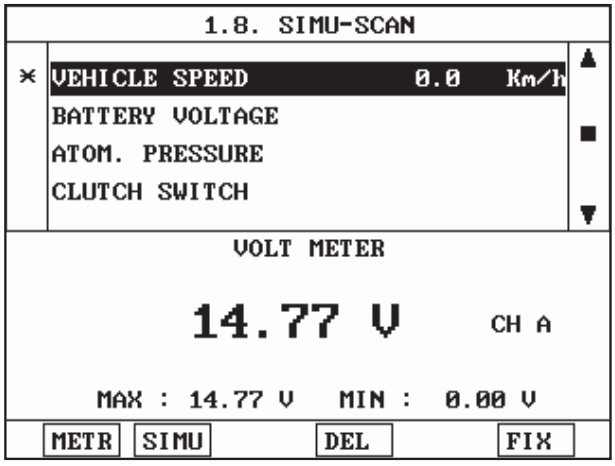


Fig. 4 "Vehicle speed" control information at 0km/h

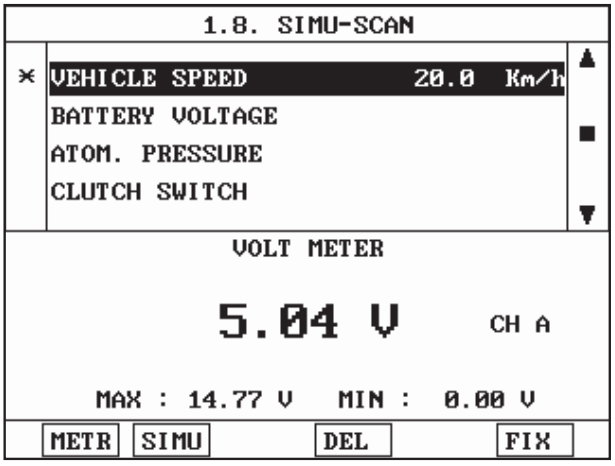


Fig. 5 "Vehicle speed" control information at 20km/h

SUDFL8227L

TERMINAL & CONNECTOR INSPECTION E5352384

Refer to DTC P0112.

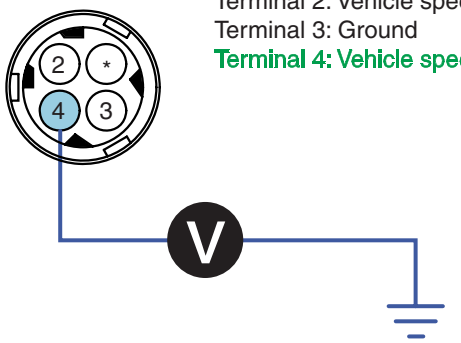
SIGNAL CIRCUIT INSPECTION EC671A0A

1. Signal Voltage Inspection

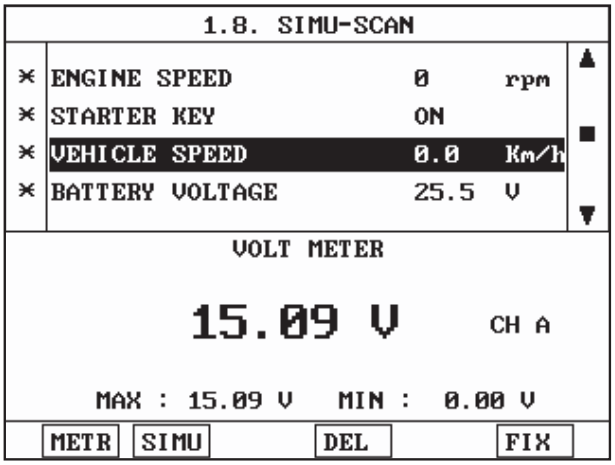
   1) Leave the vehicle speed sensor connector(F48) connected.

   2) Turn the ignition ON. Start the engine.

   3) Measure voltage between terminal 4 of the vehicle speed sensor harness connector and chassis ground.



Terminal 1: -
Terminal 2: Vehicle speed B+
Terminal 3: Ground
Terminal 4: Vehicle speed signal



▶ With vehicle speed sensor connector connected (At ignition ON)

SNBFL8096L

■ Specification: Vehicle speed sensor signal power approx. 16.39 V

   4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

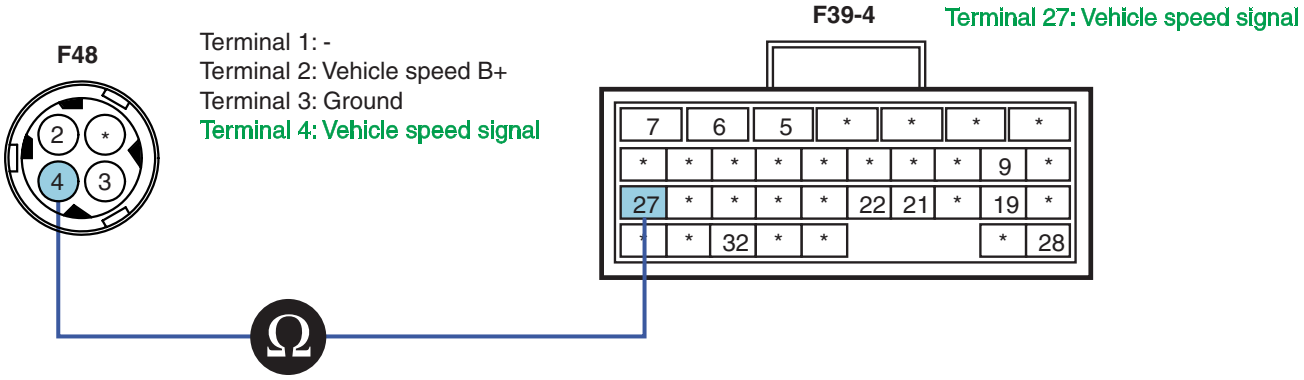
▶ Go to "Signal Open Inspection" procedure.

2. Signal Open Inspection

   1) Turn ignition OFF.

   2) Disconnect vehicle speed sensor connector(F48) and ECM connector(F39-4).

   3) Measure resistance between terminal 4 of vehicle speed sensor harness connector and terminal 27 of ECM connector(F39-4).



SNBFL8097L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Power Inspection" procedure.

NO

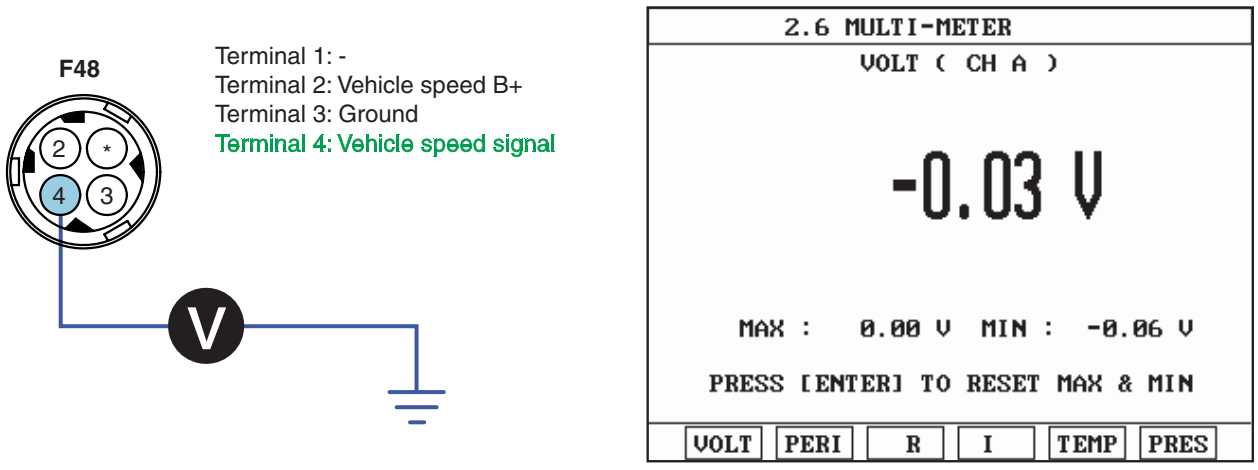
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. Signal Short to Power Inspection

1) Disconnect vehicle speed sensor connector(F48) and ECM connector(F39-4).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 4 of vehicle speed sensor harness connector and chassis ground.



SNBFL8098L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Signal Short to Ground Inspection" procedure.

NO

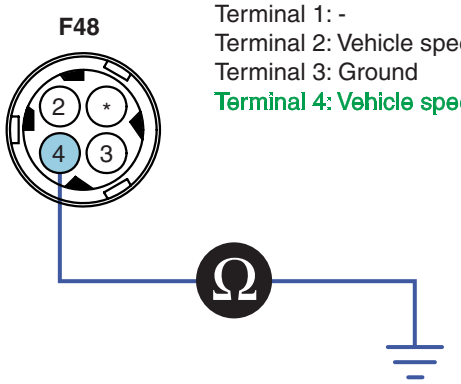
▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

4. Signal Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect vehicle speed sensor connector(F48) and ECM connector(F39-4).

3) Measure resistance between terminal 4 of vehicle speed sensor harness connector and chassis ground.



SNBFL8099L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

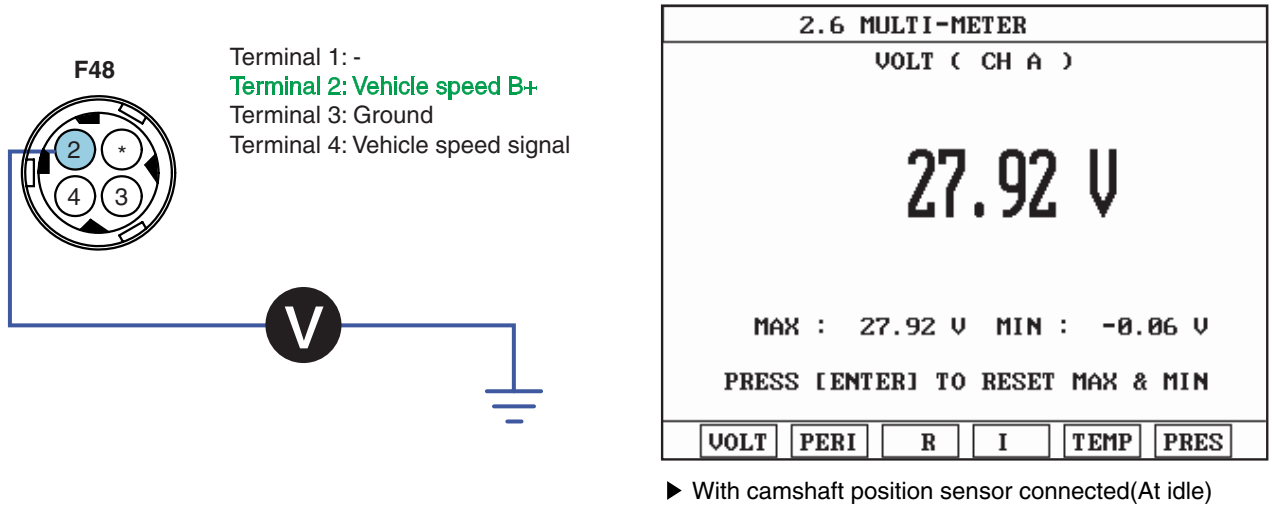
POWER SUPPLY INSPECTION EE23FAFB

1. Power Supply Voltage Inspection

1) Leave vehicle speed sensor connector(F48) connected.

2) Turn the ignition ON. Start the engine.

3) Measure voltage between terminal 2 of vehicle speed sensor harness connector and chassis ground.



▶ With camshaft position sensor connected(At idle)

SNBFL8100L

■ Specification: Vehicle speed sensor supply power B+ V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

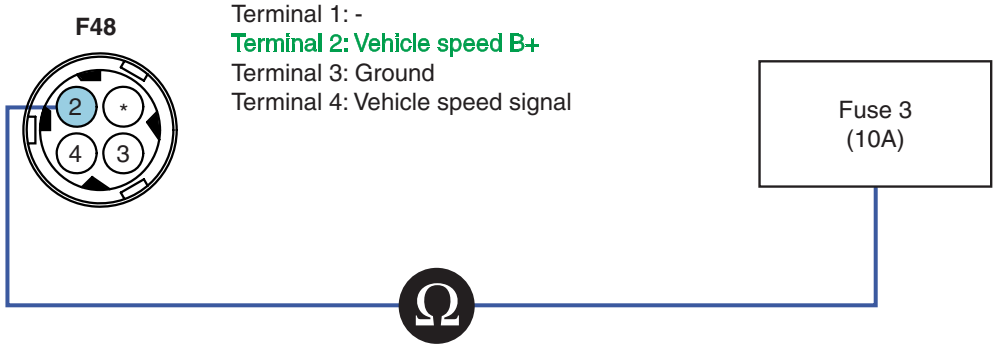
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn the ignition OFF.

2) Disconnect vehicle speed sensor connector(F48) and ECM connector(F39-4).

3) Measure resistance between terminal 2 of vehicle speed sensor harness connector and fuse 11(10A).



SNBFL8101L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

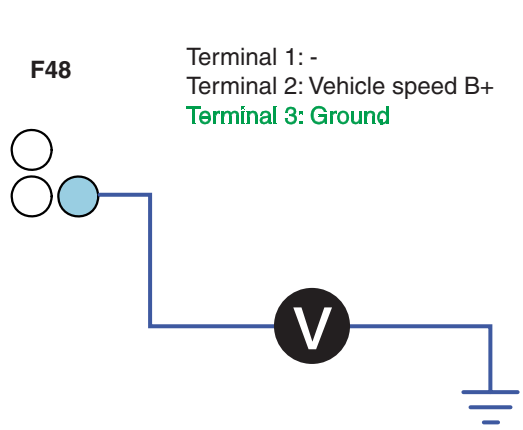
GROUND CIRCUIT INSPECTION E8B6EDC8

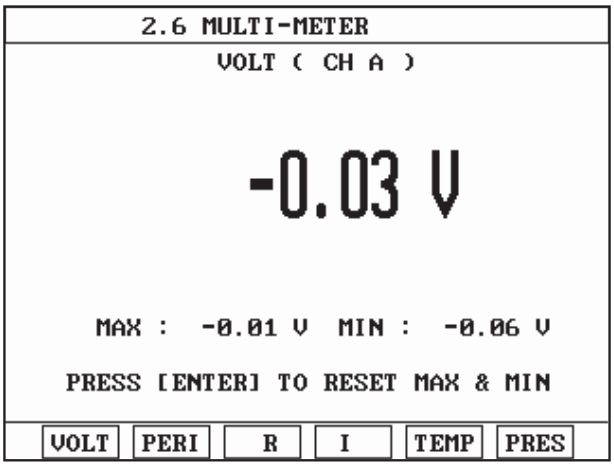
1. Ground Voltage Drop Inspection

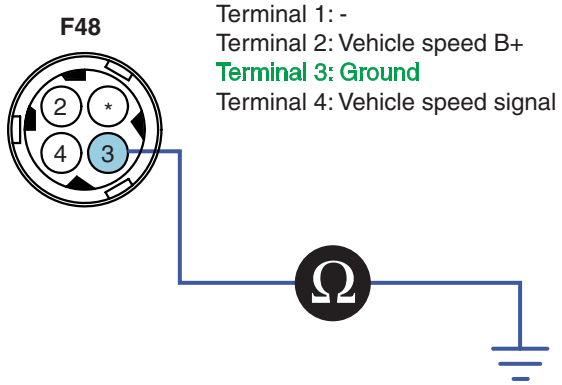
   1) Disconnect vehicle speed sensor connector(F48) and ECM connector(F39-4).

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage drop between terminal 3 of vehicle speed sensor connector(F48) and chassis ground.







SNBFL8103L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

COMPONENT INSPECTION EC500E05

1. Vehicle Speed Sensor Waveform Inspection

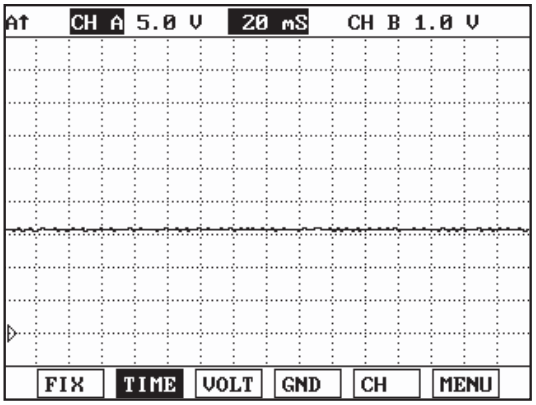
1) Turn ignition ON. The engine stops.

2) Connect vehicle speed sensor connector(F48) and ECM connector(F39-4).

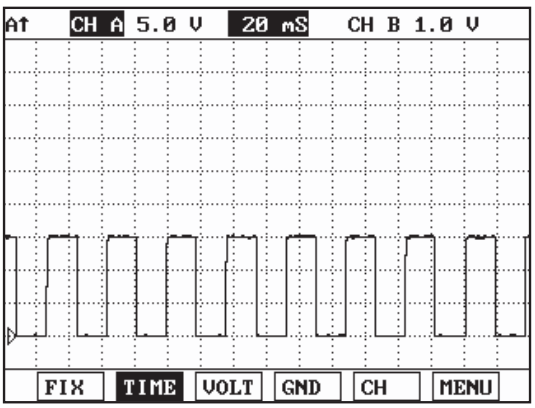
3) Connect oscilloscope to terminal 4 of vehicle speed sensor connector.

4) Check vehicle speed sensor waveform for normal operation while driving.
■ Specification

Vehicle speed sensor waveform
(0km/h at stop)



Vehicle speed sensor waveform
(20km/h at driving)



SUDFL8226L

5) Is the crankshaft position sensor waveform normal?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the vehicle speed sensor and then go to "Verification of Vehicle Repair" procedure.

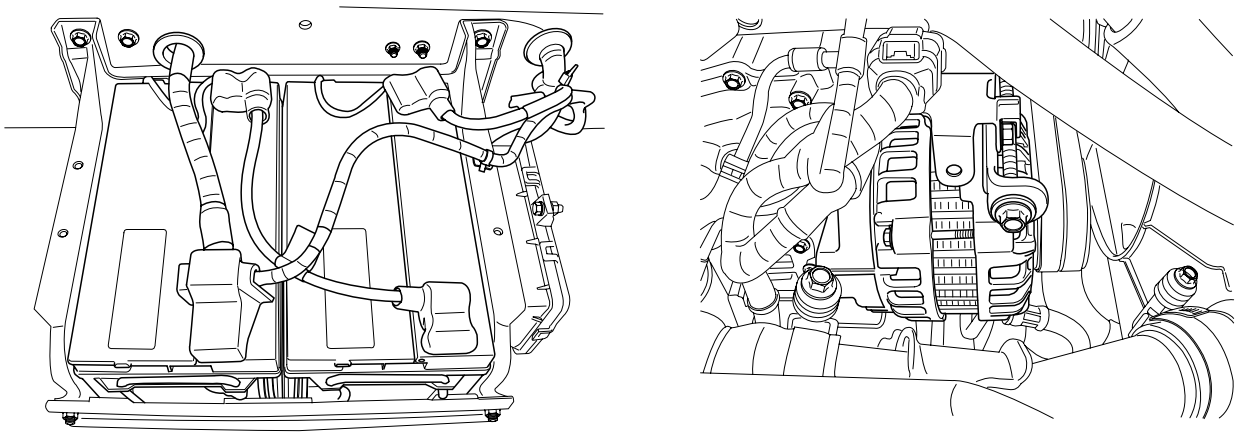
VERIFICATION OF VEHICLE REPAIR E72ADBAE

Refer to DTC P0112.

DTC P0562 SYSTEM VOLTAGE LOW

COMPONENT LOCATION EE8C6872

Battery & Charging system



SUDFL8502L

DESCRIPTION E25AD438

1. GENERAL DESCRIPTION
   The battery voltage will be fluctuated from 23.5V~28.5V, if the battery is normal. The voltage drop at cranking will occur rapidly. The actuators such as injectors, fuel supply pump and rail sensor request the precise control and the characteristics value of the actuators changes according to battery voltage change. The ECM corrects the operation time of actuator depending on voltage change by monitoring battery voltage change to correct characteristics value of actuator according to voltage change like this.

2. DTC DESCRIPTION
   If the battery voltage is detected below 16V for 10,485.6ms or more, the ECM judges this as a fault and DTC is set. The possible cause may be faulty charging system(Battery, alternator component and charging circuit) and wrong voltage of terminals 5,6 and 7 of ECM connector(F39-4).

DTC DETECTING CONDITION EE1437E0

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Check battery. • Check charge circuit. • Check voltage of terminal 5,6 and 7 of ECM connector(F39-4).
Enable Conditions	• At IG ON			
Threshold Value	• Battery voltage: Below 16V			
Diagnosis Time	• 10,485.6ms or more			
Fail Safe	Fuel Cut	No	• Impossible to start the engine	
	Fuel Limit	No		
	MIL	OFF		

SPECIFICATION EFEB866E

1. Regulator voltage

Regulator Temp.(°C)	Regulating voltage(V)
20~30	27.5~28.5V

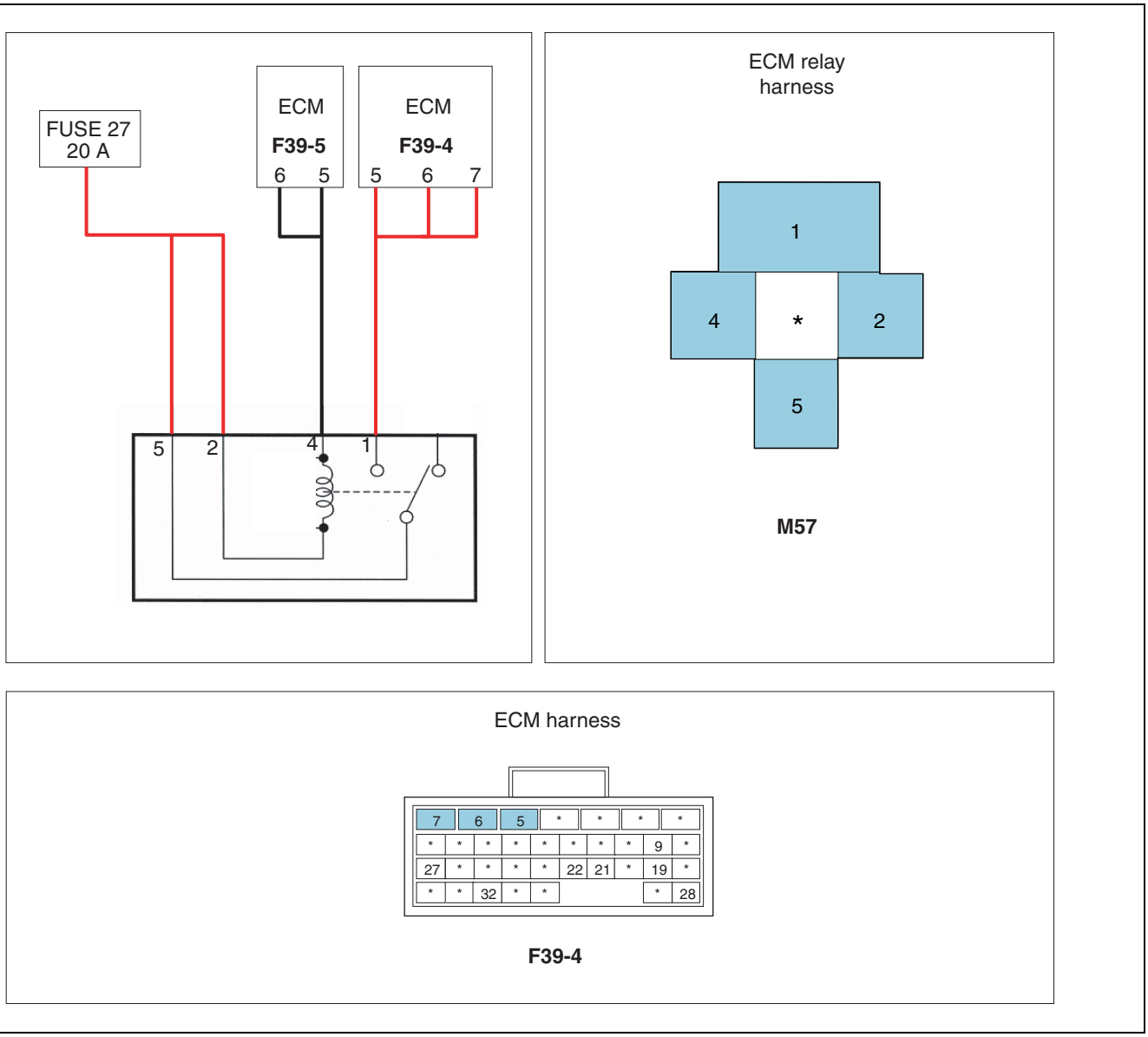
2. Specified resistance between relay terminals

Terminal 85-86 resistance(20°C)	Terminal 30-87a resistance	Terminal 85-86 when applying power
340Ω ±10%	0Ω (Continuity)	Terminal 30-87 0Ω (Continuity)

3. Specified voltage between relay connector terminals(At IG ON)

Terminal 86 voltage	Terminal 87a voltage	Terminal 30 voltage
B+ V	B+ V	B+ V

SCHEMATIC DIAGRAM E812EDEB



SNBFL8104L

SIGNAL WAVEFORM EE849816

■ Specification: 24.5~28.5V at idle

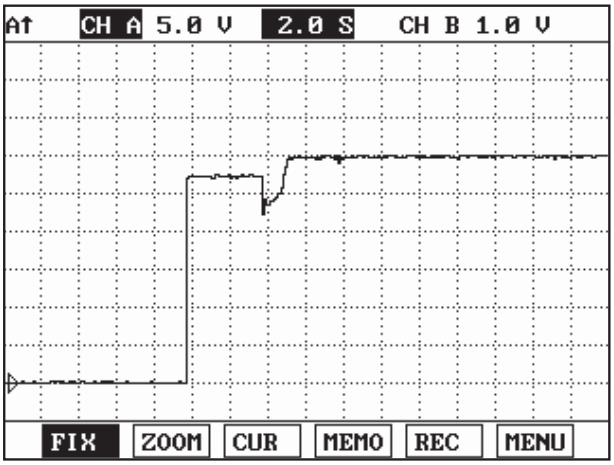


Fig. 1

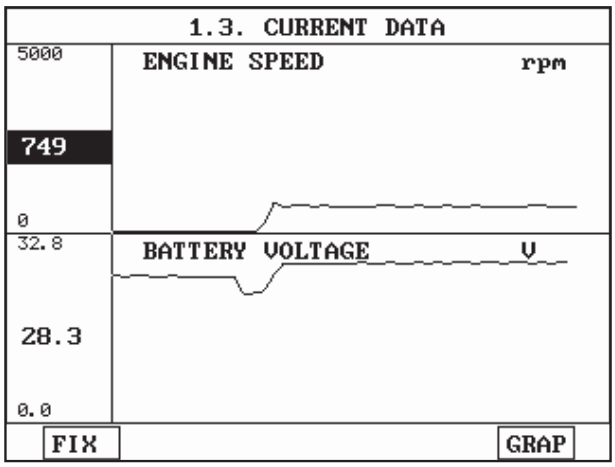


Fig. 2

Fig1) Ignition ON, keep idle state after starting the engine.(ECM 99-1 : 5,6,7 terminal)
Fig2) is output data of "Battery voltage" after engine warming-up. Operating various electric systems, check that voltage is lowered severely and symptoms below show up.

SUDFL8237L

Vehicle features that the poor charging in alternator occurs:

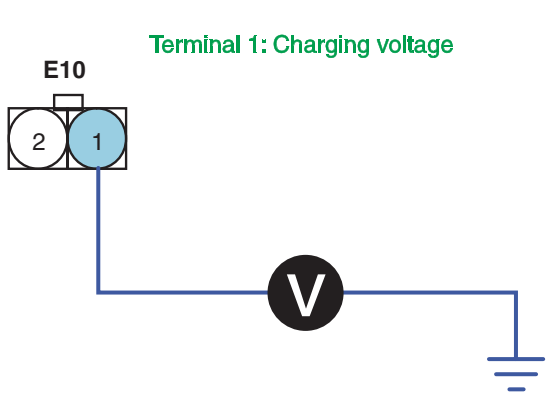
1. Lamps are getting darker at idle and are getting lighter at accelerating.
2. Engine revolution is down severely at near idle(Lower speed) and the engine stalls intermittently.
3. Smooth cranking is difficult.(Brightness of warning lamps in the cluster at cranking gets dark severely and there is no power at cranking the engine.
4. Charging warning lamp in the cluster comes on while driving.

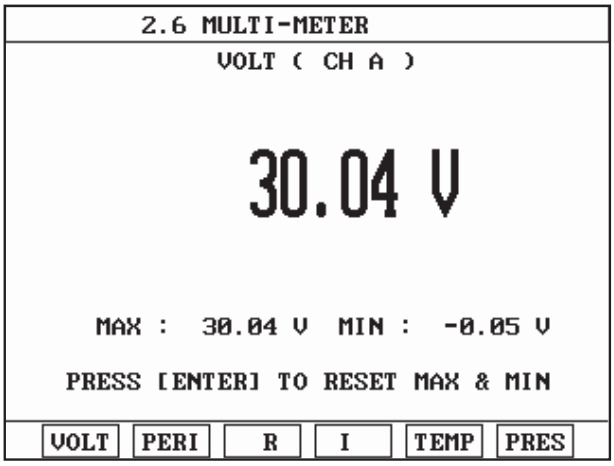
TERMINAL & CONNECTOR INSPECTION E1EF806E

Refer to DTC P0112.

POWER SUPPLY INSPECTION E9E54707

1. Alternator Connector Supply Power Inspection
   1) Leave vehicle alternator connector(E10)connected.
   2) Turn the ignition ON. Start the engine.
   3) Measure voltage between terminal 1 of alternator connector and chassis ground.





* Data can be different depending on measuring device.

SNBFL8105L

■ Specification: Charging voltage B V

4) Is the voltage measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

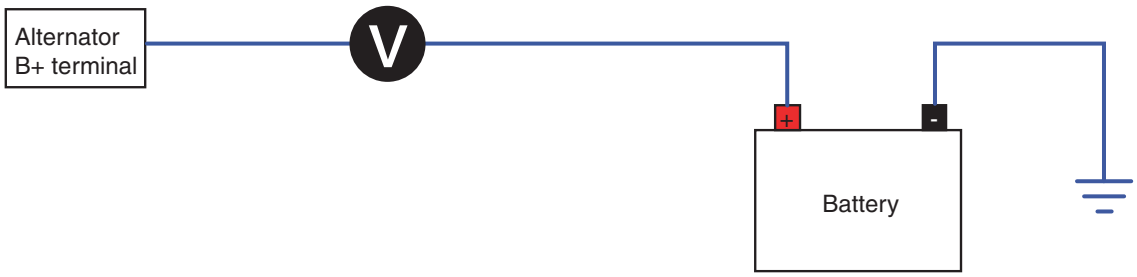
NO

▶ Go to "Alternator B+ Cable Voltage Drop Inspection" procedure.

2. Alternator B+ Cable Voltage Drop Inspection

1) Turn the ignition ON. Start the engine.

2) Measure voltage difference between terminals of alternator B+ and battery B+. (Connect terminal "+" of multi-meter to terminal "B+" of alternator and terminal "-" of multi-meter to terminal "-" of battery.)



SUDFL8239L

■ Specification: Within 0.2V(200mV)

3) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Check cable terminal of alternator B+ for corrosion, burned, replace the cable if possible.
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

COMPONENT INSPECTION E98FEC93

1. Alternator Charging Voltage Inspection

   1) Turn ignition OFF. The engine stops.

   2) Check the belt tension to drive alternator.

   3) Check battery terminal, fusible link and terminal of alternator B+ for looseness and corrosion.

   4) Start the engine.

   5) Operate the electric systems of head lamp, heater wire and blower motor etc.

   6) Check battery voltage at above 750 rpm of engine revolution.

■ SPECIFICATION

Regulator temp.(°C)	Regulating voltage(V)
20~30	27.5~28.5

   7) Is the voltage measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the regulator and then go to "Verification of Vehicle Repair" procedure.

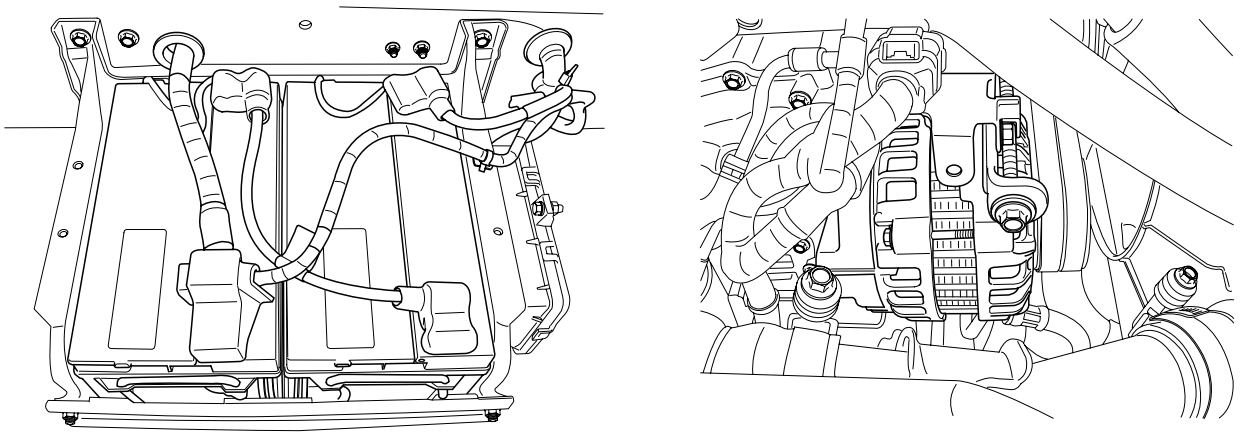
VERIFICATION OF VEHICLE REPAIR E4148078

Refer to DTC P0112.

DTC P0563 SYSTEM VOLTAGE HIGH

COMPONENT LOCATION EA98BBD8

Battery & Charging system



SUDFL8502L

DESCRIPTION E190A9E6

1. GENERAL DESCRIPTION
   The battery voltage will be fluctuated from 23.5V~28.5V, if the battery is normal. The voltage drop at cranking will occur rapidly. The actuators such as injectors, fuel supply pump and rail sensor request the precise control and the characteristics value of the actuators changes according to battery voltage change. The ECM corrects the operation time of actuator depending on voltage change by monitoring battery voltage change to correct characteristics value of actuator according to voltage change like this.

2. DTC DESCRIPTION
   If the battery voltage is detected above 32V for 10,485.6ms or more, the ECM judges this as a fault and DTC is set. The possible cause may be faulty charging system(Battery, alternator component and charging circuit) and wrong voltage of terminals 5,6 and 7 of ECM connector(F39-4).

DTC DETECTING CONDITION ECD48C6F

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Check battery. • Check charge circuit. • Check voltage of terminal 5,6 and 7 of ECM connector(F39-4).
Enable Conditions	• At IG ON			
Threshold Value	• Battery voltage: Above 32V			
Diagnosis Time	• 10,485.6ms or more			
Fail Safe	Fuel Cut	No		
	Fuel Limit	No		
	MIL	OFF		

SPECIFICATION EBF1DCA2

1. Regulator voltage

Regulator Temp.(°C)	Regulating voltage(V)
20~30	27.5~28.5V

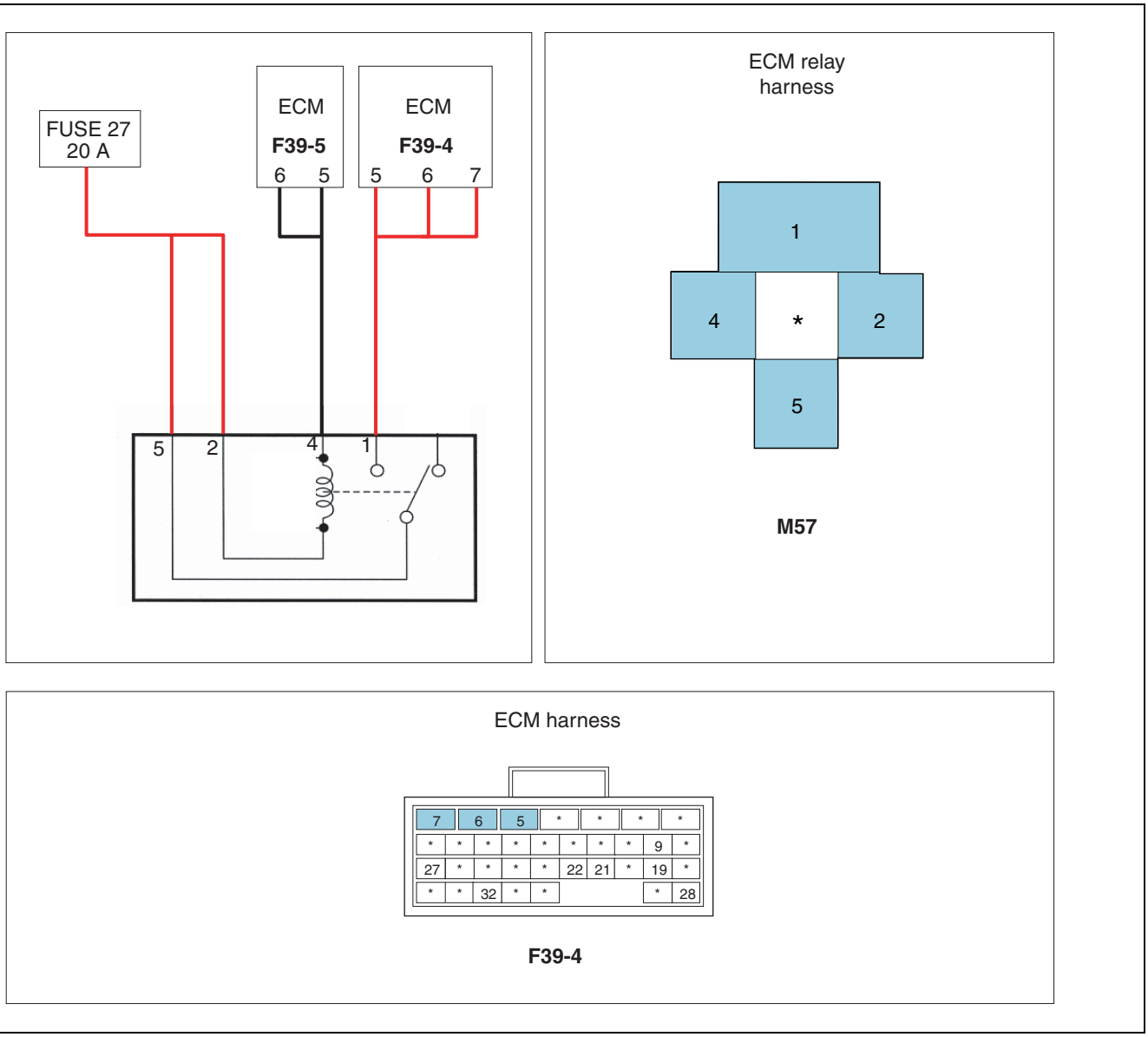
2. Specified resistance between relay terminals

Terminal 85-86 resistance(20°C)	Terminal 30-87a resistance	Terminal 85-86 when applying power
340Ω ±10%	0Ω (Continuity)	Terminal 30-87 0Ω (Continuity)

3. Specified voltage between relay connector terminals(At IG ON)

Terminal 86 voltage	Terminal 87a voltage	Terminal 30 voltage
B+ V	B+ V	B+ V

SCHEMATIC DIAGRAM E9583B82



SNBFL8104L

SIGNAL WAVEFORM EA62C4BB

■ Specification: 24.5~28.5V at idle

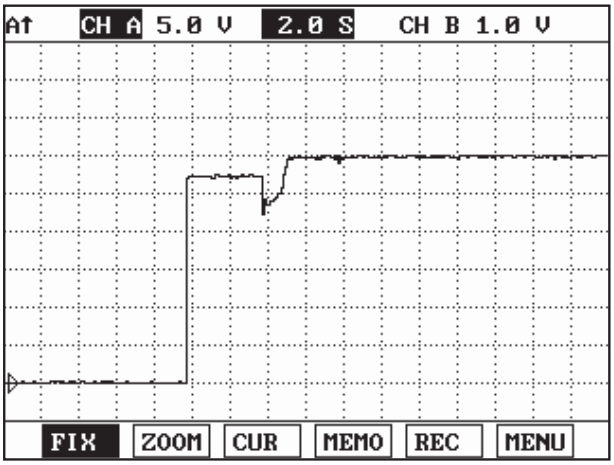


Fig. 1

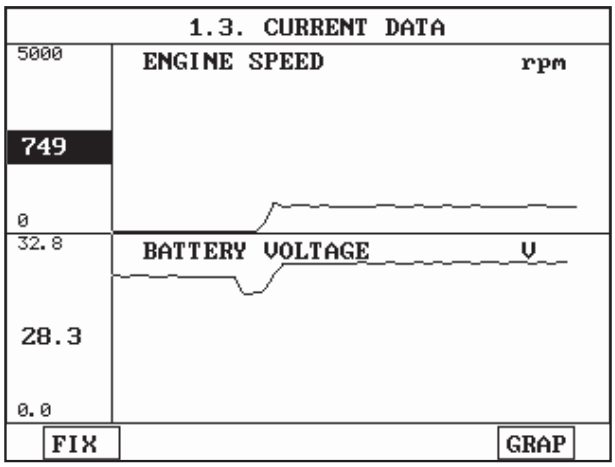


Fig. 2

Fig1) Ignition ON, keep idle state after starting the engine.(ECM 99-1 : 5,6,7 terminal)
Fig2) is output data of "Battery voltage" after engine warming-up. Operating various electric systems, check that voltage is lowered severely and symptoms below show up.

SUDFL8237L

Vehicle features that the poor charging in alternator occurs:

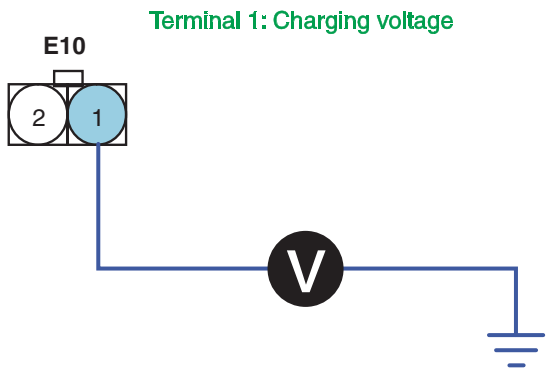
1. Lamps are getting darker at idle and are getting lighter at accelerating.
2. Engine revolution is down severely at near idle(Lower speed) and the engine stalls intermittently.
3. Smooth cranking is difficult.(Brightness of warning lamps in the cluster at cranking gets dark severely and there is no power at cranking the engine.
4. Charging warning lamp in the cluster comes on while driving.

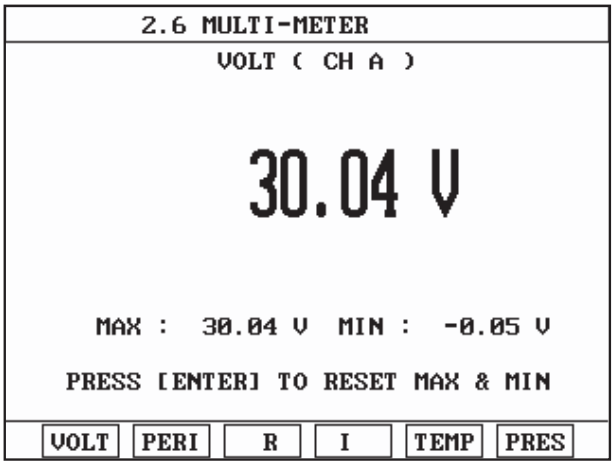
TERMINAL & CONNECTOR INSPECTION E3B6F43A

Refer to DTC P0112.

POWER SUPPLY INSPECTION E23866C6

1. Alternator Connector Supply Power Inspection
   1) Leave vehicle alternator connector(E10)connected.
   2) Turn the ignition ON. Start the engine.
   3) Measure voltage between terminal 1 of alternator connector and chassis ground.





* Data can be different depending on measuring device.

SNBFL8105L

■ Specification: Charging voltage (B V)

4) Is the voltage measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

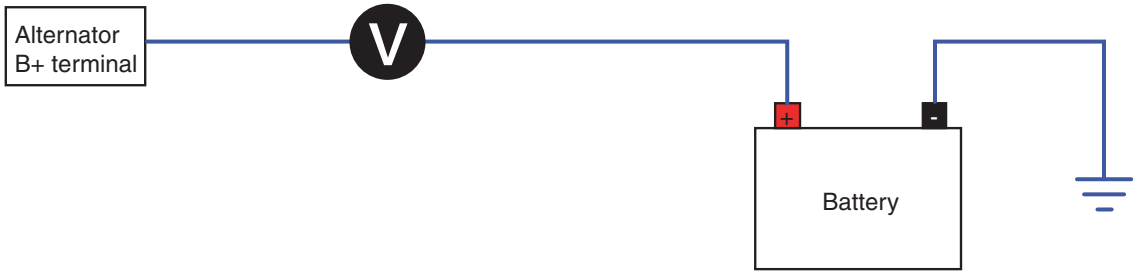
NO

▶ Go to "Alternator B+ Cable Voltage Drop Inspection" procedure.

2. Alternator B+ Cable Voltage Drop Inspection

1) Turn the ignition ON. Start the engine.

2) Measure voltage difference between terminals of alternator B+ and battery B+. (Connect terminal "+" of multi-meter to terminal "B+" of alternator and terminal "-" of multi-meter to terminal "-" of battery.)



SUDFL8239L

■ Specification: Within 0.2V(200mV)

3) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Go to "Alternator B+ Cable Voltage Drop" procedure.
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

COMPONENT INSPECTION ED4BB6CE

1. Alternator Charging Voltage Inspection

   1) Turn ignition OFF. The engine stops.

   2) Check the belt tension to drive alternator.

   3) Check battery terminal, fusible link and terminal of alternator B+ for looseness and corrosion.

   4) Start the engine.

   5) Operate the electric systems of head lamp, heater wire and blower motor etc.

   6) Check battery voltage at above 500 rpm of engine revolution.

■ SPECIFICATION

Regulator temp.(°C)	Regulating voltage(V)
20~30	27.5~28.5

   7) Is the voltage measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the regulator and then go to "Verification of Vehicle Repair" procedure.

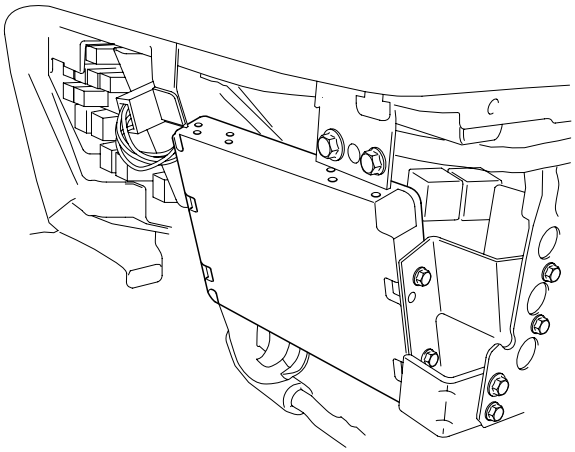
VERIFICATION OF VEHICLE REPAIR E1924C00

Refer to DTC P0112.

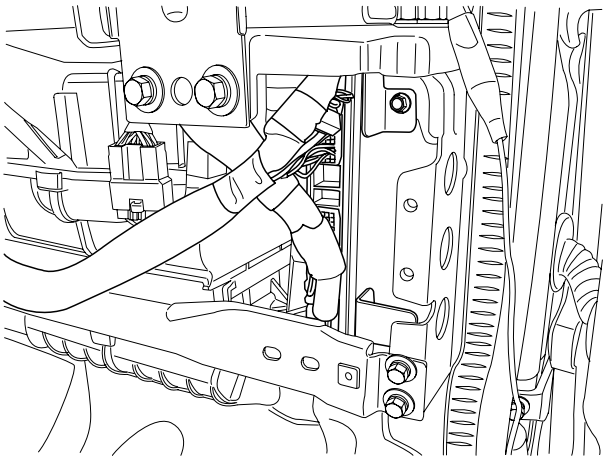
DTC P0601 CHECK SUM ERROR - FLASH AREA

COMPONENT LOCATION E7B3D2E8

Barometric pressure sensor(In the ECM) - Under glove box



[Narrow cab]



[Wide cab]

SUDFL8018L

DESCRIPTION EBCD4221

1. GENERAL DESCRIPTION
   The ECM judges whether vehicle condition is good or not through algorithm check-sum. All data of algorithm check-sum is composed of combination of "0" and "1". The algorithm check-sum means that adds all values in the character row. The criteria to judge whether the ECM is good or not is sensed by comparing the stored values in the ECM and the obtained values through algorithm.

2. DTC DESCRIPTION
   If the discrepancy of check-sum is detected 3 times in a row for 96.0ms or more, the ECM judges this as a fault and DTC is set. The possible cause may be faulty CPU of ECM. In case of fail safe, it is impossible to start the engine and to control PTO(if equipped) and fuel amount is limited to below 40mm³/st.

DTC DETECTING CONDITION EAEE2870

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Algorithm check</td><td rowspan="6">• It is impossible to check due to faulty CPU in the ECM</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• At IG ON</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• When discrepancy of check-sum is detected 3 times or more in a row</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 96.0ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• Impossible to start the engine.
• Limit to below 40mm³/st
• Impossible to control PTO</td></tr>
<tr><td>Fuel Limit</td><td>Yes</td></tr>
<tr><td>MIL</td><td>ON</td></tr>
</table>

TROUBLESHOOTING AID E01BD0BA

There is no special diagnosis procedure about this DTC because of the internal error of ECM. Check that the vehicle is in normal operation after replacing the suspected ECM with a good one temporarily. If the problem is solved, replace the ECM.

TERMINAL & CONNECTOR INSPECTION E2CF4D0B

Refer to DTC P0112.

COMPONENT INSPECTION EC94EC6C

1. Turn ignition OFF. The engine stops.
2. Remove the suspected ECM from the vehicle.
3. Check that the vehicle is in normal operation after replacing the suspected ECM with a good one temporarily.
4. If the problem is solved, replace the ECM.

NOTE

Be sure to correct injector QR correction value(30 digits) ECM data mentioned below by using the scan tool When replacing the ECM. In case correction value marked in the injector is not corrected in the ECM, there may be problems in engine performance and exhaust gas.

1. Input the upgrade when replacing the ECM
2. Correct ECM data
   a) Input QR code data
   b) Gear ratio correction value
   c) Input final reduction ratio/ tire
   d) Input VIN

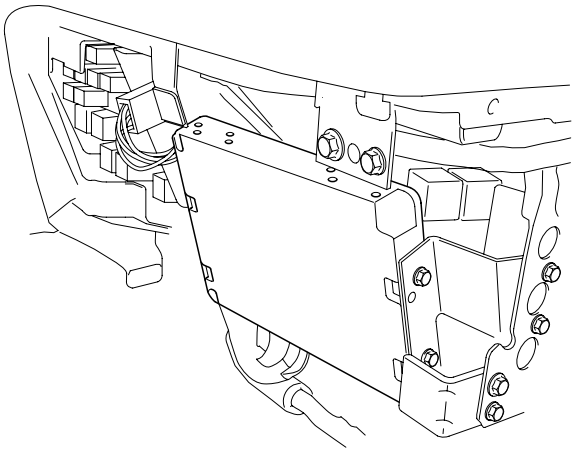
VERIFICATION OF VEHICLE REPAIR E247AFB1

Refer to DTC P0112.

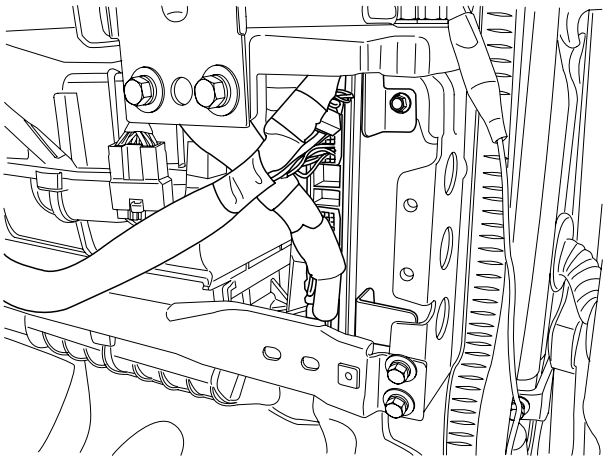
DTC P0602 QR CODE ERROR

COMPONENT LOCATION EB9C7A14

Barometric pressure sensor(In the ECM) - Under glove box



[Narrow cab]



[Wide cab]

SUDFL8018L

DESCRIPTION E45309EF

1. GENERAL DESCRIPTION
   The ECM judges whether vehicle condition is good or not through algorithm check-sum. All data of algorithm check-sum is composed of combination of "0" and "1". The algorithm check-sum means that adds all values in the character row. The criteria to judge whether the ECM is good or not is sensed by comparing the stored values in the ECM and the obtained values through algorithm.

2. DTC DESCRIPTION
   Using EEPROM memory data, if QR correction and at least one among injectors are detected for 768.0ms or more per a day, the ECM judges this as a fault and DTC is set.
   The possible cause may be mismatch between QR correction value and injector QR correction or the internal error of ECM with the scan tool.
   QR correction value in the upper of each injector connector should be inputted to the ECM by using the scan tool since the default value without QR correction value inputted is stored in the ECM.
   The engine is controlled by the previous value in case of fail safe.

DTC DETECTING CONDITION E809D978

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• QR correction value</td><td rowspan="5">• Comparison between QR correction value and injector correction value→If mismatched, input QR value marked in the injector
• Internal error of ECM</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• At IG ON/ running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• When QR correction which uses EEPROM memory data and at least one among injectors is 1</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 768.0ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• Unstable idle, lack of power
• Previous value is kept.</td></tr>
<tr><td>Fuel Limit</td><td>No</td></tr>
<tr><td>MIL</td><td>ON</td></tr>
</table>

TROUBLESHOOTING AID E121EE2B

There is no special diagnosis procedure about this DTC because of the internal error of ECM. Check that the vehicle is in normal operation after replacing the suspected ECM with a good one temporarily. If the problem is solved, replace the ECM.

TERMINAL & CONNECTOR INSPECTION EF1B95A5

Refer to DTC P0112.

COMPONENT INSPECTION E33075E7

1. Turn ignition OFF. The engine stops.
2. Remove the suspected ECM from the vehicle.
3. Check that the vehicle is in normal operation after replacing the suspected ECM with a good one temporarily.
4. If the problem is solved, replace the ECM.

NOTE

Be sure to correct injector QR correction value(30 digits) ECM data mentioned below by using the scan tool When replacing the ECM. In case correction value marked in the injector is not corrected in the ECM, there may be problems in engine performance and exhaust gas.

1. Input the upgrade when replacing the ECM
2. Correct ECM data
   a) Input QR code data
   b) Gear ratio correction value
   c) Input final reduction ratio/ tire
   d) Input VIN

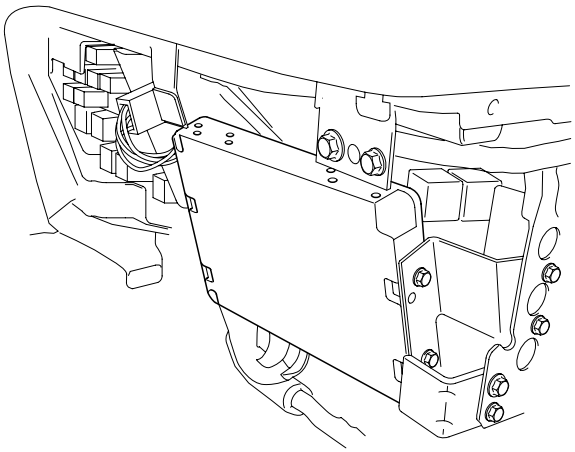
VERIFICATION OF VEHICLE REPAIR E72EB95A

Refer to DTC P0112.

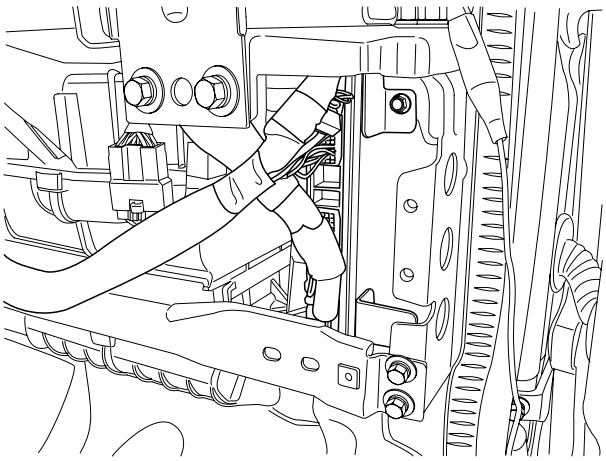
DTC P0606 CPU FAULT; MAIN CPU FAULT

COMPONENT LOCATION ED13FFD5

Barometric pressure sensor(In the ECM) - Under glove box



[Narrow cab]



[Wide cab]

SUDFL8018L

DESCRIPTION E31F8A80

1. GENERAL DESCRIPTION
   ECM receives power, is activated and receives signals from the various sensors such as the crankshaft position sensor and the accelerator pedal position sensor etc. Based on the input signals, the ECM controls engine by driving injector, various solenoids and relay through comparison algorithm between micro controller and control logic stored in EEPROM. Also to improve reliability, the ECM performs diagnoses of self test of ECM itself, various sensors and actuators and informs a driver of trouble information to protect serious problem of drive ability and performs the function to shut off system to protect dangerous condition with wrong control.

2. DTC DESCRIPTION
   If RUN Pulse after Power ON Reset is detected 5 times in a row for 96.0ms when is not opposite rotation within certain set-time, the ECM judges this as a fault and DTC is set. The possible cause may be the faulty CPU in the ECM.
   In case of fail safe, it is impossible to start the engine and to control PTO(if equipped) and fuel amount is limited to below 40mm^3/st.

DTC DETECTING CONDITION E7B534CC

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• EEPROM monitoring</td><td rowspan="5">• It is impossible to check due to faulty CPU in the ECM</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• At IG ON</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• When RUN Pulse opposite no-rotation within certain set-time after Power ON Reset is detected 5 times in a row</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 96.0ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• Impossible to start the engine.
• Limit to below 40mm³/st of fuel amount
• Impossible to control PTO</td></tr>
<tr><td>Fuel Limit</td><td>Yes</td></tr>
<tr><td>MIL</td><td>ON</td></tr>
</table>

TROUBLESHOOTING AID EBE42587

There is no special diagnosis procedure about this DTC because of the internal error of ECM. Check that the vehicle is in normal operation after replacing the suspected ECM with a good one temporarily. If the problem is solved, replace the ECM.

TERMINAL & CONNECTOR INSPECTION E54E8E36

Refer to DTC P0112.

COMPONENT INSPECTION E9E6B493

1. Turn ignition OFF. The engine stops.
2. Remove the suspected ECM from the vehicle.
3. Check that the vehicle is in normal operation after replacing the suspected ECM with a good one temporarily.
4. If the problem is solved, replace the ECM.

NOTE

Be sure to correct injector QR correction value(30 digits) ECM data mentioned below by using the scan tool When replacing the ECM. In case correction value marked in the injector is not corrected in the ECM, there may be problems in engine performance and exhaust gas.

1. *Input the upgrade when replacing the ECM*
2. *Correct ECM data*
   - *a) Input QR code data*
   - *b) Gear ratio correction value*
   - *c) Input final reduction ratio/ tire*
   - *d) Input VIN*

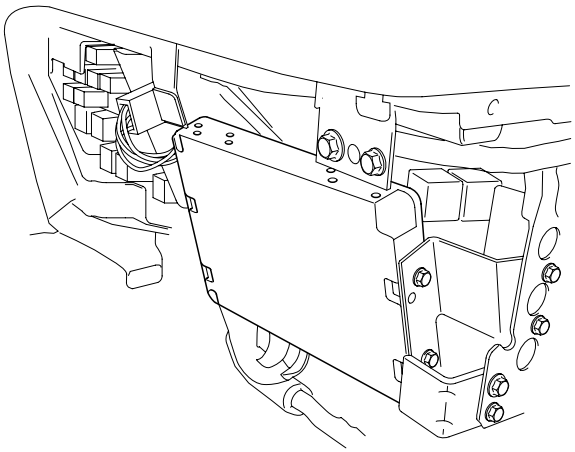
VERIFICATION OF VEHICLE REPAIR EDFB08B2

Refer to DTC P0112.

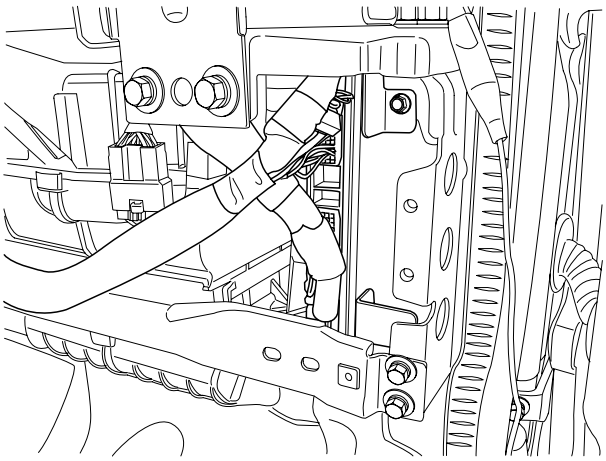
DTC P0607 CPU FAULT; WATCHDOG IC FAULT

COMPONENT LOCATION E95FC154

Barometric pressure sensor(In the ECM) - Under glove box



[Narrow cab]



[Wide cab]

SUDFL8018L

DESCRIPTION E44D72EE

1. GENERAL DESCRIPTION
   ECM receives power, is activated and receives signals from the various sensors such as the crankshaft position sensor and the accelerator pedal position sensor etc. Based on the input signals, the ECM controls engine after driving injector, various solenoids and relay through comparison algorithm between micro controller and control logic stored in EEPROM. Also to improve reliability, the ECM performs diagnoses of self test of ECM itself, various sensors and actuators and informs a driver of trouble information to protect serious problem of drive ability and performs the function to shut off system to protect dangerous condition with wrong control.

2. DTC DESCRIPTION
   If RUN Pulse of Watchdog IC output is detected for 96.0ms or more when is not opposite rotation within certain set-time, the ECM judges this as a fault and DTC is set. The possible cause may be the faulty CPU in the ECM.
   In case of fail safe, it is impossible to start the engine and to control PTO(if equipped) and fuel amount is limited to below 40mm^3/st.

DTC DETECTING CONDITION E9C80C22

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• EEPROM monitoring</td><td rowspan="5">• It is impossible to check due to faulty CPU in the ECM</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• At IG ON</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• When RUN Pulse of Watchdog IC output is detected 5 times in a row which is not opposite rotation above certain set-time</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 96.0ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• Impossible to start the engine.
• Limit to below 40mm³/st of fuel amount
• Impossible to control PTO</td></tr>
<tr><td>Fuel Limit</td><td>Yes</td></tr>
<tr><td>MIL</td><td>ON</td></tr>
</table>

TROUBLESHOOTING AID E9E89EEF

There is no special diagnosis procedure about this DTC because of the internal error of ECM. Check that the vehicle is in normal operation after replacing the suspected ECM with a good one temporarily. If the problem is solved, replace the ECM.

TERMINAL & CONNECTOR INSPECTION ECDBDAED

Refer to DTC P0112.

COMPONENT INSPECTION E7AFCEF2

1. Turn ignition OFF. The engine stops.
2. Remove the suspected ECM from the vehicle.
3. Check that the vehicle is in normal operation after replacing the suspected ECM with a good one temporarily.
4. If the problem is solved, replace the ECM.

NOTE

Be sure to correct injector QR correction value(30 digits) ECM data mentioned below by using the scan tool When replacing the ECM. In case correction value marked in the injector is not corrected in the ECM, there may be problems in engine performance and exhaust gas.

1. *Input the upgrade when replacing the ECM*
2. *Correct ECM data*
   - *a) Input QR code data*
   - *b) Gear ratio correction value*
   - *c) Input final reduction ratio/ tire*
   - *d) Input VIN*

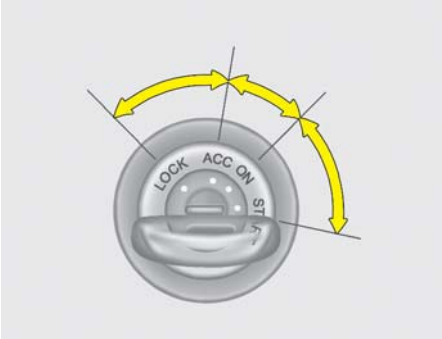
VERIFICATION OF VEHICLE REPAIR E1D59E6C

Refer to DTC P0112.

DTC P0615 START SWITCH SHORT TO BATTERY

COMPONENT LOCATION ED1ABB6D

Start switch



SUDFL8503L

DESCRIPTION E0BDA521

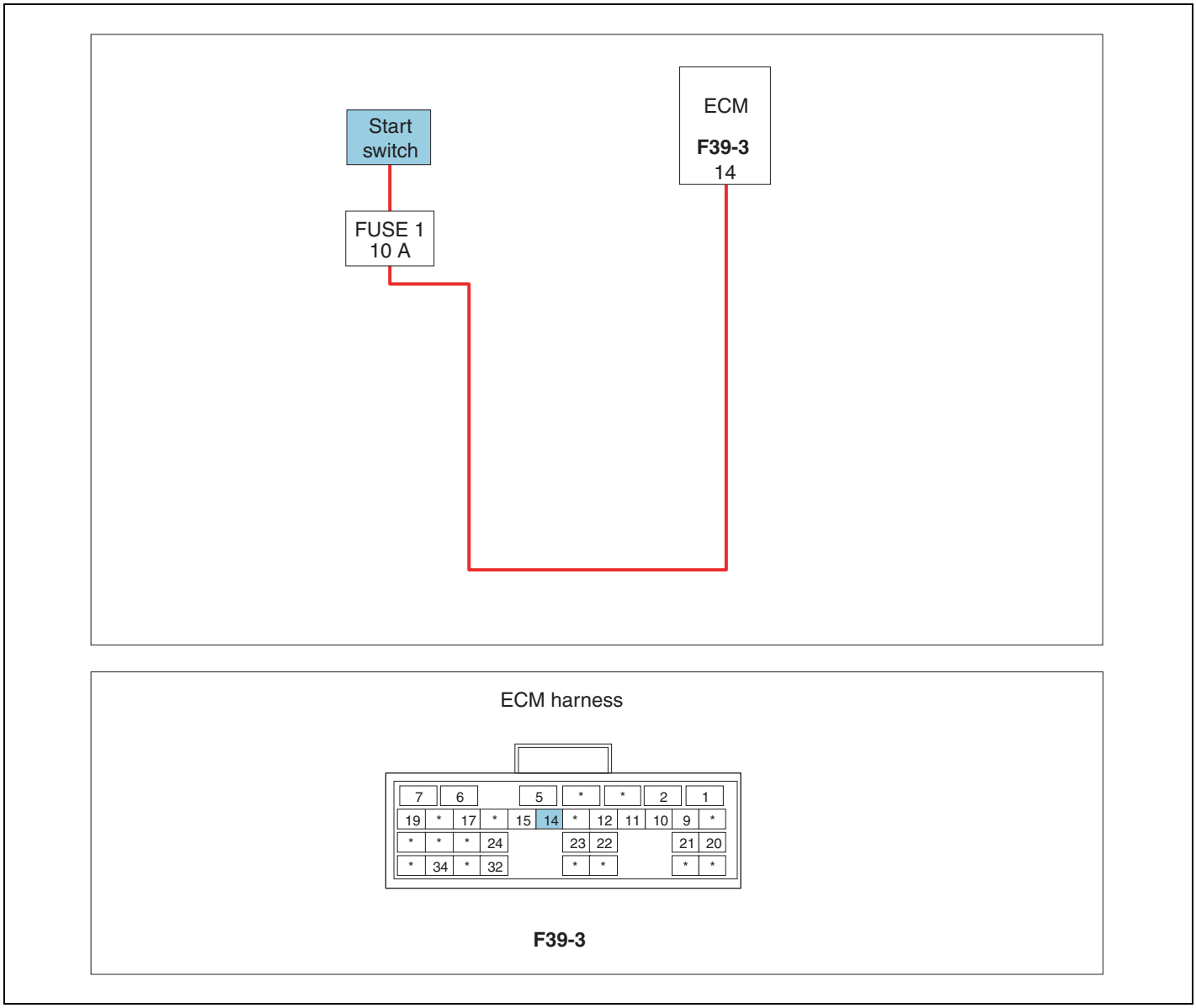
1. Starting system is composed of battery, start motor, solenoid switch, start switch(ignition switch), connecting wiring and battery cable etc.
   When the ignition key turns to start position, current energizes the solenoid coil of start motor.
   The solenoid plunger and the clutch shift lever are operating and the engine is cranked since clutch pinion is engaged with ring gear.

2. DTC DESCRIPTION
   If the voltage is detected above 0 V for 8,388.5ms or more when the engine revolution is above 300 rpm after starting the engine. the ECM judges this as a fault and DTC is set. The probable causes may be short to battery power side of terminal 14 of ECM connector(F39-3) or melted start switch.
   In case of fail safe, the ECM stops the engine after elapse of certain time to protect damage to the start motor.

DTC DETECTING CONDITION EE80A173

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="5">• Check start switch for melted.
• Check terminal 14 of ECM connector(F39-3) for voltage.</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• At IG ON/ Running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• Crankshaft position sensor>300rpm</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 8,388.5ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• Engine stop</td></tr>
<tr><td>Fuel Limit</td><td>No</td></tr>
<tr><td>MIL</td><td>ON</td></tr>
</table>

SCHEMATIC DIAGRAM EB365E52



SNBFL8106L

MONITOR SCAN TOOL DATA E6385010

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Start switch" parameter on the scan tool.

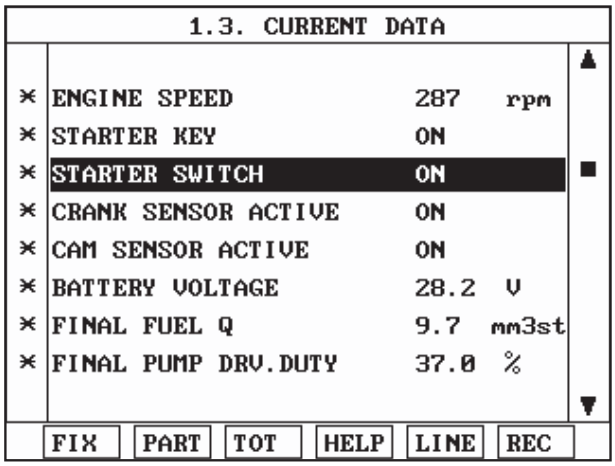


Fig. 1 "Start switch" data at cranking

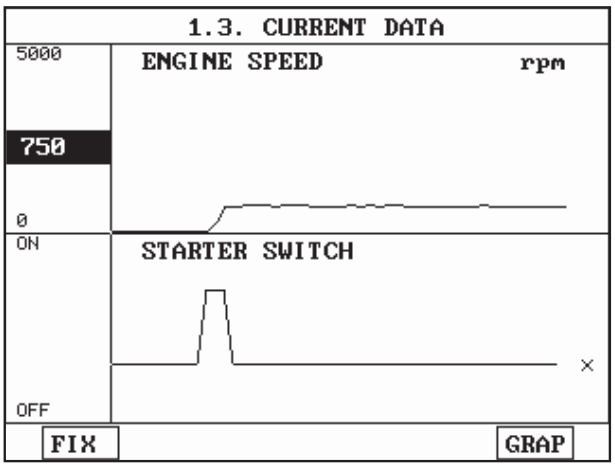


Fig. 2 Hold "Idle state" after start switch ON

SUDFL8241L

TERMINAL & CONNECTOR INSPECTION E5DB1E7D

Refer to DTC P0112.

SIGNAL CIRCUIT INSPECTION EBB11872

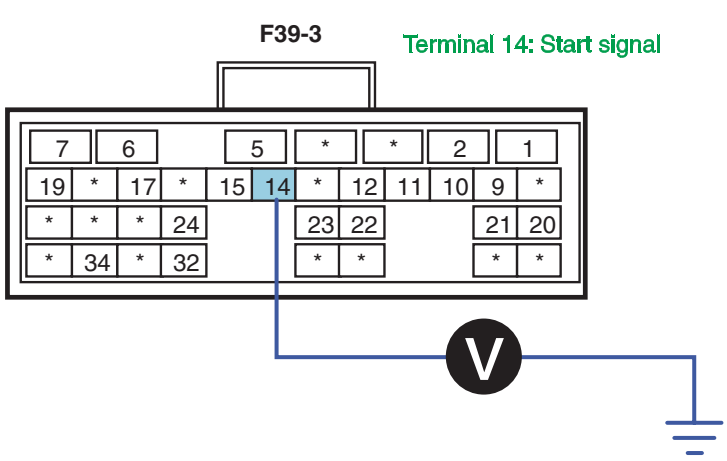
1. Start Signal Power Inspection

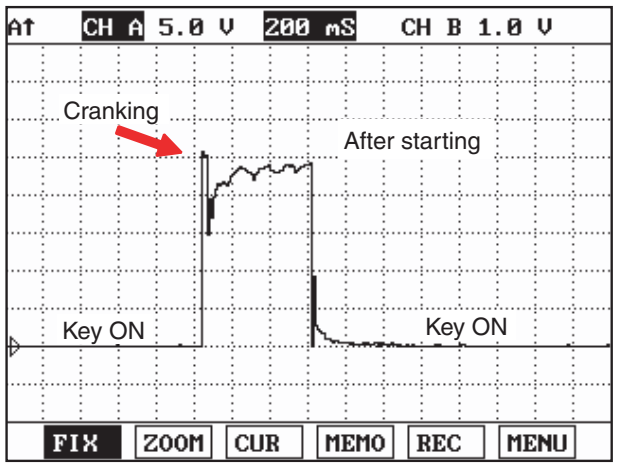
   1) Leave the ECM connector(F39-3) connected.

   2) Turn the ignition OFF.

   3) Connect oscilloscope to terminal 14 of ECM connector(F39-3)

   4) Measure waveform at IG OFF after holding idle state with the engine cranked.





SNBFL8107L

■ Specification: Below 0 V after detecting start signal voltage(B V)

5) Is the voltage measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

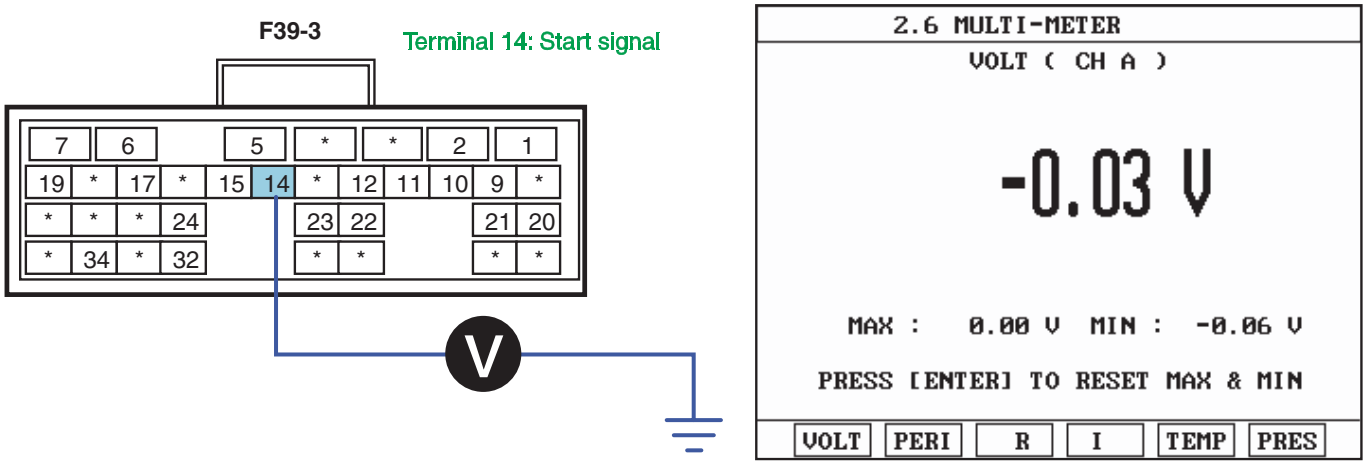
▶ Go to "Signal Short to Power Inspection" procedure.

2. Signal Short to Power Inspection

1) Disconnect ignition fusible link and ECM connector(F39-3).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 14 of ECM connector(F39-3) harness connector and chassis ground.



SNBFL8108L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

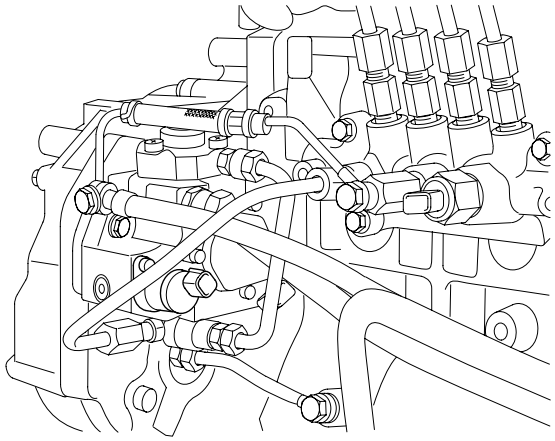
VERIFICATION OF VEHICLE REPAIR E1FE2057

Refer to DTC P0112.

DTC P0627 FUEL PUMP CONTROL CIRCUIT - OPEN

COMPONENT LOCATION E3FB623F

Supply control valve(SCV)



SUDFL8246L

DESCRIPTION EEC04135

1. Supply control valve(SCV) is solenoid type. The ECM controls time to open/close valve, controls pump fuel amount by controlling current to be supplied to SCV to adjust target rail pressure. When the SCV is closed, fuel passage is cut off and fuel is compressed. The compressed fuel is supplied to common rail. If fuel pressure is decreased, the SCV is opened and then fuel is inhaled for next pumping.
   Fuel pump relay is supplied power to low fuel pump by the ECM. At the ignition key ON, the fuel pump relay works for about 1.5sec. and stops to diagnose fuel pump relay. If the engine rpm is detected above 45rpm, the ECM makes relay turn ON and feeds fuel to high pressure pump.
   Low pressure fuel pump which is vane pump to be driven by electric motor is installed in the fuel tank and feeds fuel to high pressure.

2. DTC DESCRIPTION
   If the SCV current duty is detected above 30% and current is detected below 1,100mA for 819.2ms or more, the ECM judges this as a fault and DTC is set. The probable causes may be short to ground of terminals 8, 9, 10 and 11 of ECM connector(F39-1), open circuit in ECM or SCV wiring or pin resistance of SCV.
   In case of fail safe, a care should be taken due to causing a damage to common rail system.
   Therefore, the ECM limits engine power and abnormal high pressure is made if there is open circuit of fuel pump at starting and pressure limiter is operated etc.

DTC DETECTING CONDITION EAF44C22

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Current monitoring</td><td rowspan="5">• Short to ground of terminals 8, 9, 10 and 11 of ECM connector(F39-1)
• Open circuit in ECM, SCV wiring
• Pin resistance in SCV</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• At IG ON</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• SCV current duty: above 30% current: below 1,100mA</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 819.2ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• Engine power is limited(Limit of common rail pressure)</td></tr>
<tr><td>Fuel Limit</td><td>Yes</td></tr>
<tr><td>MIL</td><td>ON</td></tr>
</table>

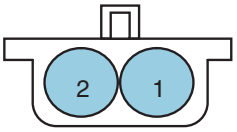
SPECIFICATION E18D5013

Item	Specification
Resistance	7.9 ± 0.25 Ω

SCV driving frequency	SCV control type
200 Hz	Current control

SCV driving voltage	SCV driving current
16 ~ 32 V	Below 1.29A at operating
	Below 1.16A(within 270sec.) at stop

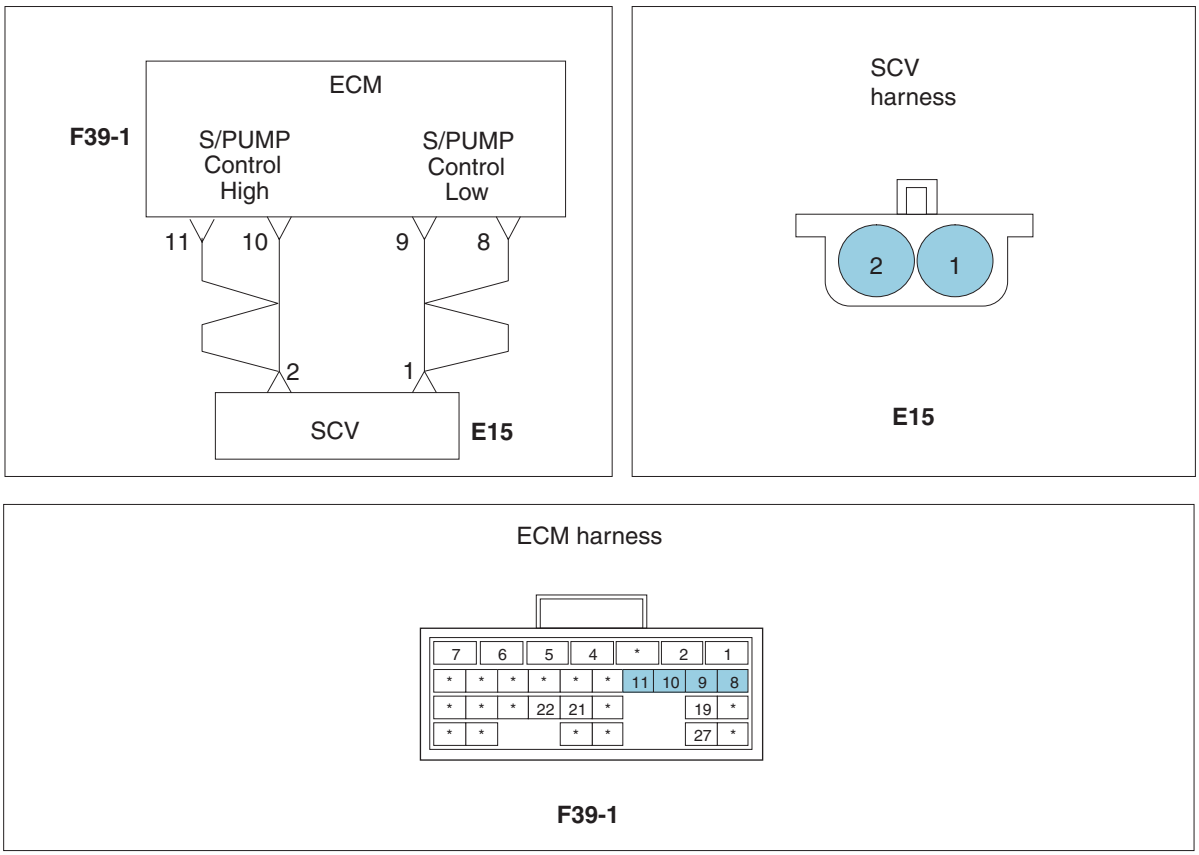
Terminal 1: S/pump control Low
Terminal 2: S/pump control High



Sensor connector

SUDFL8247L

SCHEMATIC DIAGRAM E833A43C



SNBFL8109L

WAVEFORM EDE8014D

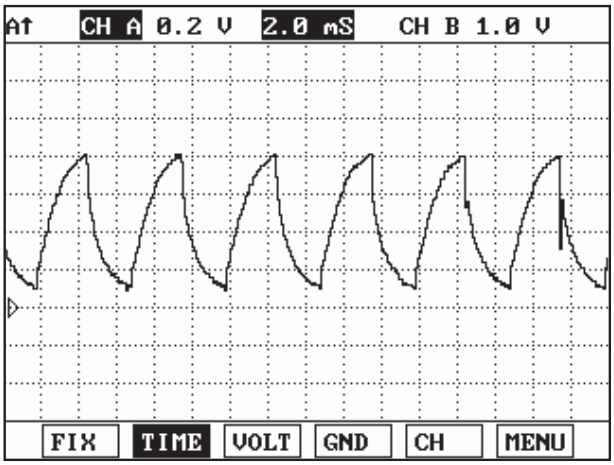


Fig. 1 SCV waveform of LOW side

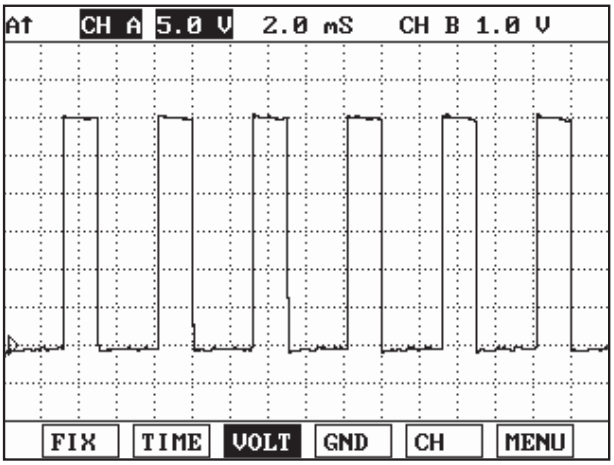


Fig. 2 SCV waveform of HIGH side

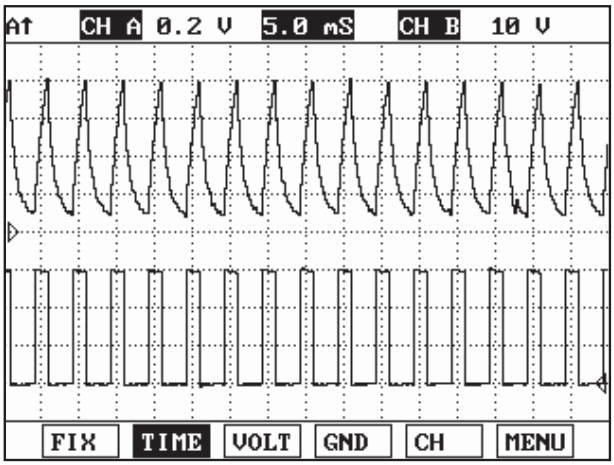


Fig. 3 SCV both waveforms of LOW/HIGH

SUDFL8249L

MONITOR SCAN TOOL DATA EFFFA524

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Pump control duty" parameter on the scan tool.

NOTE

"Pump control duty" changes depending on operating condition according to DTC detecting condition. In case of fail safe. be sure to check since engine output(common rail pressure limit) is limited.

■ Specification

Pump control duty: About 37% at idle

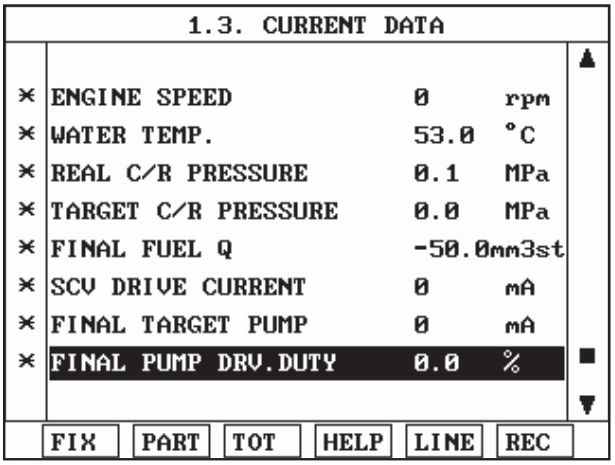


Fig. 1 "Pump control duty" data at IG ON

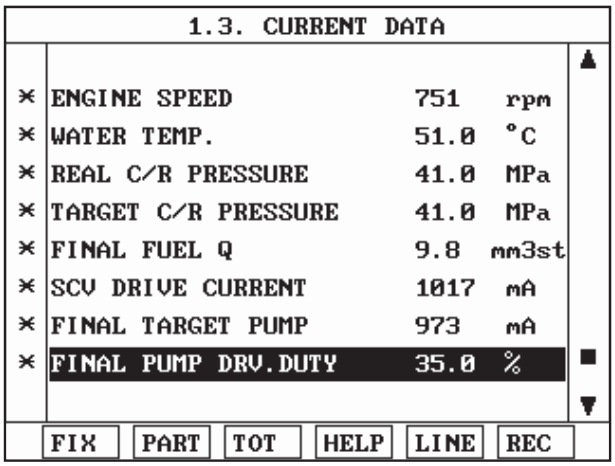


Fig. 2 "Pump control duty" data at idle

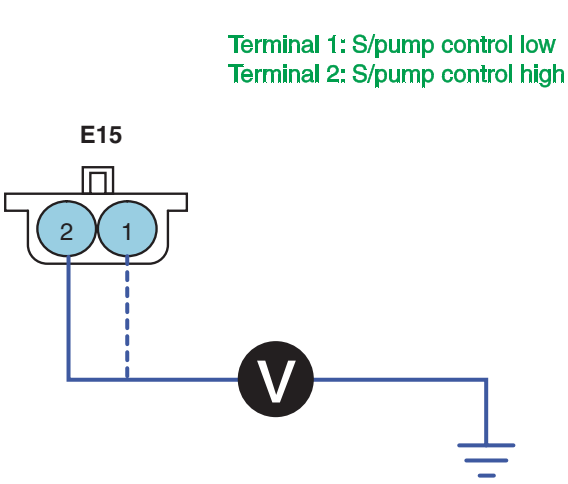
SUDFL8250L

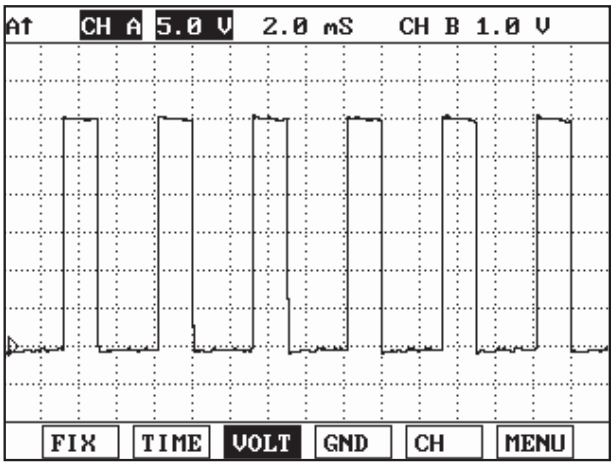
TERMINAL & CONNECTOR INSPECTION E80244F4

Refer to DTC P0112.

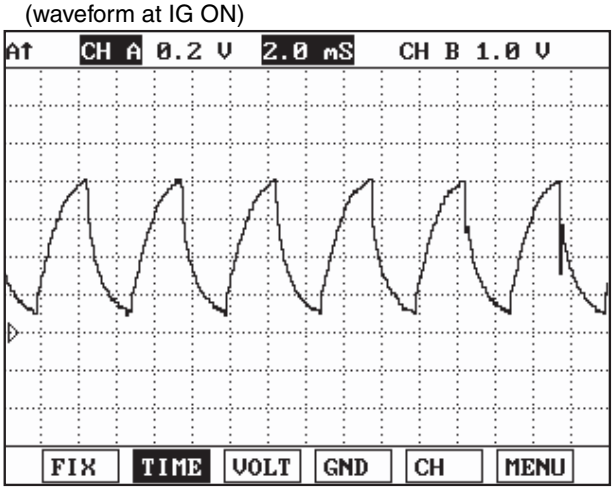
SIGNAL CIRCUIT INSPECTION ED16BEEB

1. Signal Voltage(LOW/HIGH) Inspection
   1) Leave the SCV connector(E15) connected.
   2) Turn the ignition ON. The engine stops.
   3) Monitor waveform between terminal 1, 2 of SCV harness connector and chassis ground.





▶ With terminal 2 of SCV connector connected in HIGH side (waveform at IG ON)



▶ With terminal 1 of SCV connector connected in LOW side (waveform at IG ON)

SUDFL8251L

■ Specification:
Terminal 1 of SCV power signal: Approx. 0.1~0.63V(Voltage fluctuating)
Note) Easy to judge trouble when checking with waveform
Terminal 2 of SCV power signal: Approx. 0~B+ V(Voltage fluctuating)
Below 0 V after detecting start signal voltage(B V)

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

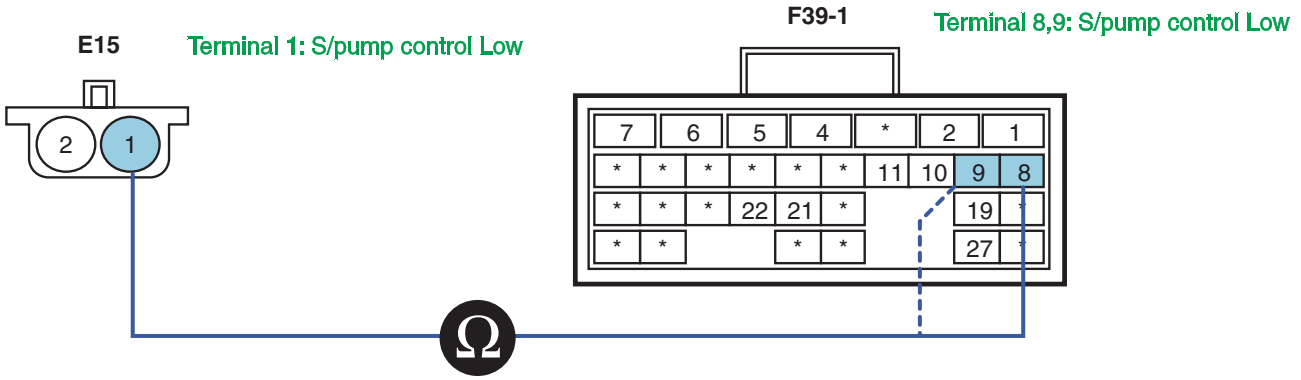
▶ Go to "Signal Open(LOW/HIGH) Inspection" procedure.

2. Signal Open(LOW/HIGH) Inspection

1) Turn the ignition OFF.

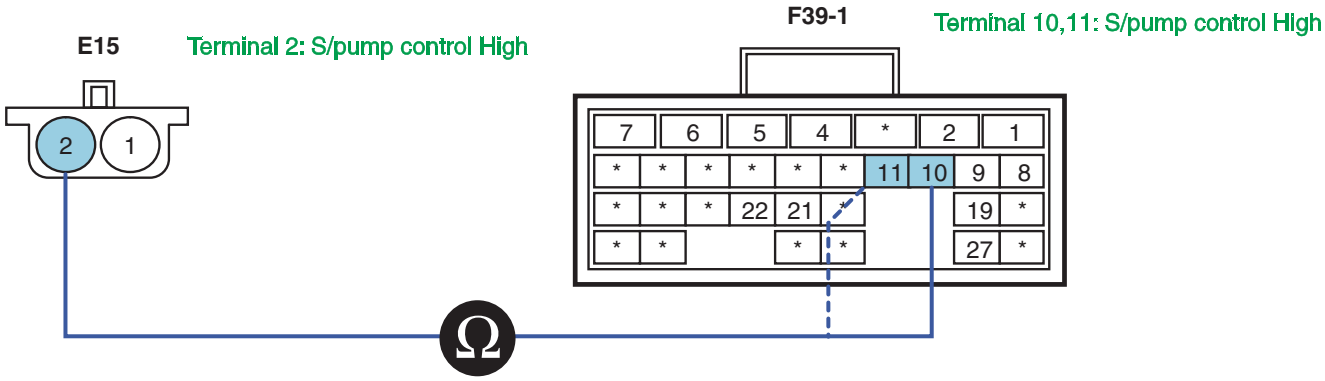
2) Disconnect SCV connector(E15) and ECM connector(F39-1).

3) Measure resistance between terminal 1 of SCV harness connector and terminals 8, 9 of ECM connector(F39-1).



SNBFL8110L

4) Measure resistance between terminal 2 of SCV harness connector and terminals 10,11 of ECM connector(F39-1).



SNBFL8111L

■ Specification: Continuity(Below 1.0Ω)

5) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Power(LOW/HIGH) Inspection" procedure.

NO

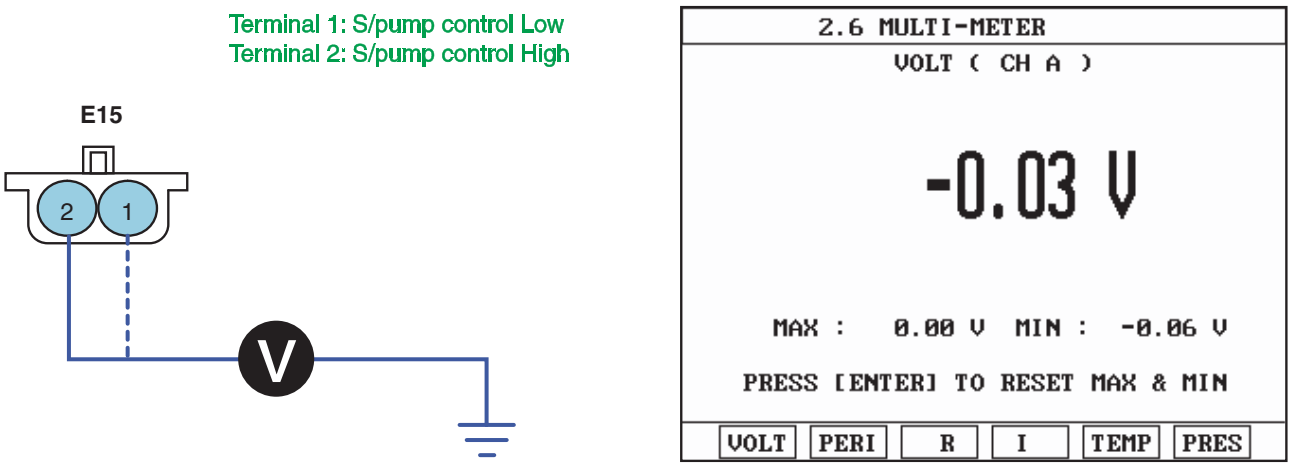
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. Signal Short to Power(LOW/HIGH) Inspection

1) Disconnect SCV connector(E15) and ECM connector(F39-1).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminals 1,2 of SCV harness connector and chassis ground.



SUDFL8254L

■ Specification: Below 0~0.1 V

4) Is the voltage measured within specification?

YES

▶ Go to "Signal Short to Ground(LOW/HIGH) Inspection" procedure.

NO

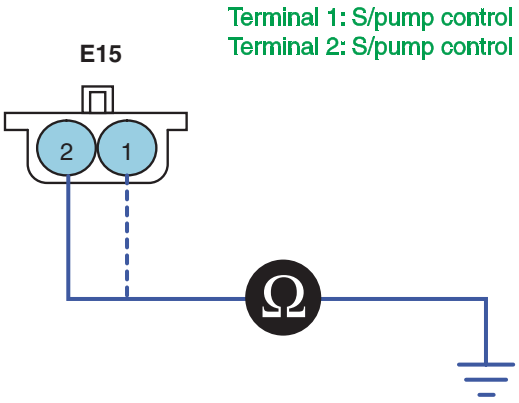
▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

4. Signal Short to Ground(LOW/HIGH) Inspection

1) Turn the ignition OFF.

2) Disconnect SCV connector(E15) and ECM connector(F39-1).

3) Measure resistance between terminals 1,2 of SCV harness connector and chassis ground.



SUDFL8255L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

COMPONENT INSPECTION EC9CB4A9

1. SCV Visual Inspection

   1) Turn the ignition OFF.

   2) Disconnect SCV connector(E15).

   3) Check terminal of the SCV connector for corrosion, contamination.

   4) Check the SCV for torque and fuel leaks.

   5) Is there any problem for SCV?

   YES

   ▶ Replace the SCV if necessary and then go to "Verification of Vehicle Repair" procedure.

   NO

   ▶ Go to "SCV Waveform Inspection" procedure

2. SCV Waveform Inspection

   1) Turn the ignition OFF.

   2) Disconnect SCV connector(E15).

   3) Connect oscilloscope to terminal 2 of SCV connector(E15).

   4) Check the waveform for normal operation at idle and acceleration state .
   ■ Specification: Refer to "Standard waveform" in the general information.

   5) Is the SCV waveform normal?

   YES

   ▶ Go to "Verification of Vehicle Repair" procedure.

   NO

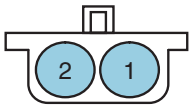
   ▶ Go to "SCV Resistance Inspection" procedure.

3. SCV Resistance Inspection

   1) Turn ignition OFF.

   2) Disconnect SCV connector(E15).

   3) Measure resistance between terminal 1 and 2 of SCV connector.

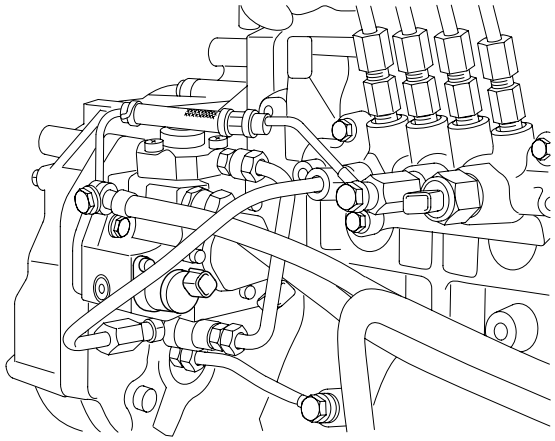


Terminal 1: S/pump control Low
Terminal 2: S/pump control High

DTC P0629 FUEL PUMP SHORT TO BATTERY

COMPONENT LOCATION E5825476

Supply control valve(SCV)



SUDFL8246L

DESCRIPTION EB504F29

1. Supply control valve(SCV) is solenoid type. The ECM controls time to open/close valve, controls pump fuel amount by controlling current to be supplied to SCV to adjust target rail pressure. When the SCV is closed, fuel passage is cut off and fuel is compressed. The compressed fuel is supplied to common rail. If fuel pressure is decreased, the SCV is opened and then fuel is inhaled for next pumping.
   Fuel pump relay is supplied power to low fuel pump by the ECM. At the ignition key ON, the fuel pump relay works for about 1.5sec. and stops to diagnose fuel pump relay. If the engine rpm is detected above 45rpm, the ECM makes relay turn ON and feeds fuel to high pressure pump.
   Low pressure fuel pump which is vane pump to be driven by electric motor is installed in the fuel tank and feeds fuel to high pressure.

2. DTC DESCRIPTION
   If the SCV current duty is detected below 30% and current is detected above 1,100mA for 819.2ms or more, the ECM judges this as a fault and DTC is set. The probable causes may be short to power(16V or more) of terminals 8, 9, 10 and 11 of ECM connector(F39-1), open circuit in ECM or SCV wiring.
   In case of fail safe, a care should be taken due to causing a damage to common rail system.
   Therefore, the ECM limits engine power and abnormal high pressure is made if there is open circuit of fuel pump at starting and pressure limiter is operated etc.

DTC DETECTING CONDITION EB21DFCD

Item	Detecting Condition			Possible Cause
DTC Strategy	• Current monitoring			• Short to power of terminals 8, 9, 10 and 11 of ECM connector(F39-1) • Open circuit in ECM, SCV wiring
Enable Conditions	• At IG ON			
Threshold Value	• SCV current duty: below 30% current: above 1,100mA			
Diagnosis Time	• 819.2ms or more			
Fail Safe	Fuel Cut	No	• Engine power is limited(Limit of common rail pressure)	
	Fuel Limit	Yes		
	MIL	ON		

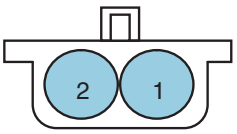
SPECIFICATION ECEF3C98

Item	Specification
Resistance	7.9 ± 0.25 Ω

SCV driving frequency	SCV control type
200 Hz	Current control

SCV driving voltage	SCV driving current
16 ~ 32 V	Below 1.29A at operating
	Below 1.16A(within 270sec.) at stop

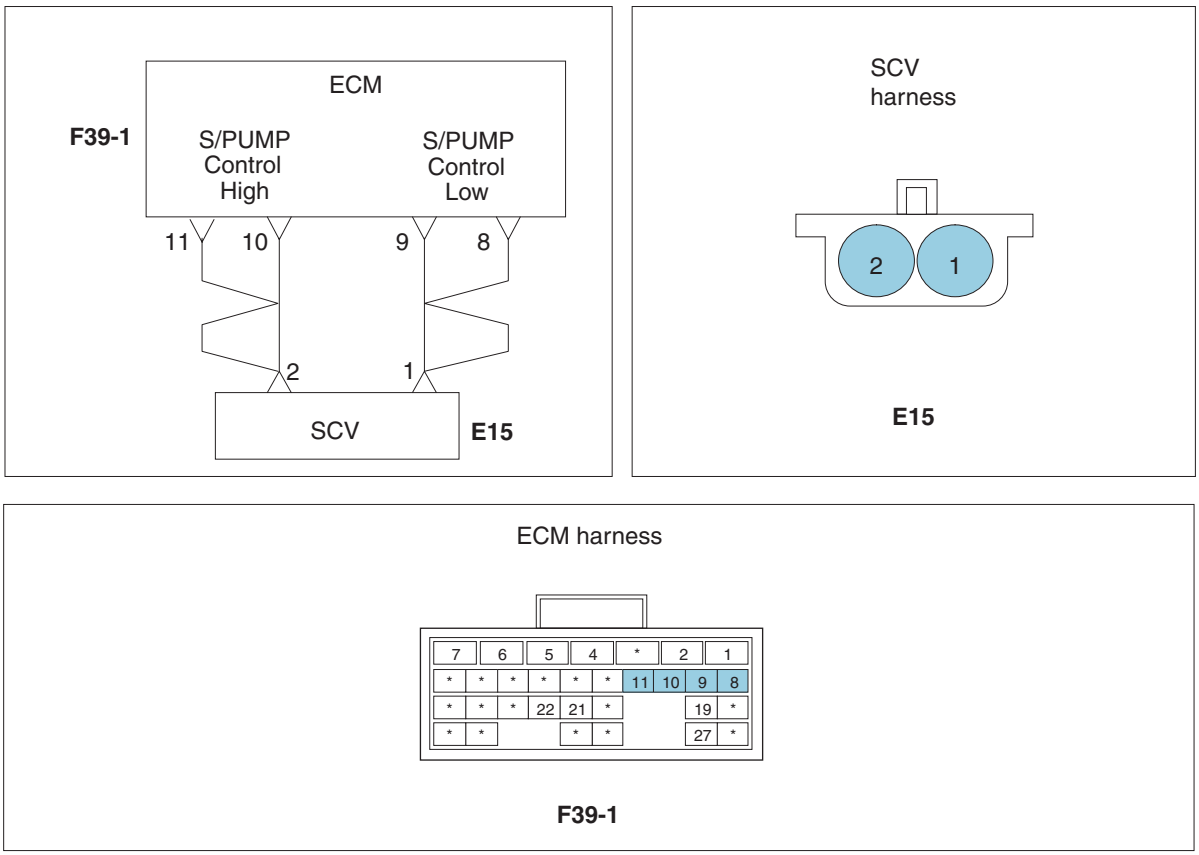
Terminal 1: S/pump control Low
Terminal 2: S/pump control High



Sensor connector

SUDFL8247L

SCHEMATIC DIAGRAM E5555376



SNBFL8109L

WAVEFORM EDD09A77

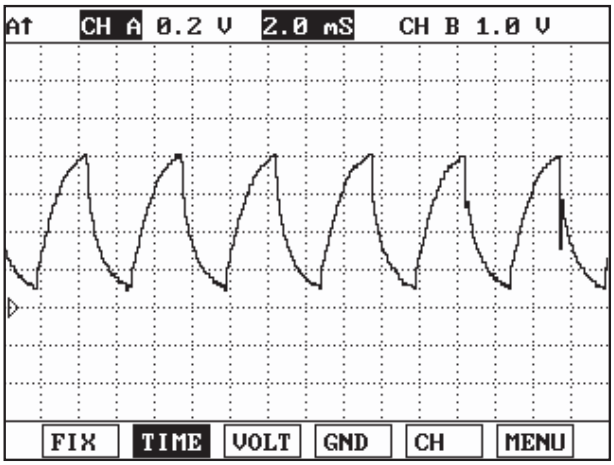


Fig. 1 SCV waveform of LOW side

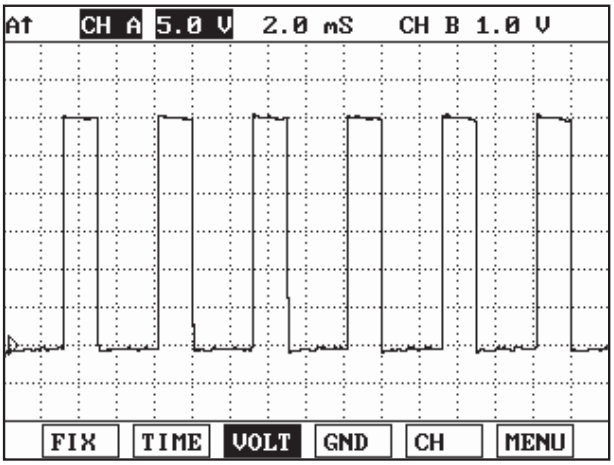


Fig. 2 SCV waveform of HIGH side

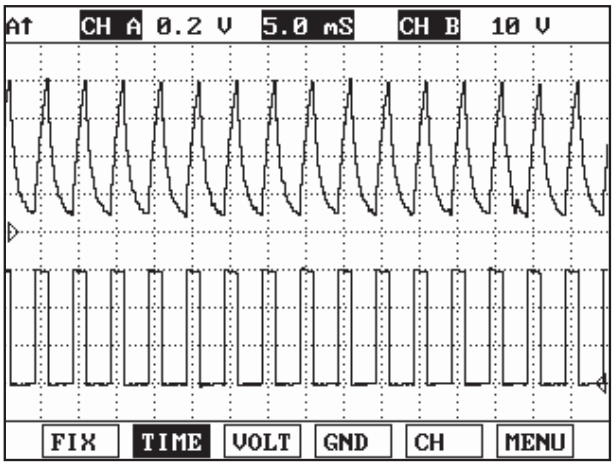


Fig. 3 SCV both waveforms of LOW/HIGH

SUDFL8249L

MONITOR SCAN TOOL DATA EAA94FC3

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Pump control duty" parameter on the scan tool.

NOTE

"Pump control duty" changes depending on operating condition according to DTC detecting condition. In case of fail safe. be sure to check since engine output(common rail pressure limit) is limited.

■ Specification

Pump control duty: About 37% at idle

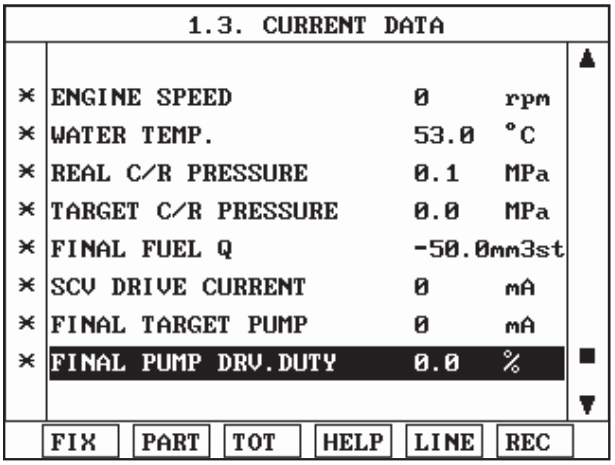


Fig. 1 "Pump control duty" data at IG ON

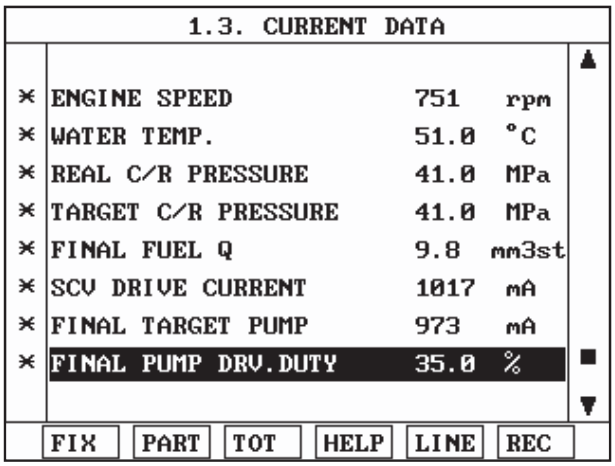


Fig. 2 "Pump control duty" data at idle

SUDFL8250L

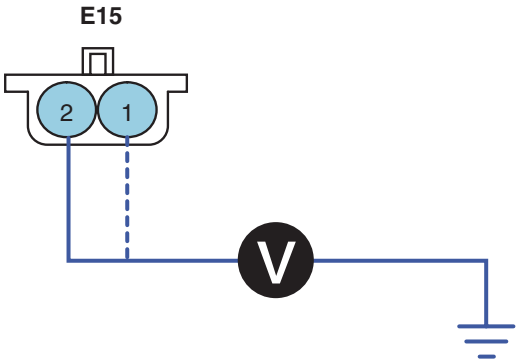
TERMINAL & CONNECTOR INSPECTION EEBA4058

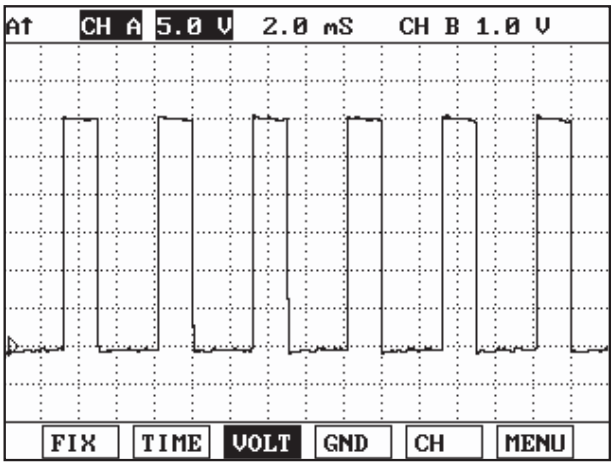
Refer to DTC P0112.

SIGNAL CIRCUIT INSPECTION EBC79C0E

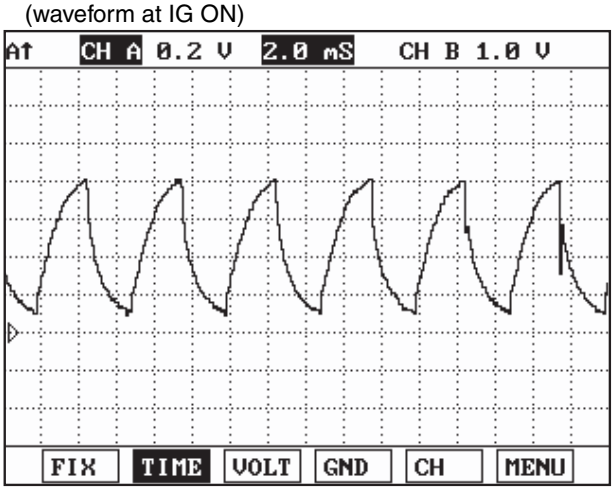
1. Signal Voltage(LOW/HIGH) Inspection
   1) Leave the SCV connector(E15) connected.
   2) Turn the ignition ON. The engine stops.
   3) Monitor waveform between terminal 1, 2 of SCV harness connector and chassis ground.

Terminal 1: S/pump control low
Terminal 2: S/pump control high





▶ With terminal 2 of SCV connector connected in HIGH side (waveform at IG ON)



▶ With terminal 1 of SCV connector connected in LOW side (waveform at IG ON)

SUDFL8251L

■ Specification:
Terminal 1 of SCV power signal: Approx. 0.1~0.63V(Voltage fluctuating)
Note) Easy to judge trouble when checking with waveform
Terminal 2 of SCV power signal: Approx. 0~B+ V(Voltage fluctuating)

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

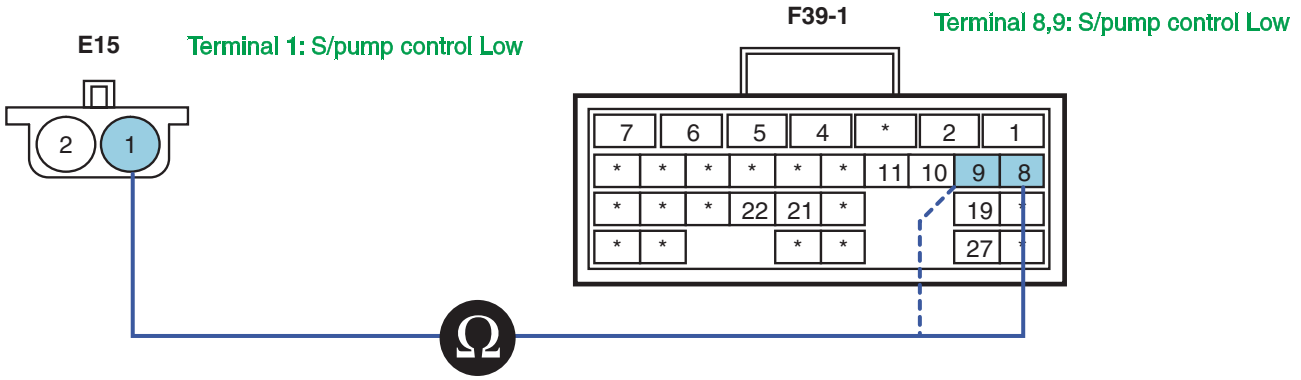
▶ Go to "Signal Open(LOW/HIGH) Inspection" procedure.

2. Signal Open(LOW/HIGH) Inspection

1) Turn the ignition OFF.

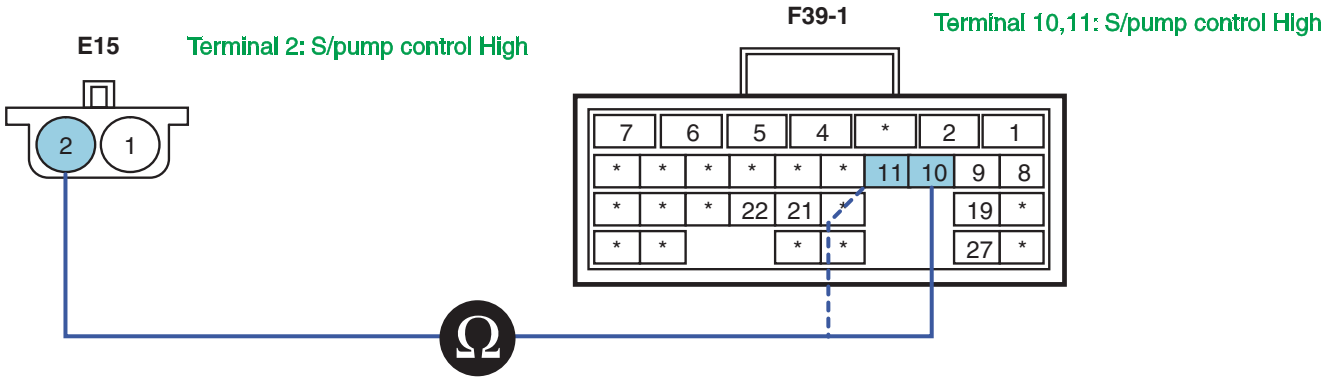
2) Disconnect SCV connector(E15) and ECM connector(F39-1).

3) Measure resistance between terminal 1 of SCV harness connector and terminals 8, 9 of ECM connector(F39-1).



SNBFL8110L

4) Measure resistance between terminal 2 of SCV harness connector and terminals 10,11 of ECM connector(F39-1).



SNBFL8111L

■ Specification: Continuity(Below 1.0Ω)

5) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Power(LOW/HIGH) Inspection" procedure.

NO

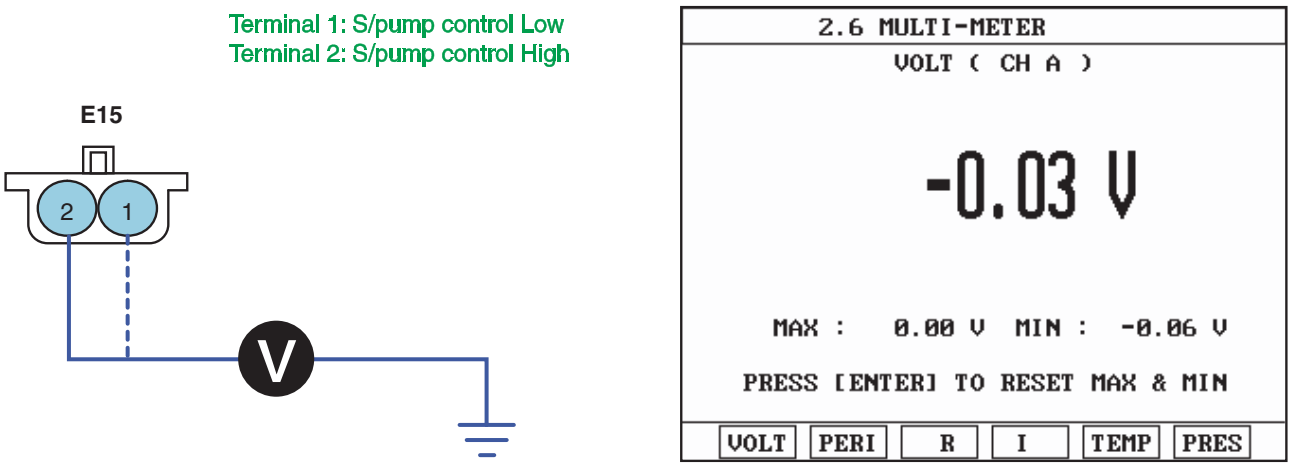
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. Signal Short to Power(LOW/HIGH) Inspection

1) Disconnect SCV connector(E15) and ECM connector(F39-1).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminals 1,2 of SCV harness connector and chassis ground.



SUDFL8254L

■ Specification: Below 0~0.1 V

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Ground(LOW/HIGH) Inspection" procedure.

NO

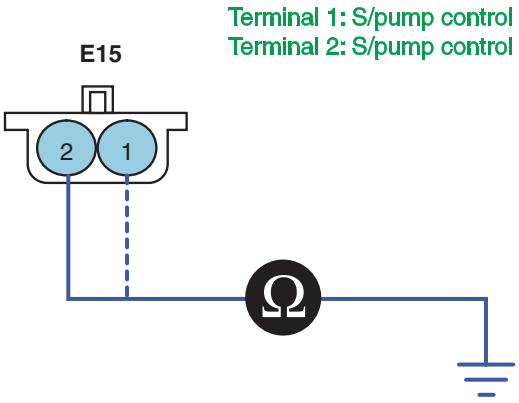
▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

4. Signal Short to Ground(LOW/HIGH) Inspection

1) Turn the ignition OFF.

2) Disconnect SCV connector(E15) and ECM connector(F39-1).

3) Measure resistance between terminals 1,2 of SCV harness connector and chassis ground.



SUDFL8255L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

COMPONENT INSPECTION E6C0C746

1. SCV Visual Inspection

   1) Turn the ignition OFF.

   2) Disconnect SCV connector(E15).

   3) Check terminal of the SCV connector for corrosion, contamination.

   4) Check the SCV for torque and fuel leaks.

   5) Is there any problem for SCV?

   YES

   ▶ Replace the SCV if necessary and then go to "Verification of Vehicle Repair" procedure.

   NO

   ▶ Go to "SCV Waveform Inspection" procedure

2. SCV Waveform Inspection

   1) Turn the ignition OFF.

   2) Disconnect SCV connector(E15).

   3) Connect oscilloscope to terminal 2 of SCV connector(E15).

   4) Check the waveform for normal operation at idle and acceleration state.
   ■ Specification: Refer to "Standard waveform" in the general information.

   5) Is the SCV waveform normal?

   YES

   ▶ Go to "Verification of Vehicle Repair" procedure.

   NO

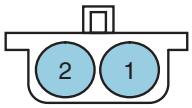
   ▶ Go to "SCV Resistance Inspection" procedure.

3. SCV Resistance Inspection

   1) Turn ignition OFF.

   2) Disconnect SCV connector(E15).

   3) Measure resistance between terminal 1 and 2 of SCV connector.

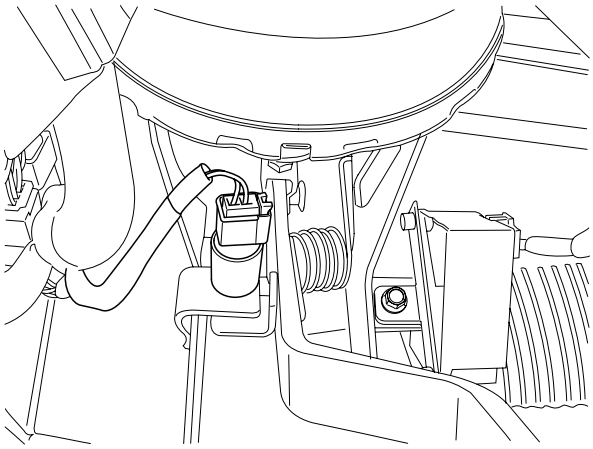


Terminal 1: S/pump control Low
Terminal 2:

DTC P0704 CLUTCH SWITCH MALFUNCTION (M/T)

COMPONENT LOCATION EEABC678

Clutch switch



SUDFL8504L

DESCRIPTION E6C56F69

1. The clutch is positioned between engine and transmission. The friction disc disengages flywheel and pressure plate when operating and interlocks with flywheel.
   If the clutch pedal is depressed, the friction disc is disengaged by clutch fork and cut off from engine power. Cutting off from torque transmission enables the gear shift to engage safely and easily. The clutch switch is installed at the upper part of clutch pedal and the ECM detects clutch state through signal of clutch switch.

2. DTC DESCRIPTION
   The vehicle speed repeats from 0km/h(stop) to 50km/h(driving) and 0km/h(stop). But if the clutch switch input signal is not detected above 1,048.6ms, the ECM judges this as a fault and DTC is set. The probable causes may be short to power of terminals 8 of ECM connector(F39-5), open circuit in ECM or faulty clutch switch component.
   In case of fail safe, it is impossible to operate the exhaust brake.

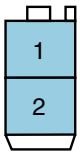
DTC DETECTING CONDITION E1722B38

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="5">• Short to power of terminals 8 of ECM connector(F39-5)
• Clutch switch component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• There is no clutch signal until the vehicle speed repeats from 0km/h(stop) to 50km/h(driving) and 0km/h(stop)</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 1,048.6ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• It is impossible to operate the exhaust brake.
• It is impossible to idle-up when operating A/C.</td></tr>
<tr><td>Fuel Limit</td><td>No</td></tr>
<tr><td>MIL</td><td>OFF</td></tr>
</table>

SPECIFICATION EC3DF8F5

Item	Specification
Clutch switch resistance	0~1Ω

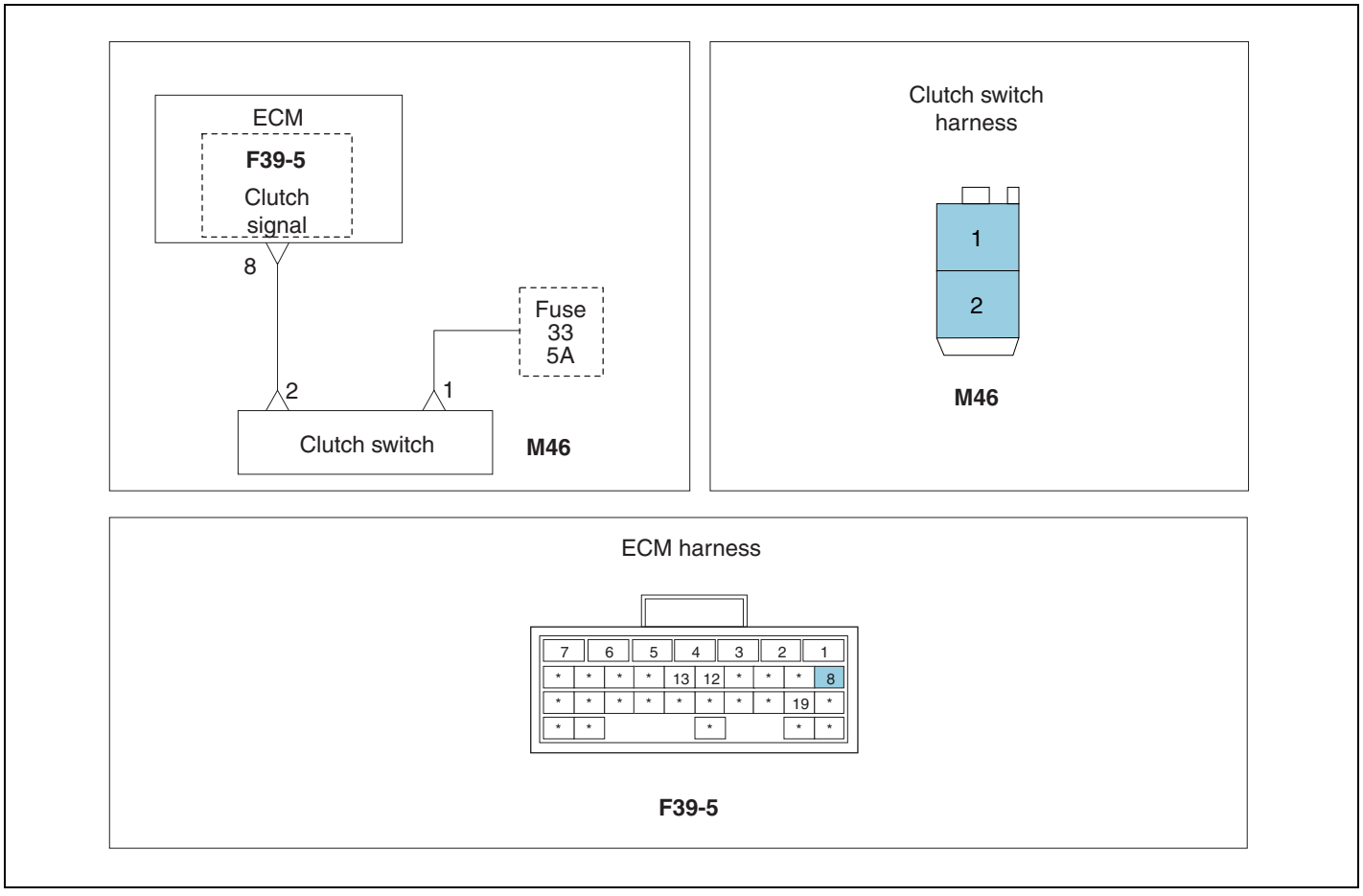
Terminal 1: Battery power
Terminal 2: Clutch switch signal



Sensor connector

SNBFL8112L

SCHEMATIC DIAGRAM ECE73D55



SNBFL8113L

MONITOR SCAN TOOL DATA EE4F1166

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Clutch switch" parameter on the scan tool.

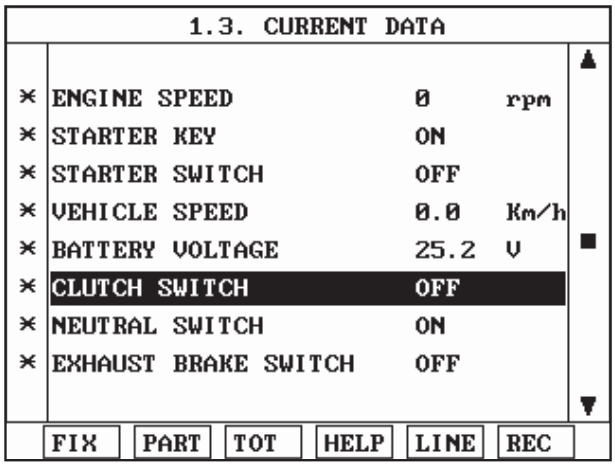


Fig. 1 "OFF" data when operating clutch switch

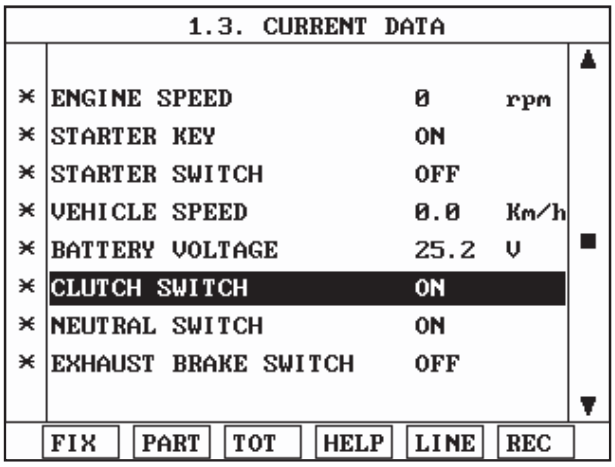
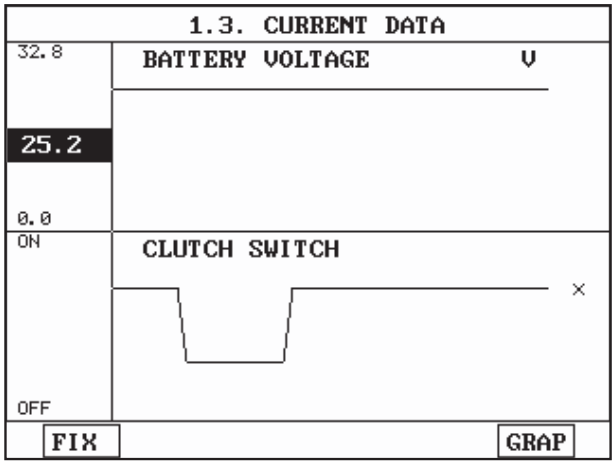


Fig. 2 "ON" data when not operating clutch switch



SUDFL8259L

TERMINAL & CONNECTOR INSPECTION E9385A35

Refer to DTC P0112.

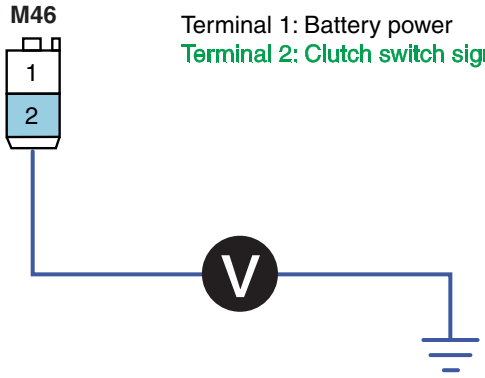
SIGNAL CIRCUIT INSPECTION E1D82EF9

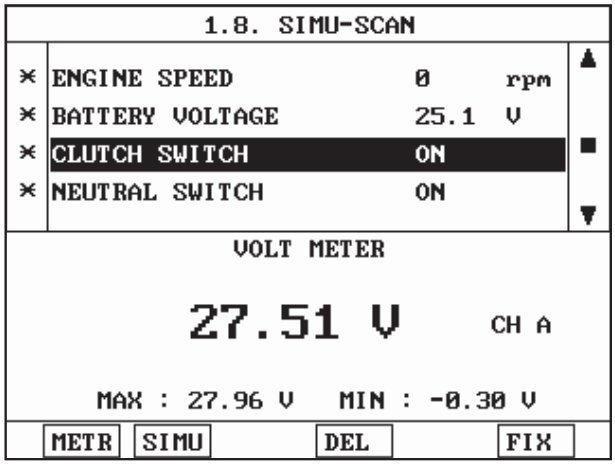
1. Signal Voltage Inspection

   1) Leave the clutch switch connector(M46) connected.

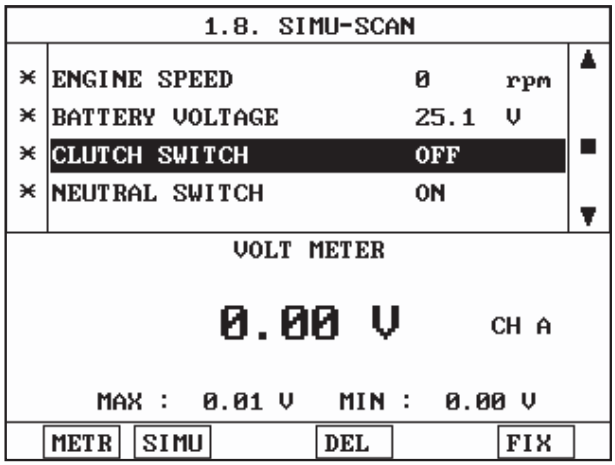
   2) Turn the ignition ON. The engine stops.

   3) Monitor waveform between terminal 2 of clutch harness connector and chassis ground.





▶ Clutch switch(At IG ON)



▶ Clutch switch(At IG OFF)

SNBFL8114L

■ Specification:
Clutch switch(OFF) signal power: Approx. 0V
Clutch switch(ON) signal power: Approx. B+ V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

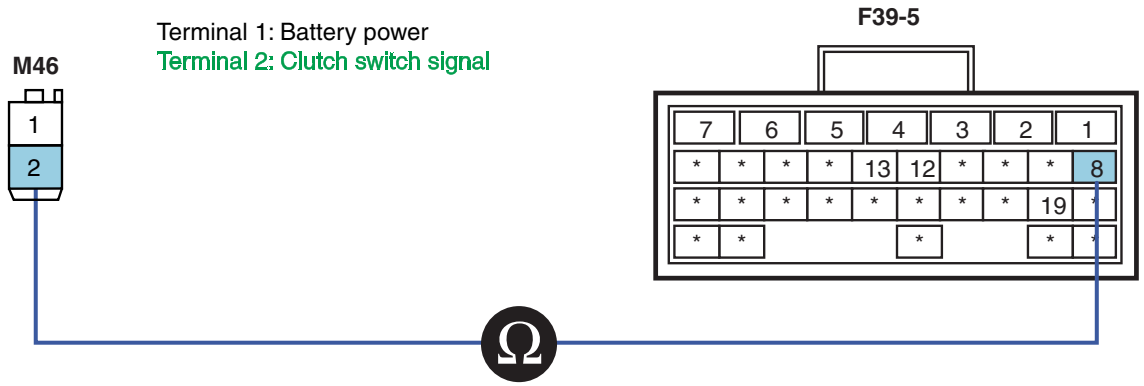
▶ Go to "Signal Open Inspection" procedure.

2. Signal Open Inspection

1) Turn the ignition OFF.

2) Disconnect clutch switch connector(M46) and ECM connector(F39-5).

3) Measure resistance between terminal 2 of clutch switch connector and terminal 8 of ECM connector(F39-5).



SNBFL8115L

■ Specification: Continuity(Below 1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Power Inspection" procedure.

NO

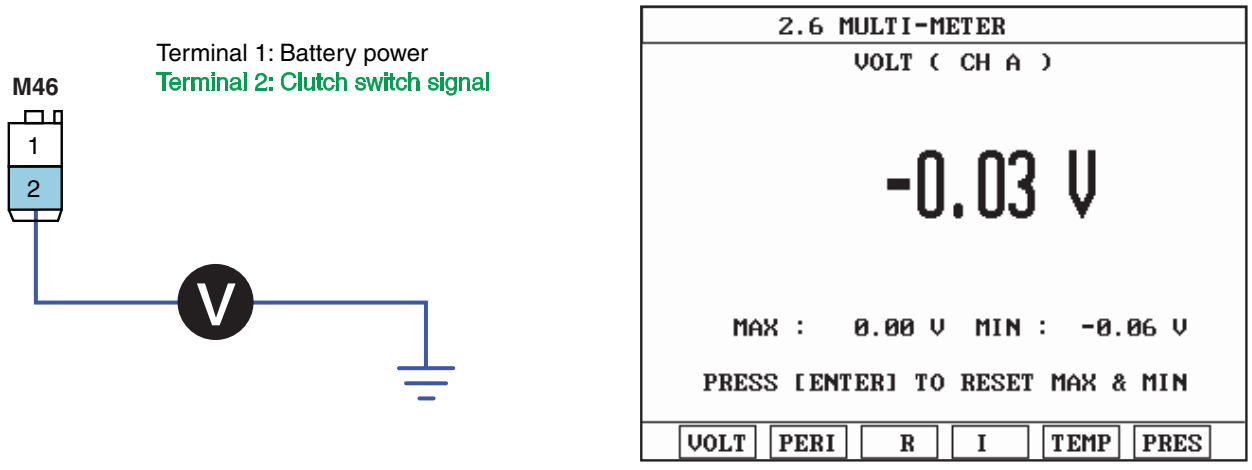
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. Signal Short to Power Inspection

1) Disconnect Clutch switch connector(M46) and ECM connector(F39-1).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 2 of clutch switch harness connector and chassis ground.



SNBFL8116L

■ Specification: Below 0~0.1 V

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

COMPONENT INSPECTION E4236E0C

1. SCV Visual Inspection

   1) Turn the ignition OFF.

   2) Disconnect clutch switch connector(M46).

   3) Check terminal of the clutch switch connector for corrosion, contamination.

   4) Is there any problem for SCV?

   YES

   ▶ Replace the clutch switch if necessary and then go to "Verification of Vehicle Repair" procedure.

   NO

   ▶ Go to "Clutch Switch Resistance Inspection" procedure

2. Clutch Switch Resistance Inspection

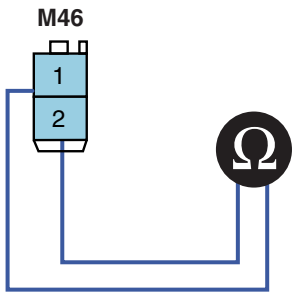
   1) Turn the ignition OFF.

   2) Disconnect clutch switch connector(M46).

   3) Measure resistance between terminal 1 and 2 of clutch switch.

■ SPECIFICATION

Condition	Resistance between terminal 1 and 2(Ω)
When not operating	0
When operating	Infinite



Terminal 1: Battery power
Terminal 2: Clutch switch signal

SNBFL8117L

   4) Is the resistance measured within specification?

   YES

   ▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the clutch switch and then go to "Verification of Vehicle Repair" procedure.

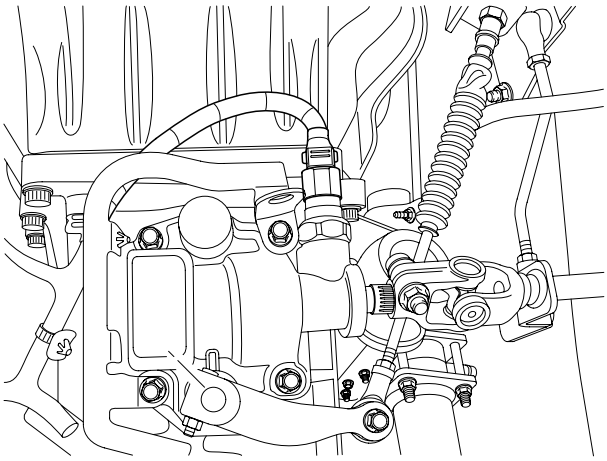
VERIFICATION OF VEHICLE REPAIR E81B7AF0

Refer to DTC P0112.

DTC P0850 PARK/NEUTRAL SWITCH MALFUNCTION

COMPONENT LOCATION EF48BABD

Neutral switch



SUDFL8505L

DESCRIPTION EAFF943A

1. The neutral switch is located in the control housing of the upper of transmission, the neutral switch sends signal to the ECM, the ECM decides fuel injection amount after the ECM judges the vehicle is in the neutral.

2. DTC DESCRIPTION
   The vehicle speed repeats from 0km/h(stop) to 50km/h(driving) and 0km/h(stop). But if the neutral switch input signal is not changed for above 1,048.6ms, the ECM judges this as a fault and DTC is set. The probable causes may be short to power of terminals 32 of ECM connector(F39-3), open wiring or faulty neutral switch.
   In case of fail safe, it is impossible to operate the exhaust brake and PTO(if equipped).

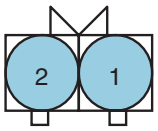
DTC DETECTING CONDITION EA36DC9D

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="5">• Short to power of terminal 32 of ECM connector(F39-3)
• Neutral switch component</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• When there is no clutch signal until the vehicle speed repeats from 0km/h(stop) to 50km/h(driving) and 0km/h(stop)</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 1,048.6ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• It is impossible to operate the exhaust brake and PTO.
• It is impossible to control idle.</td></tr>
<tr><td>Fuel Limit</td><td>No</td></tr>
<tr><td>MIL</td><td>OFF</td></tr>
</table>

SPECIFICATION EF71A174

Item	Specification
Clutch switch resistance	0~1Ω

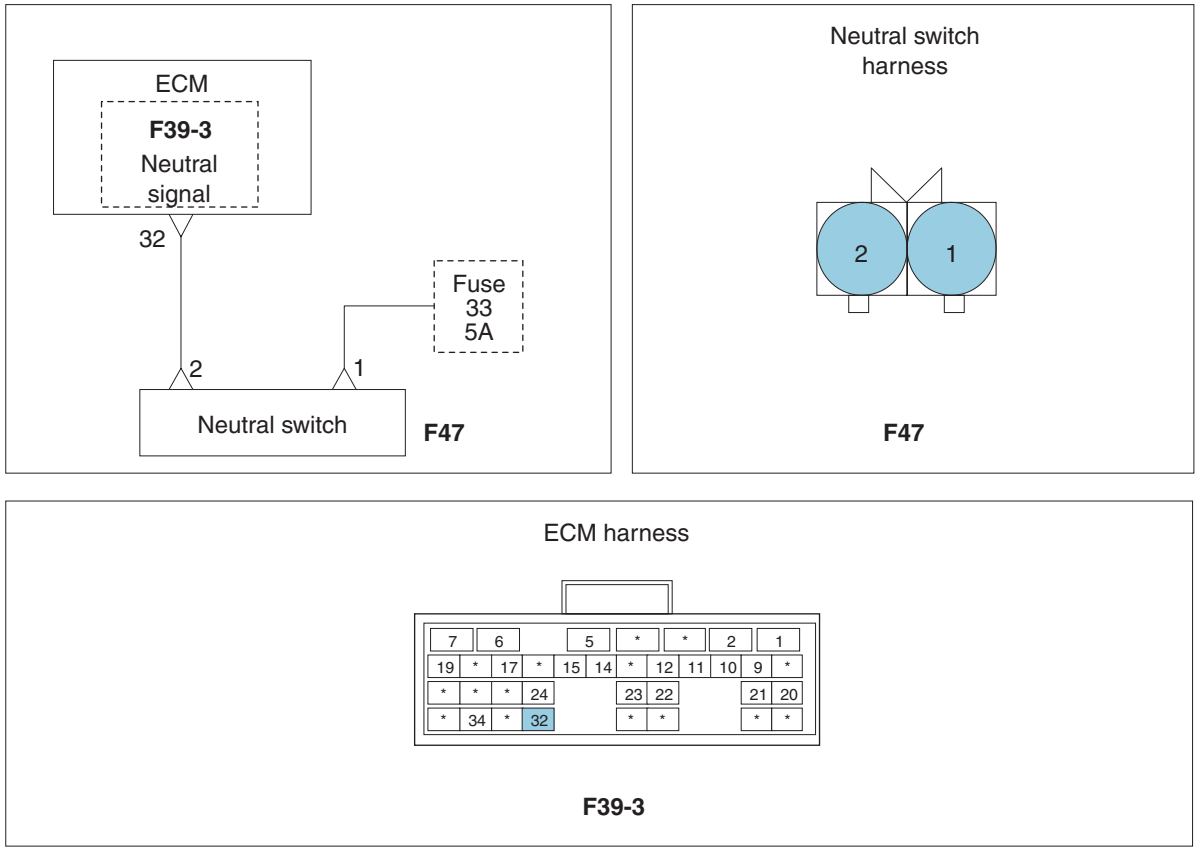
Terminal 1: Battery power
Terminal 2: Neutral signal



Sensor connector

SUDFL8264L

SCHEMATIC DIAGRAM E7680F54



SNBFL8118L

MONITOR SCAN TOOL DATA E478A563

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Neutral switch" parameter on the scan tool.

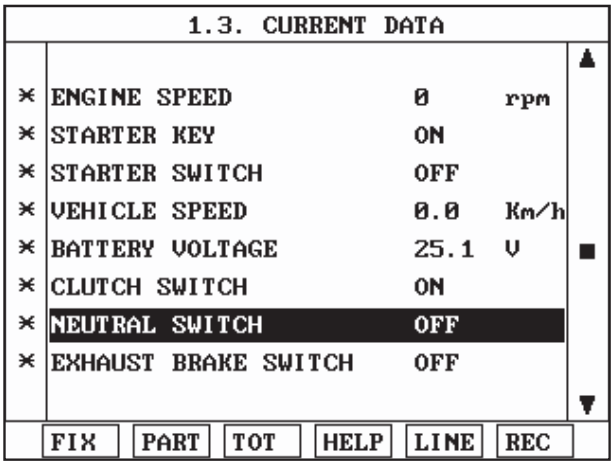


Fig. 1 "OFF" data when operating neutral switch

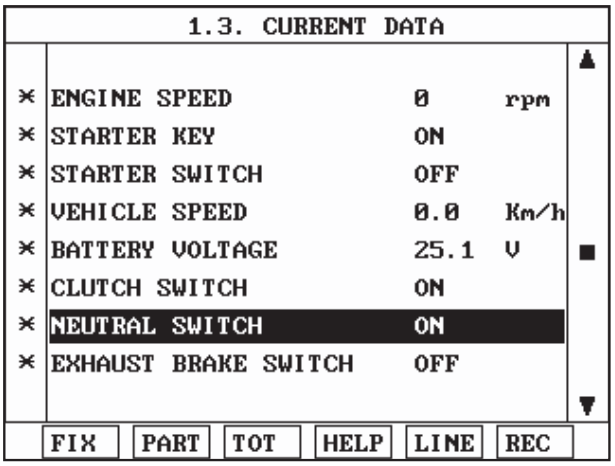
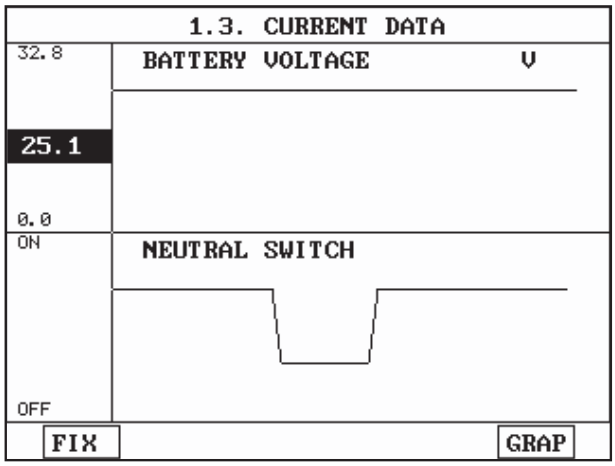


Fig. 2 "ON" data when not operating neutral switch



SUDFL8266L

TERMINAL & CONNECTOR INSPECTION EFB1B512

Refer to DTC P0112.

SIGNAL CIRCUIT INSPECTION E95C21F1

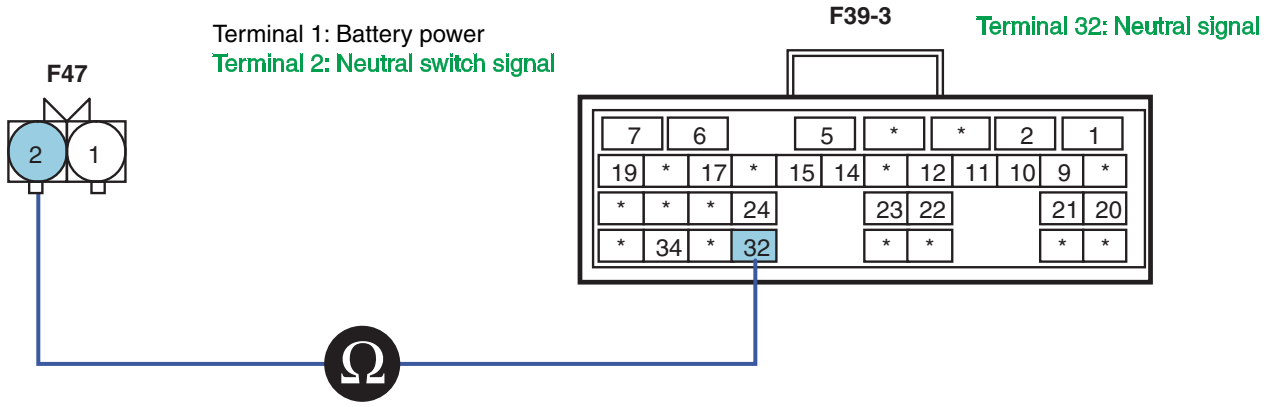
1. Signal Voltage Inspection

   1) Leave the park/neutral switch connector(F47) connected.

   2) Turn the ignition ON. Stop the engine and put the gear in the neutral position.

   3) Measure voltage between terminal 2 of park/neutral switch harness connector and chassis ground.

Terminal 1: Battery power
Terminal 2: Neutral switch signal



SNBFL8120L

■ Specification: Continuity(Below 1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Power Inspection" procedure.

NO

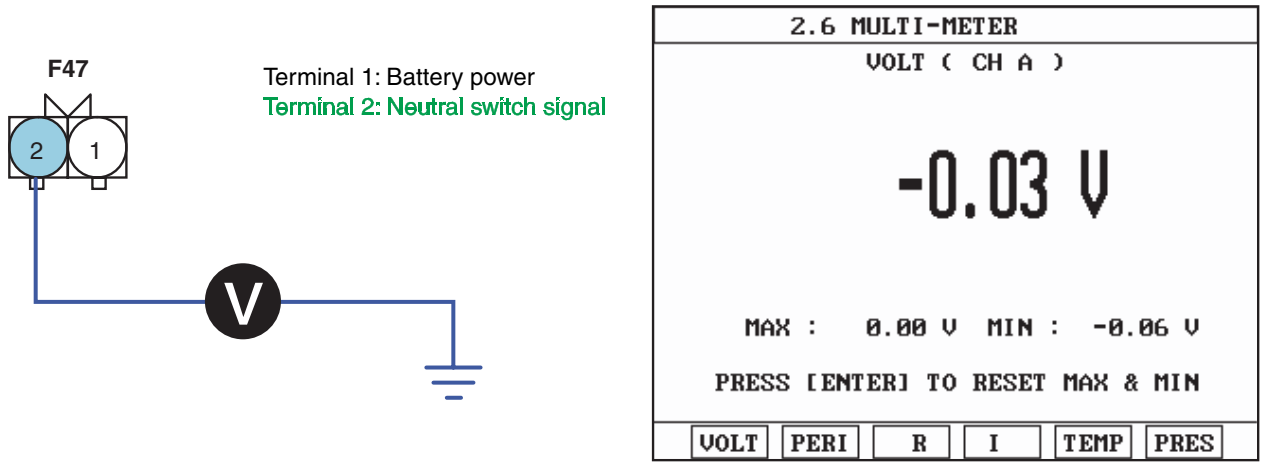
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. Signal Short to Power Inspection

1) Disconnect park/neutral switch connector(F47) and ECM connector(F39-3).

2) Turn the ignition ON. Stop the engine and put the gear in the neutral position.

3) Measure voltage between terminal 2 of park/neutral switch harness connector and chassis ground.



SNBFL8121L

■ Specification: Below 0~0.1 V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

COMPONENT INSPECTION EB1B4C35

1. Park/neutral Switch Visual Inspection

   1) Turn the ignition OFF.

   2) Disconnect park/neutral switch connector(F47).

   3) Check terminal of the park/neutral switch connector for corrosion, contamination.

   4) Is there any problem for the park/neutral switch?

   YES

   ▶ Replace the park/neutral switch if necessary and then go to "Verification of Vehicle Repair" procedure.

   NO

   ▶ Go to "Park/neutral Switch Resistance Inspection" procedure

2. Park/neutral Switch Resistance Inspection

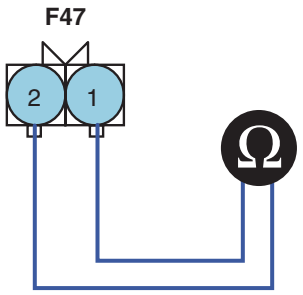
   1) Turn the ignition OFF.

   2) Disconnect park/neutral switch connector(F47).

   3) Measure resistance between terminal 1 and 2 of park/neutral switch.

■ SPECIFICATION

Condition	Resistance between terminal 1 and 2(Ω)
When not operating	0
When operating	Infinite



Terminal 1: Battery power
Terminal 2: Neutral switch signal

SNBFL8122L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

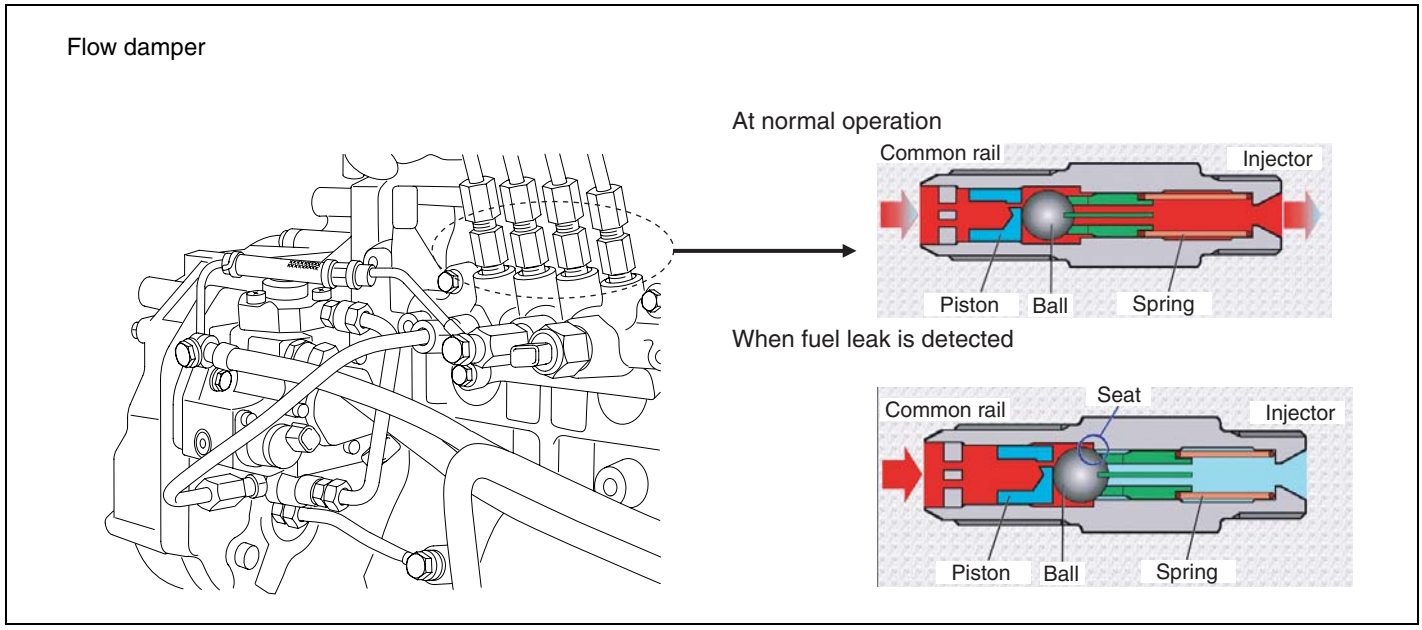
▶ Replace the park/neutral switch and then go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E3E735BE

Refer to DTC P0112.

DTC P1091 FUEL SYSTEM #1 CYLINDER LEAK DETECT

COMPONENT LOCATION EC78AB37



SUDFL8333L

DESCRIPTION ED811304

1. GENERAL DESCRIPTION
   The flow damper is located in the upper of common rail, and plays a role to reduce high pressure pulse between injector and common rail and stabilizes fuel to send to injector. If pressure difference between injector and common rail occurs, the flow damper plays a role to cut off fuel to send to high pressure pipe and injector.
   When there is a leak of an excessive fuel, flow damper is activated and the engine is unstable and engine power is restricted due to unstable fuel flow by blocking fuel passage.
   Release condition of flow damper elapses 30sec. or more after the engine is OFF. If pressure difference between injector and common rail is even, normal fuel supply is possible.
   The electric signal is not necessary to operate flow damper to open and close check valve since the ECM judges with cylinder angular speed.

2. DTC DESCRIPTION
   If change of time axis by cylinder due to fuel leak of high pressure system is detected for 0ms or more, ECM judges this as a fault and DTC is set. The possible cause is leak in cylinder #1 injector and fuel line. At this moment, the engine is unstable and the engine power is restricted since the flow damper #1 of rail is operated and closed.
   Try to restart the engine after elapse of certain time as it takes a certain time to return after flow damper is operated.

DTC DETECTING CONDITION EAC4DC27

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Check cylinder injector #1 and high pressure in fuel line.
Enable Conditions	• Running			
Threshold Value	• When the change of time axis by cylinder is detected			
Diagnosis Time	• 0ms or more			
Fail Safe	Fuel Cut	No	• Engine is unstable and power is restricted.	
	Fuel Limit	Yes		
	MIL	OFF		

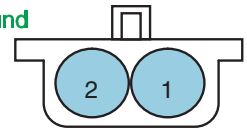
SPECIFICATION E2C04234

Injector resistance(terminal-to-terminal)

Item	Specification
Resistance	0.45Ω(At 20˚C)

Injector driving voltage	135V
Injector driving current	20A
Injector control type	Current control

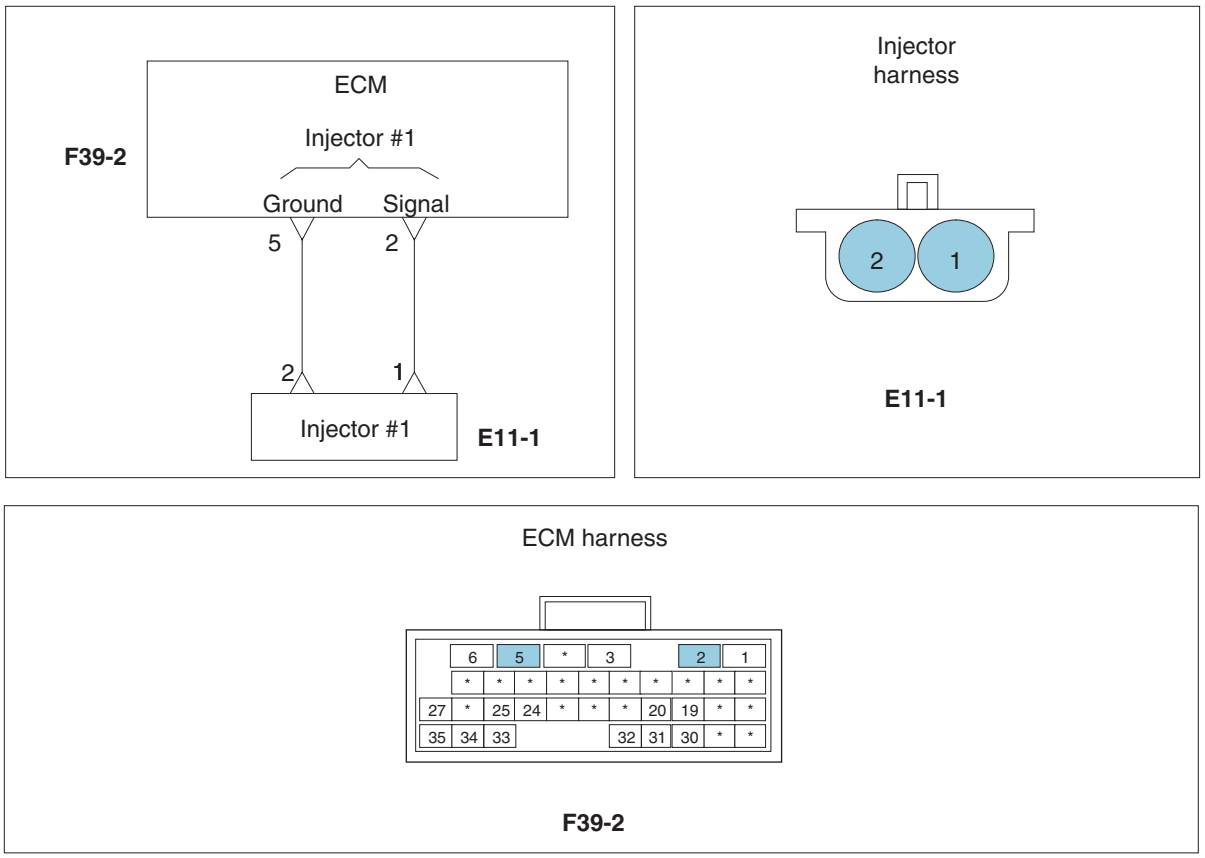
Terminal 1: Signal
Terminal 2: Ground



Sensor connector

SUDFL8334L

SCHEMATIC DIAGRAM EA678AAD



SNBFL8045L

SIGNAL WAVEFORM E9EADE54

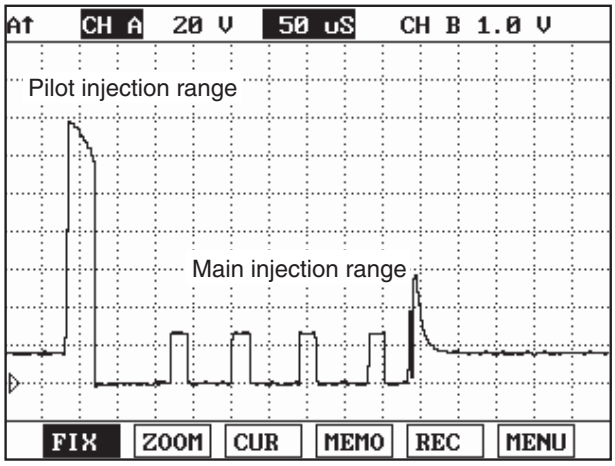


Fig. 1 Low side waveform when activating injector(Ground side)

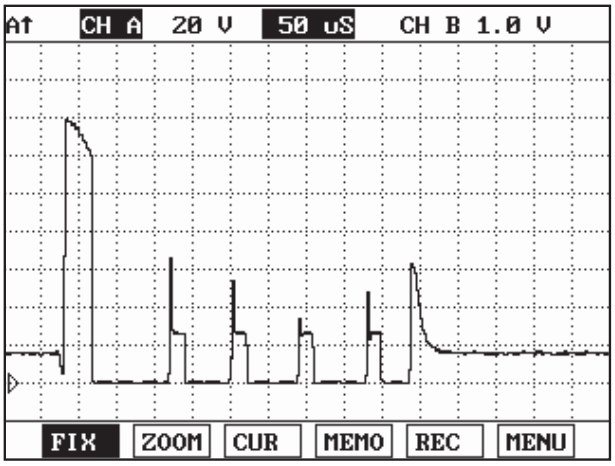


Fig. 2 High side injector power waveform(Signal side)

Fig.1) is divided into pilot injection range and main injection range as low side waveform when activating injector.
Fig.2) is high side injector power waveform.

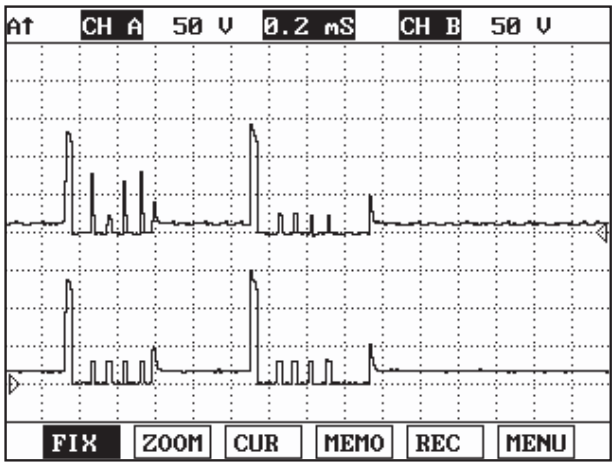


Fig. 3 Injector power waveform combined with High/Low side

SUDFL8101L

NOTE

Waveforms of Fig.1) and Fig.2) are displayed by turns in the course of checking injector waveform in LOW side. The reason that the waveform like a Fig.2) is displayed is used in LOW side in common the power of HIGH side of injector #1, #4 or injector #2, #3 which is not activated.

MONITOR SCAN TOOL DATA EA504DB1

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Fuel injection amount" parameter on the scan tool.

■ Specification: Fuel amount - Approx. 9.0~10.5 mm³/st at idle

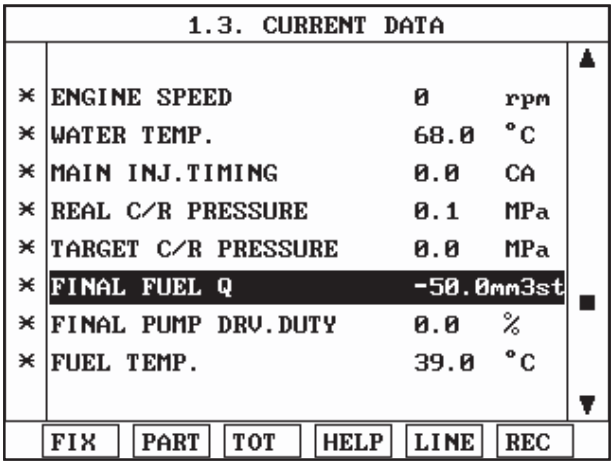


Fig. 1 Fuel injection amount data at ignition ON

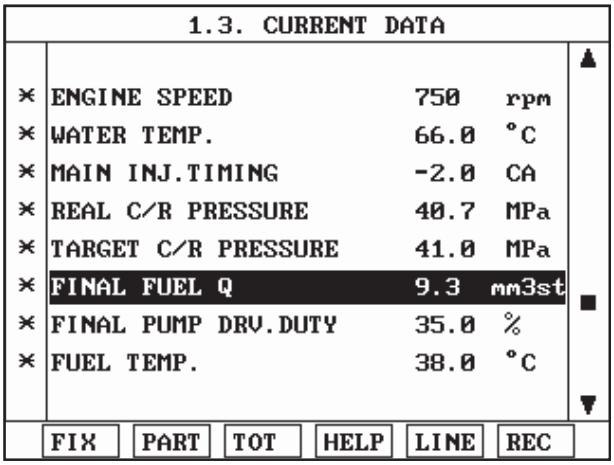


Fig. 2 Fuel injection amount data at idle

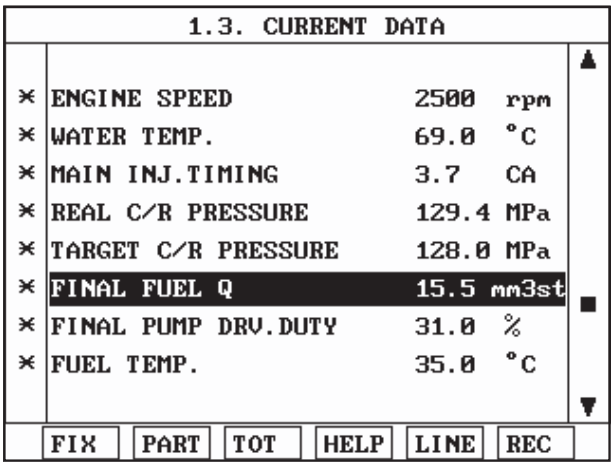


Fig. 3 Fuel injection amount data at 2,500rpm

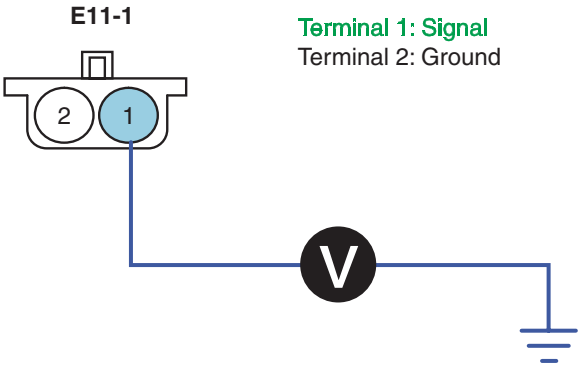
SUDFL8102L

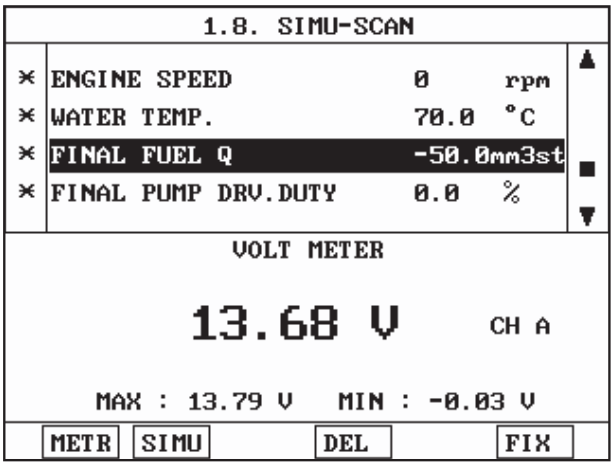
TERMINAL & CONNECTOR INSPECTION EF90184C

Refer to DTC P0112.

POWER SUPPLY INSPECTION EF9DE326

1. Power Supply Voltage Inspection
   1) Leave injector #1 connector(E11-1) installed.
   2) Turn the ignition ON. The engine stops.
   3) Measure voltage between terminal 1 of the injector #1 and chassis ground.





▶ With injector #1 connector disconnected/connected (At IG ON)

SUDFL8178L

■ Specification: Injector #1 signal power approx. 13.57 V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

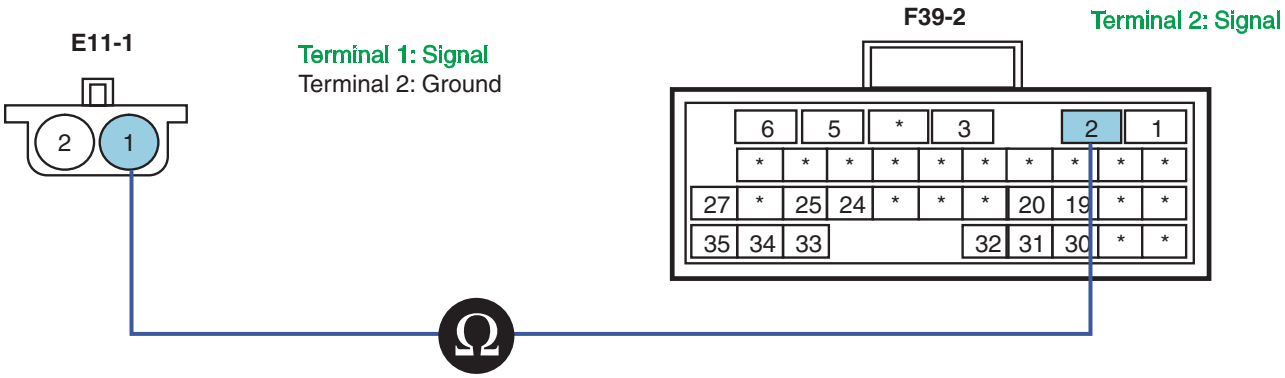
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn ignition OFF.

2) Disconnect injector #1 connector(E11-1) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of injector #1 harness connector(E11-1) and terminal 2 of ECM connector(F39-2).



SNBFL8080L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

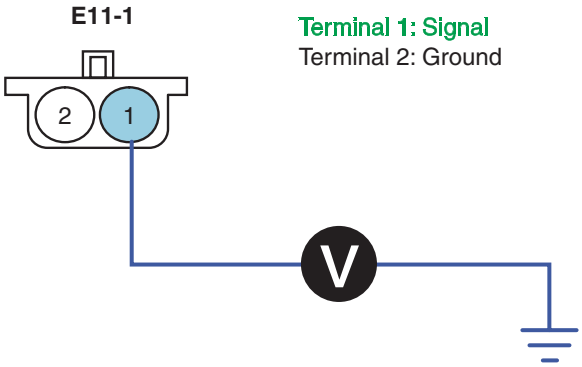
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

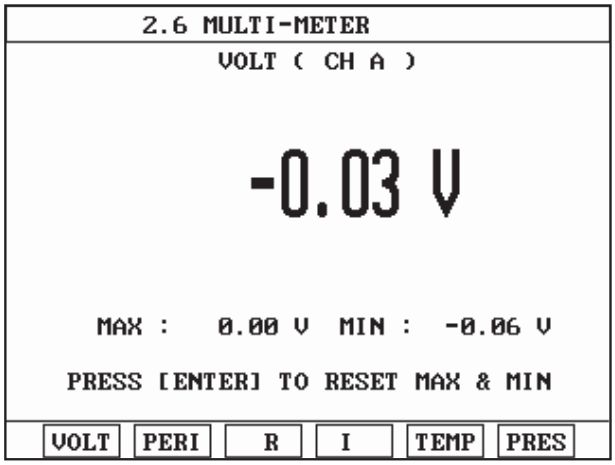
3. Power Supply Short to Power Inspection

1) Disconnect injector #1 connector(E11-1) and ECM connector(F39-2).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of injector #1 harness connector(E11-1) and chassis ground.





SUDFL8180L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

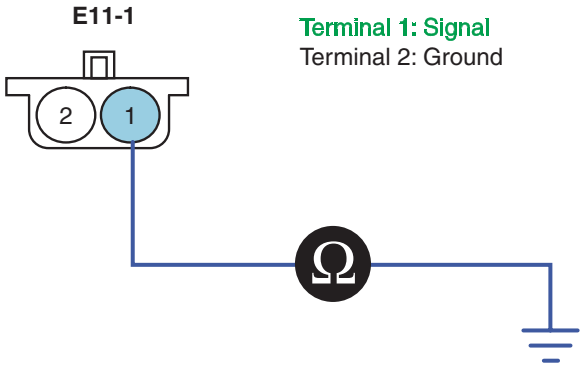
▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

4. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect injector #1 connector(E11-1) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of injector #1 harness connector(E11-1) and chassis ground.



SUDFL8181L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

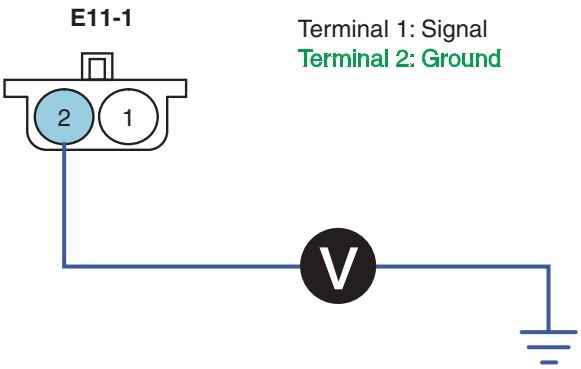
GROUND CIRCUIT INSPECTION EECA4E54

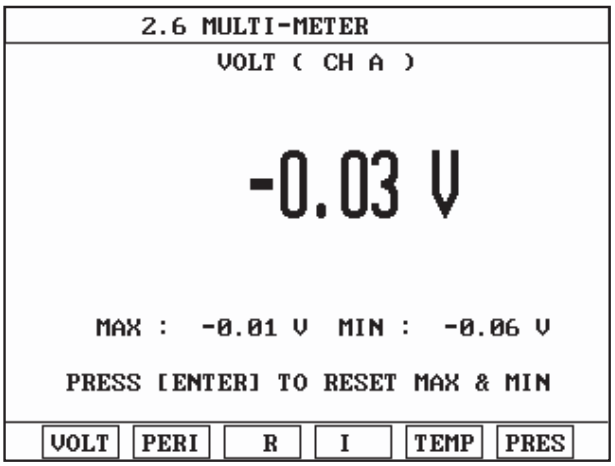
1. Ground Voltage Drop Inspection

1) Disconnect injector #1 connector(E11-1).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 2 of injector #1 harness connector(E11-1) and chassis ground.





SUDFL8182L

■ Specification: Ground voltage drop-Within 200mV

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

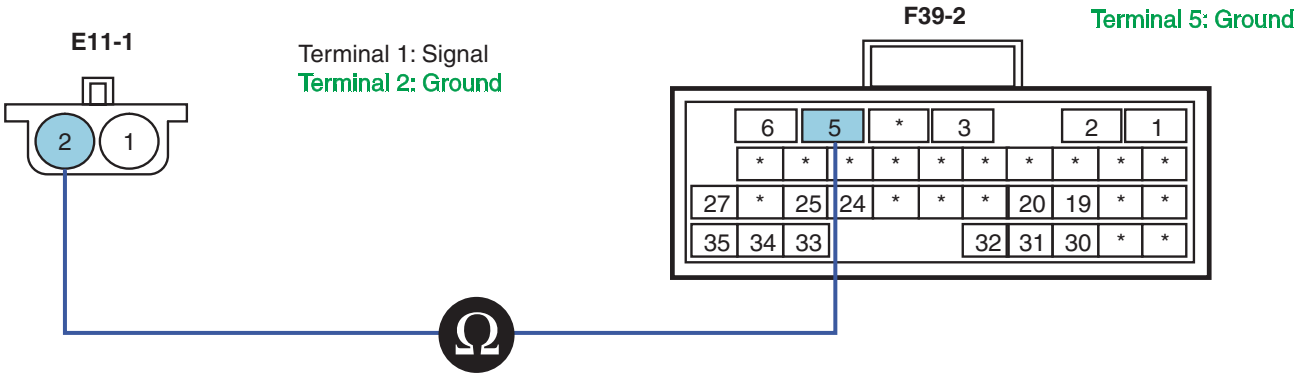
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect injector #1 connector(E11-1) and ECM connector(F39-2).

3) Measure resistance between terminal 2 of injector #1 harness connector(E11-1) and terminal 5 of ECM connector(F39-2).



SNBFL8081L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

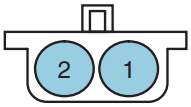
COMPONENT INSPECTION E8F8D39A

1. Injector Component Inspection

1) Turn ignition OFF.

2) Disconnect injector#1 connector(E11-1).

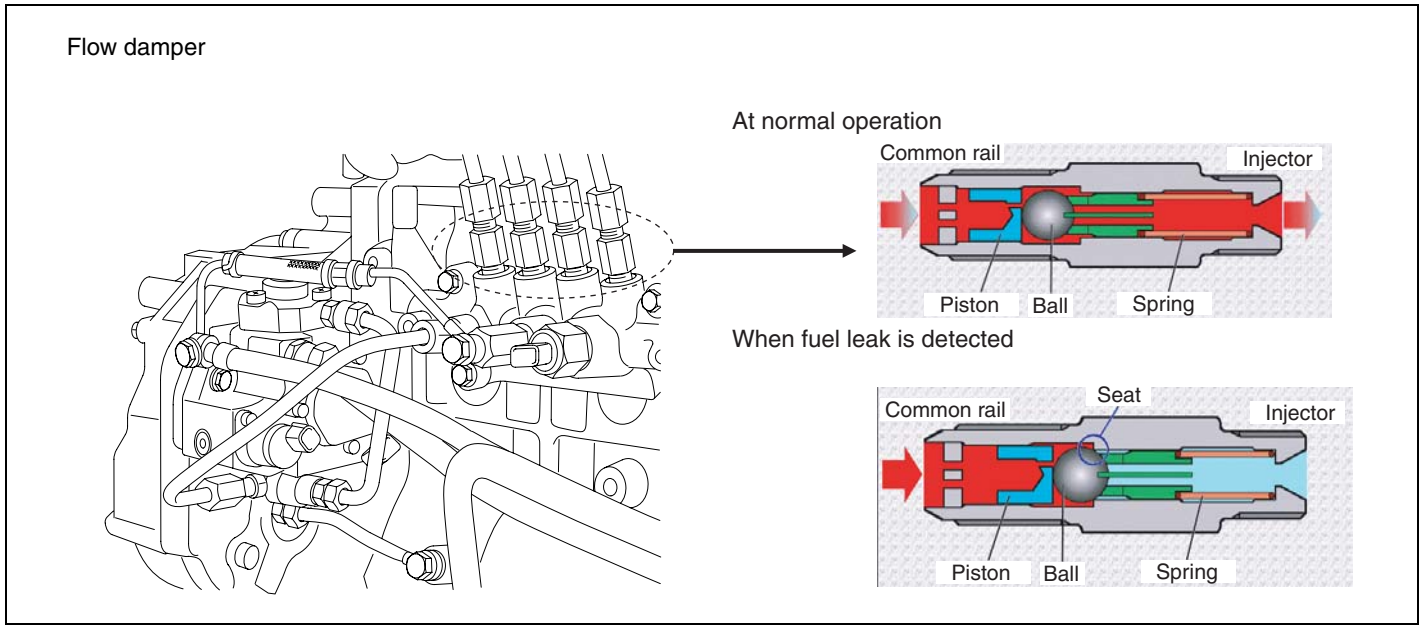
3) Measure resistance between terminal 1 and 2 of injector#1 connector.



Terminal 1: Signal
Ter

DTC P1092 FUEL SYSTEM #2 CYLINDER LEAK DETECT

COMPONENT LOCATION EB48A64D



SUDFL8333L

DESCRIPTION EB03F31E

1. GENERAL DESCRIPTION
   The flow damper is located in the upper of common rail, and plays a role to reduce high pressure pulse between injector and common rail and stabilizes fuel to send to injector. If pressure difference between injector and common rail occurs, the flow damper plays a role to cut off fuel to send to high pressure pipe and injector.
   When there is a leak of an excessive fuel, flow damper is activated and the engine is unstable and engine power is restricted due to unstable fuel flow by blocking fuel passage.
   Release condition of flow damper elapses 30sec. or more after the engine is OFF. If pressure difference between injector and common rail is even, normal fuel supply is possible.
   The electric signal is not necessary to operate flow damper to open and close check valve since the ECM judges with cylinder angular speed.

2. DTC DESCRIPTION
   If change of time axis by cylinder due to fuel leak of high pressure system is detected for 0ms or more, ECM judges this as a fault and DTC is set. The possible cause is leak in cylinder #2 injector and fuel line. At this moment, the engine is unstable and the engine power is restricted since the flow damper #2 of rail is operated and closed.
   Try to restart the engine after elapse of certain time as it takes a certain time to return after flow damper is operated.

DTC DETECTING CONDITION E471BD56

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Check cylinder injector #2 and high pressure in fuel line.
Enable Conditions	• Running			
Threshold Value	• When the change of time axis by cylinder is detected			
Diagnosis Time	• 0ms or more			
Fail Safe	Fuel Cut	No	• Engine is unstable and power is restricted.	
	Fuel Limit	Yes		
	MIL	OFF		

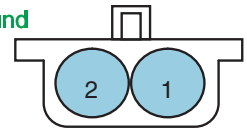
SPECIFICATION E528833B

Injector resistance(terminal-to-terminal)

Item	Specification
Resistance	0.45Ω(At 20˚C)

Injector driving voltage	135V
Injector driving current	20A
Injector control type	Current control

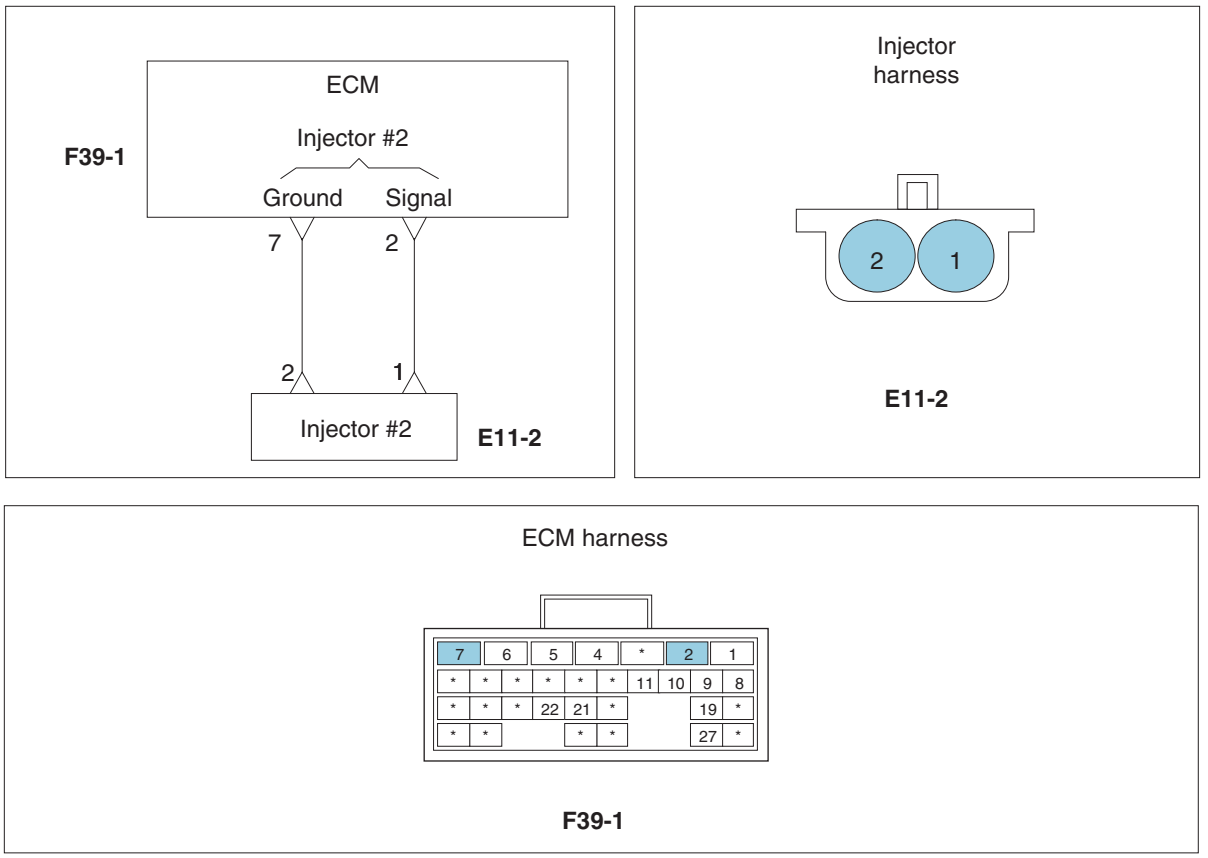
Terminal 1: Signal
Terminal 2: Ground



Sensor connector

SUDFL8334L

SCHEMATIC DIAGRAM E036F14B



SNBFL8048L

SIGNAL WAVEFORM E67D7F48

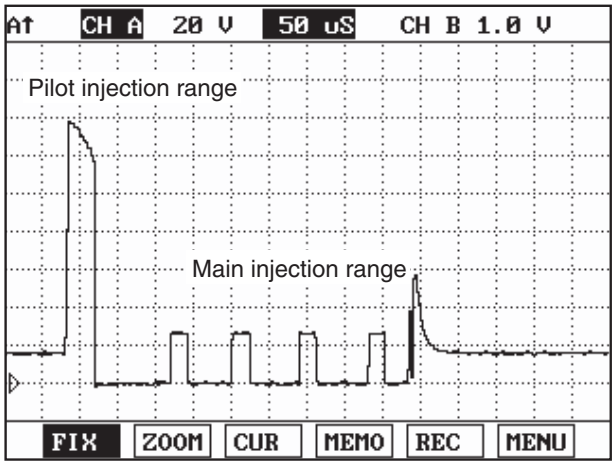


Fig. 1 Low side waveform when activating injector(Ground side)

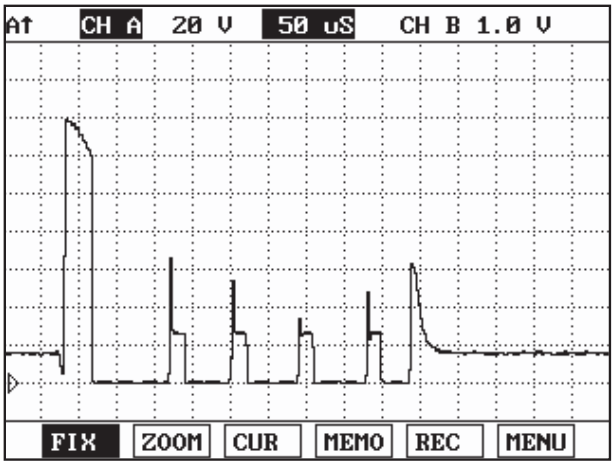


Fig. 2 High side injector power waveform(Signal side)

Fig.1) is divided into pilot injection range and main injection range as low side waveform when activating injector.
Fig.2) is high side injector power waveform.

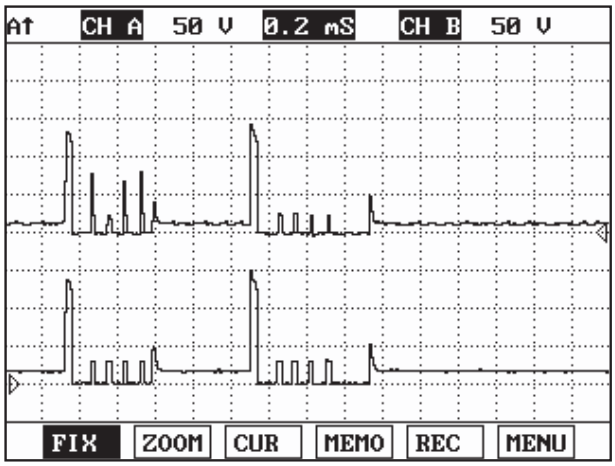


Fig. 3 Injector power waveform combined with High/Low side

SUDFL8101L

NOTE

Waveforms of Fig.1) and Fig.2) are displayed by turns in the course of checking injector waveform in LOW side. The reason that the waveform like a Fig.2) is displayed is used in LOW side in common the power of HIGH side of injector #1, #4 or injector #2, #3 which is not activated.

MONITOR SCAN TOOL DATA ECF7C838

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Fuel injection amount" parameter on the scan tool.

■ Specification: Fuel amount - Approx. 9.0~10.5 mm³/st at idle

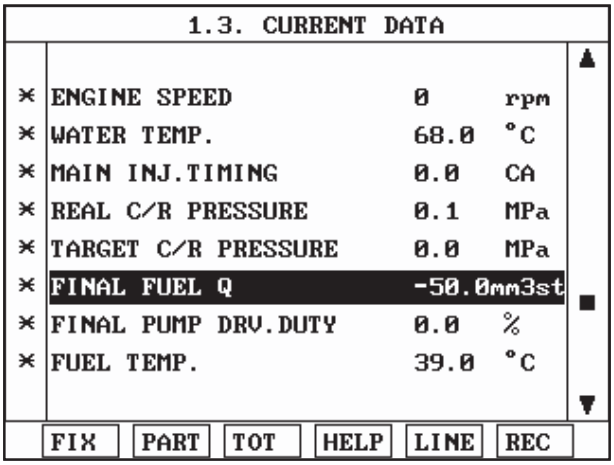


Fig. 1 Fuel injection amount data at ignition ON

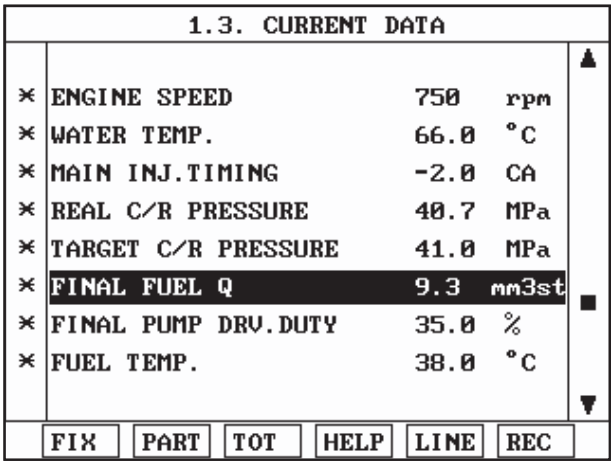


Fig. 2 Fuel injection amount data at idle

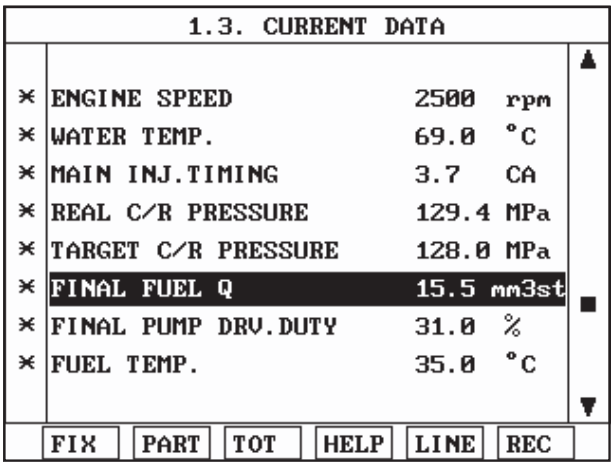


Fig. 3 Fuel injection amount data at 2,500rpm

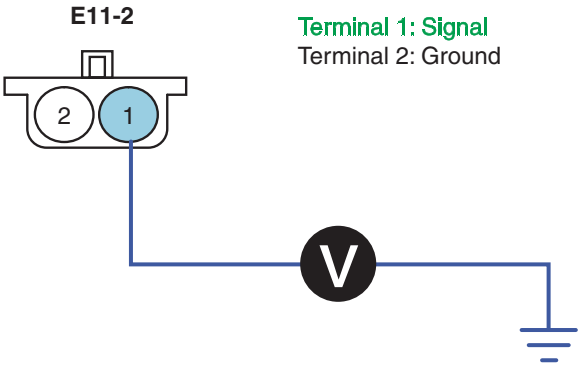
SUDFL8102L

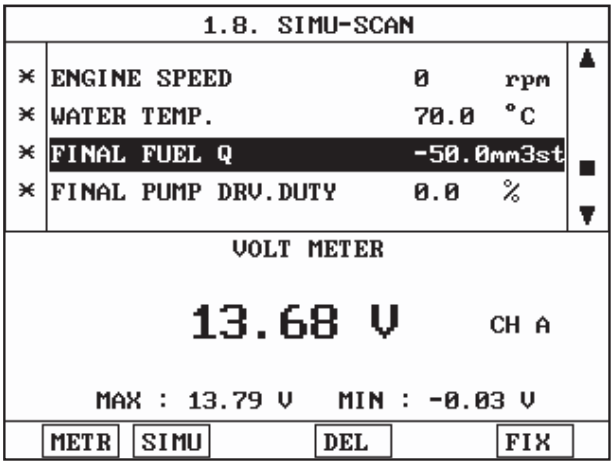
TERMINAL & CONNECTOR INSPECTION EEEF07FD

Refer to DTC P0112.

POWER SUPPLY INSPECTION EFA6F13D

1. Power Supply Voltage Inspection
   1) Leave injector #2 connector(E11-2) installed.
   2) Turn the ignition ON. The engine stops.
   3) Measure voltage between terminal 1 of the injector #2 and chassis ground.





▶ With injector #2 connector disconnected/connected (At IG ON)

SUDFL8185L

■ Specification: Injector #2 signal power approx. 13.57 V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

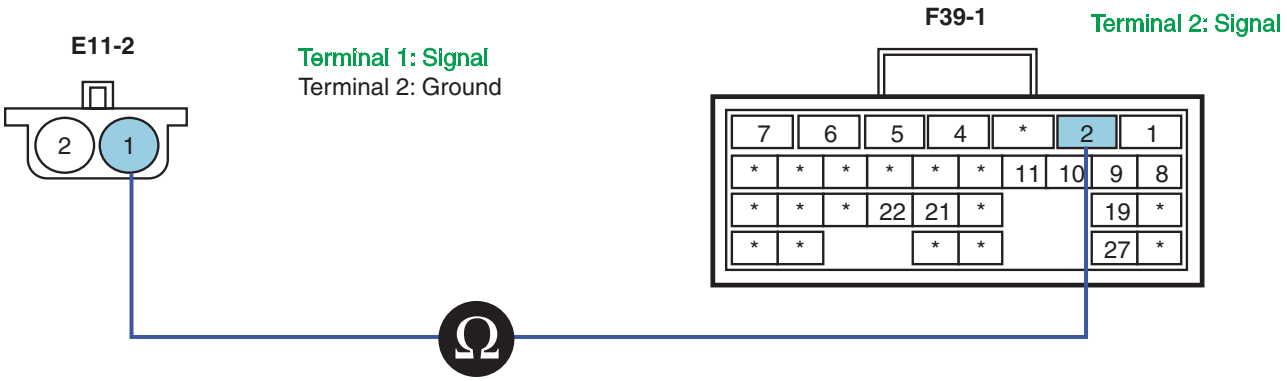
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn ignition OFF.

2) Disconnect injector #2 connector(E11-2) and ECM connector(F39-1).

3) Measure resistance between terminal 1 of injector #2 harness connector(E11-2) and terminal 2 of ECM connector(F39-1).



SNBFL8082L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

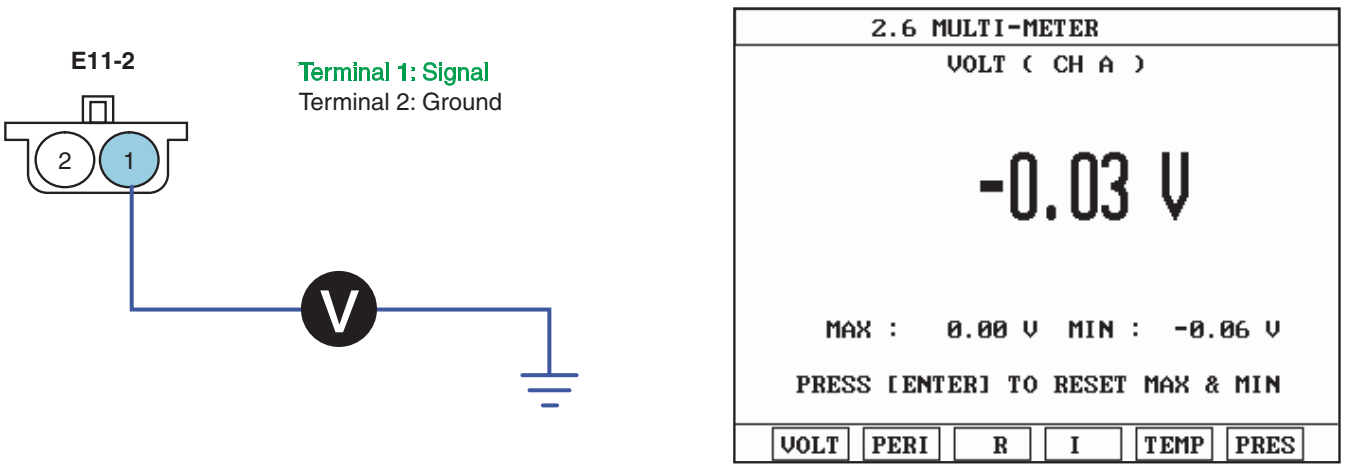
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. Power Supply Short to Power Inspection

1) Disconnect injector #2 connector(E11-2) and ECM connector(F39-1).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of injector #2 harness connector(E11-2) and chassis ground.



SUDFL8187L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

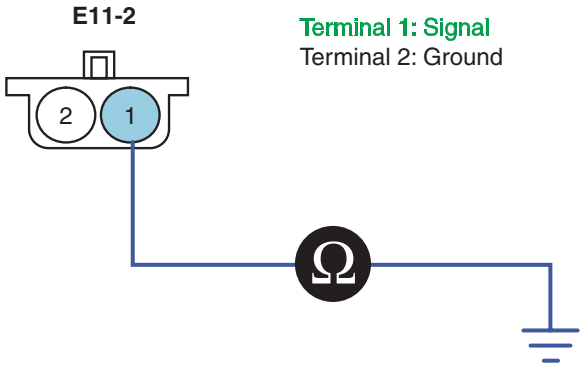
▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

4. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect injector #2 connector(E11-2) and ECM connector(F39-1).

3) Measure resistance between terminal 1 of injector #2 harness connector(E11-2) and chassis ground.



SUDFL8188L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

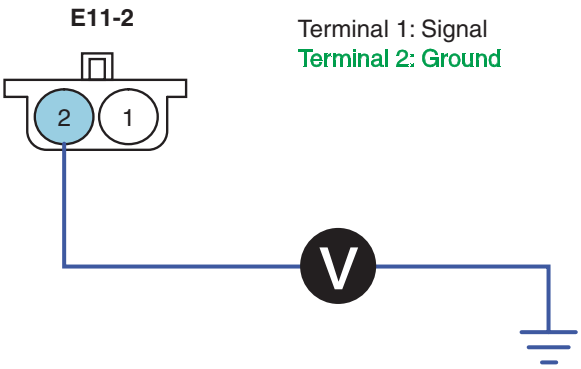
GROUND CIRCUIT INSPECTION EE492C78

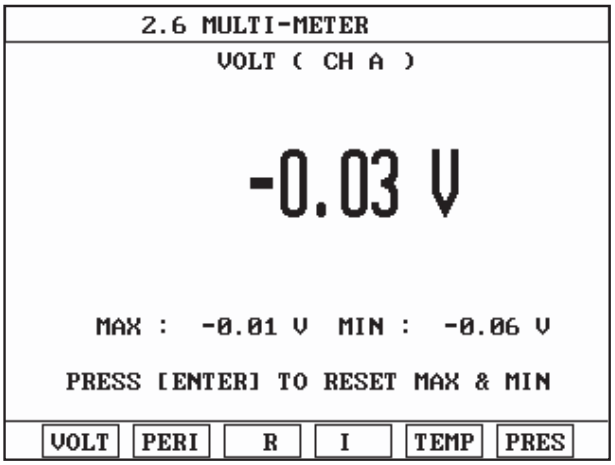
1. Ground Voltage Drop Inspection

1) Disconnect injector #2 connector(E11-2).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 2 of injector #2 harness connector(E11-2) and chassis ground.





SUDFL8189L

■ Specification: Ground voltage drop-Within 200mV

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

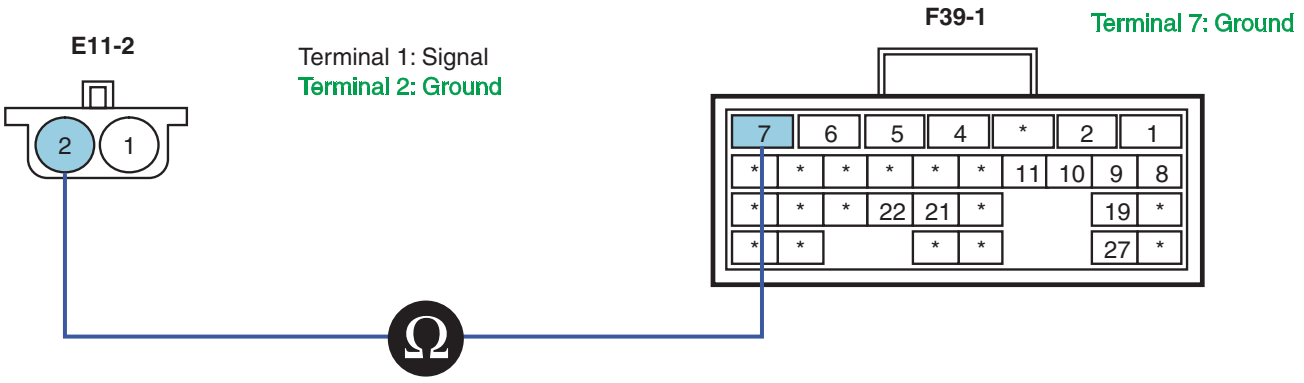
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect injector #2 connector(E11-2) and ECM connector(F39-1).

3) Measure resistance between terminal 2 of injector #2 harness connector(E11-2) and terminal 7 of ECM connector(F39-1).



SNBFL8083L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

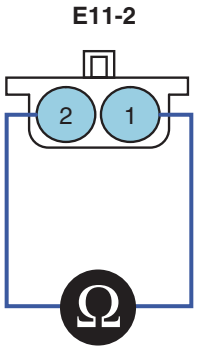
COMPONENT INSPECTION EE15D714

1. Injector Component Inspection

1) Turn ignition OFF.

2) Disconnect injector#2 connector(E11-2).

3) Measure resistance between terminal 1 and 2 of injector#2 connector.



Terminal 1: Signal
Terminal 2: Ground

■ Specification

Item	Specification
Resistance	0.45 Ω(20˚C)

SUDFL8336L

4) Is the resistance measured within specification?

YES

▶ Go to "High Pressure Fuel Supply System Visual Inspection" procedure.

NO

▶ Replace the injector and then go to "Verification of Vehicle Repair" procedure.

2. High Pressure Fuel Supply System Visual Inspection

1) Turn the ignition OFF.

2) Check high pressure fuel pipe and fuel system for crack, bending and leaks.

3) Start the engine and check high pressure fuel line for leaks.

4) Check flow damper for damage and leaks.

5) Check fuel.

6) Is there any problem for fuel and high pressure fuel supply system?

YES

▶ If problem, repair as required and then go to "Verification of Vehicle Repair".

NO

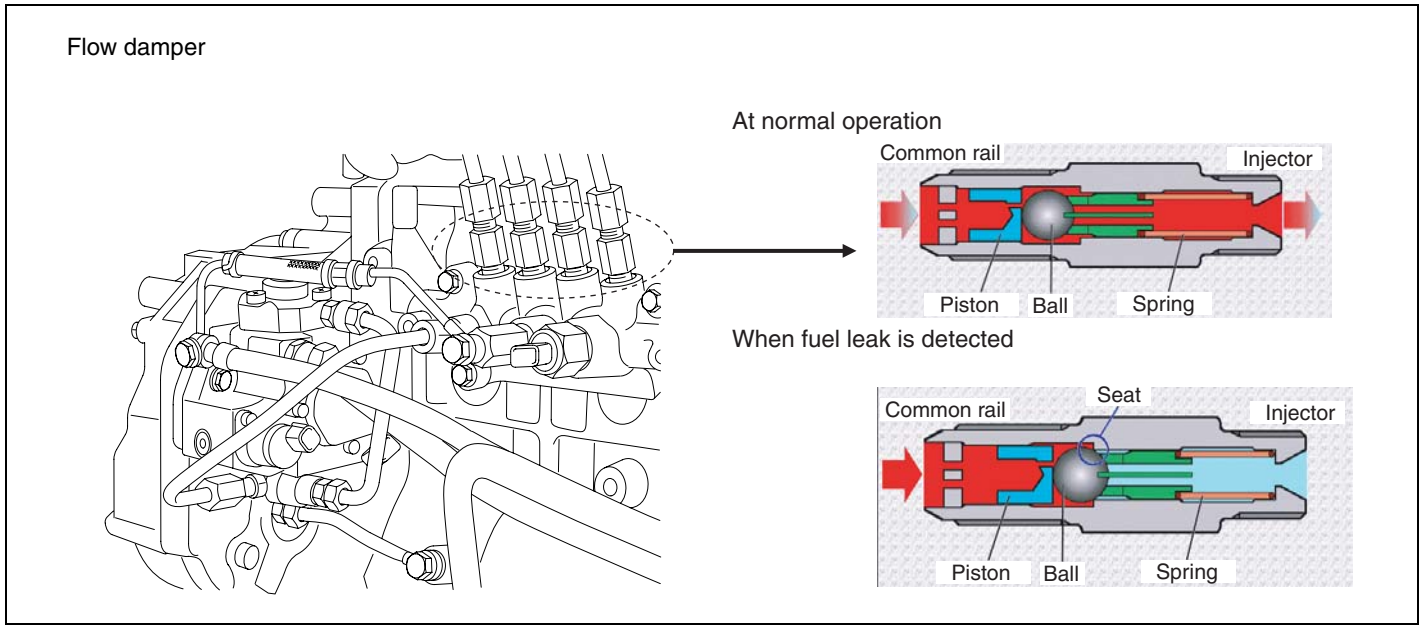
▶ Go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR EEC14D7C

Refer to DTC P0112.

DTC P1093 FUEL SYSTEM #3 CYLINDER LEAK DETECT

COMPONENT LOCATION EF53283E



SUDFL8333L

DESCRIPTION EFB65510

1. GENERAL DESCRIPTION
   The flow damper is located in the upper of common rail, and plays a role to reduce high pressure pulse between injector and common rail and stabilizes fuel to send to injector. If pressure difference between injector and common rail occurs, the flow damper plays a role to cut off fuel to send to high pressure pipe and injector.
   When there is a leak of an excessive fuel, flow damper is activated and the engine is unstable and engine power is restricted due to unstable fuel flow by blocking fuel passage.
   Release condition of flow damper elapses 30sec. or more after the engine is OFF. If pressure difference between injector and common rail is even, normal fuel supply is possible.
   The electric signal is not necessary to operate flow damper to open and close check valve since the ECM judges with cylinder angular speed.

2. DTC DESCRIPTION
   If change of time axis by cylinder due to fuel leak of high pressure system is detected for 0ms or more, ECM judges this as a fault and DTC is set. The possible cause is leak in cylinder #3 injector and fuel line. At this moment, the engine is unstable and the engine power is restricted since the flow damper #3 of rail is operated and closed.
   Try to restart the engine after elapse of certain time as it takes a certain time to return after flow damper is operated.

DTC DETECTING CONDITION EB27E286

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Check cylinder injector #3 and high pressure in fuel line.
Enable Conditions	• Running			
Threshold Value	• When the change of time axis by cylinder is detected			
Diagnosis Time	• 0ms or more			
Fail Safe	Fuel Cut	No	• Engine is unstable and power is restricted.	
	Fuel Limit	Yes		
	MIL	OFF		

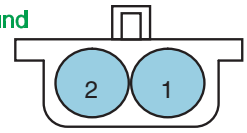
SPECIFICATION E7A1D710

Injector resistance(terminal-to-terminal)

Item	Specification
Resistance	0.45Ω(At 20˚C)

Injector driving voltage	135V
Injector driving current	20A
Injector control type	Current control

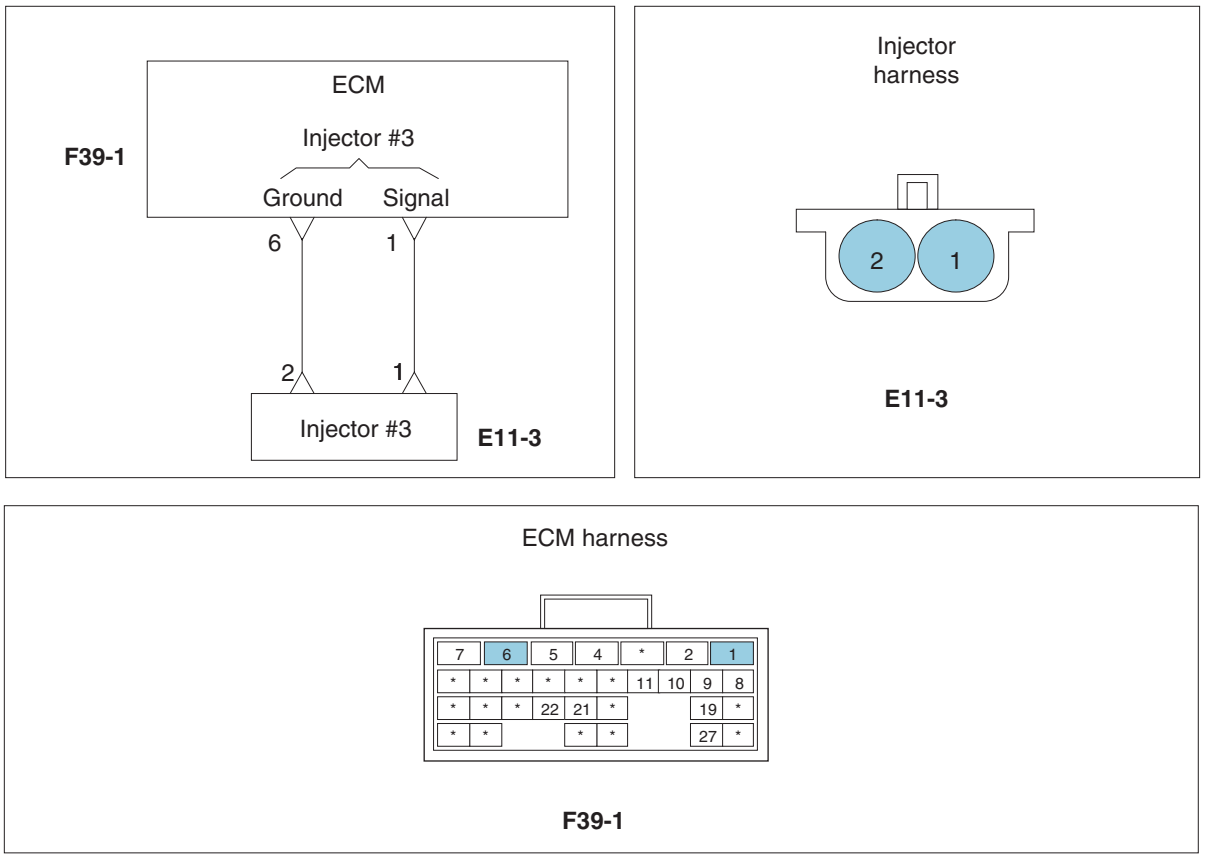
Terminal 1: Signal
Terminal 2: Ground



Sensor connector

SUDFL8334L

SCHEMATIC DIAGRAM E7FCB7B1



SNBFL8051L

SIGNAL WAVEFORM E0B14F1E

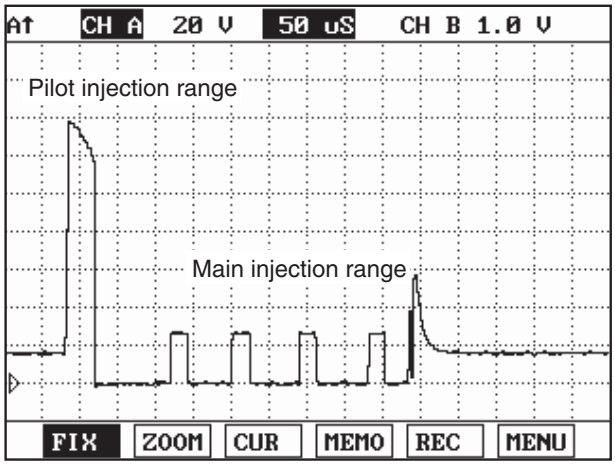


Fig. 1 Low side waveform when activating injector(Ground side)

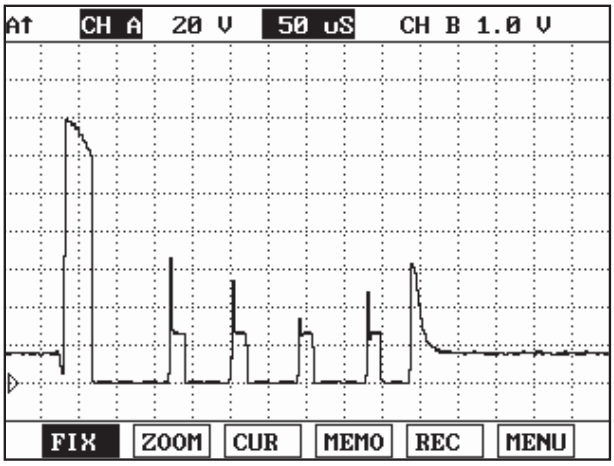


Fig. 2 High side injector power waveform(Signal side)

Fig.1) is divided into pilot injection range and main injection range as low side waveform when activating injector.
Fig.2) is high side injector power waveform.

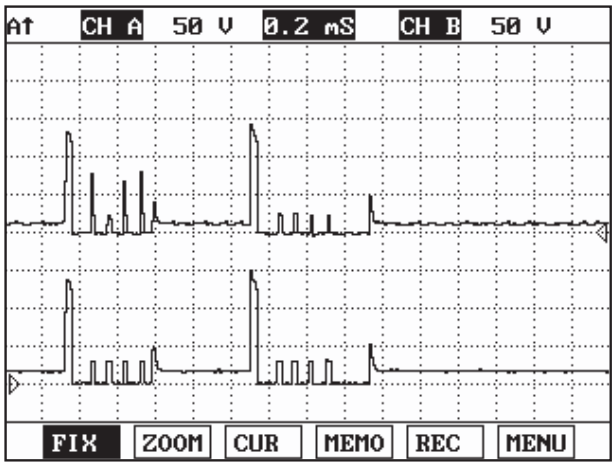


Fig. 3 Injector power waveform combined with High/Low side

SUDFL8101L

NOTE

Waveforms of Fig.1) and Fig.2) are displayed by turns in the course of checking injector waveform in LOW side. The reason that the waveform like a Fig.2) is displayed is used in LOW side in common the power of HIGH side of injector #1, #4 or injector #3, #3 which is not activated.

MONITOR SCAN TOOL DATA E2BF0294

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Fuel injection amount" parameter on the scan tool.

■ Specification: Fuel amount - Approx. 9.0~10.5 mm³/st at idle

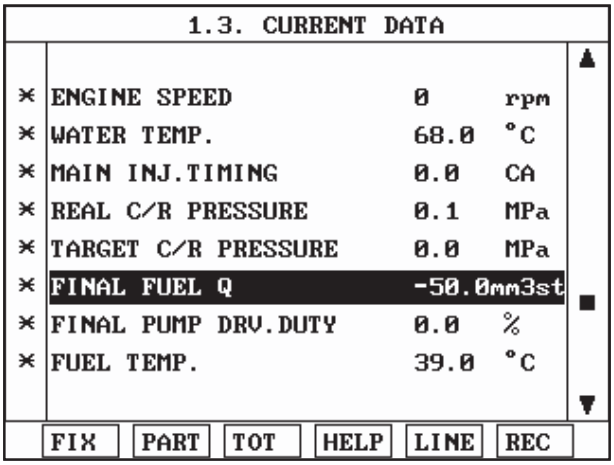


Fig. 1 Fuel injection amount data at ignition ON

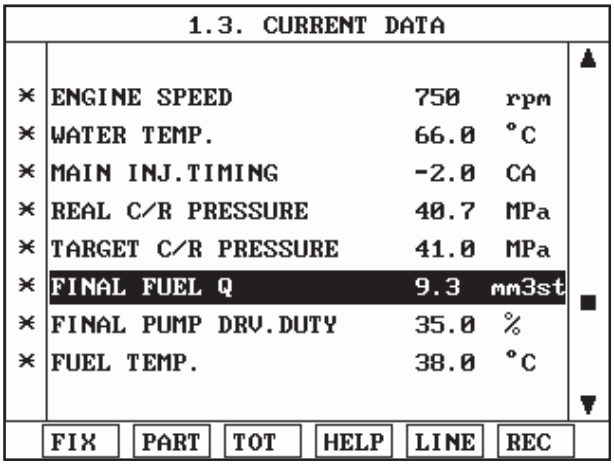


Fig. 2 Fuel injection amount data at idle

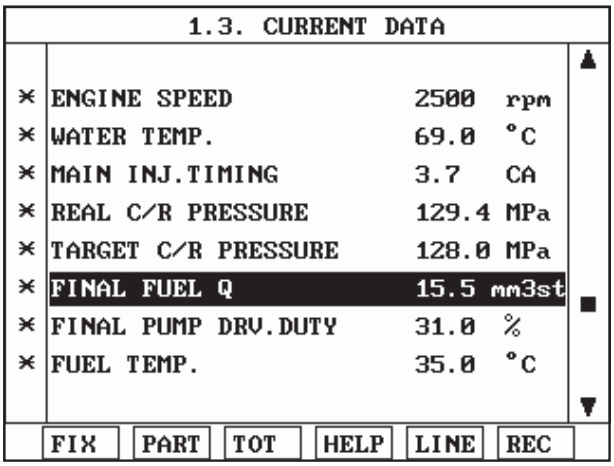


Fig. 3 Fuel injection amount data at 2,500rpm

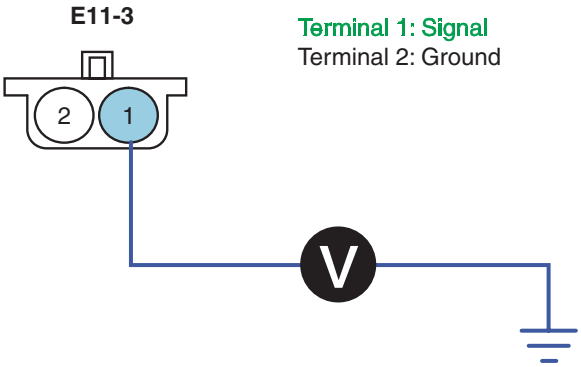
SUDFL8102L

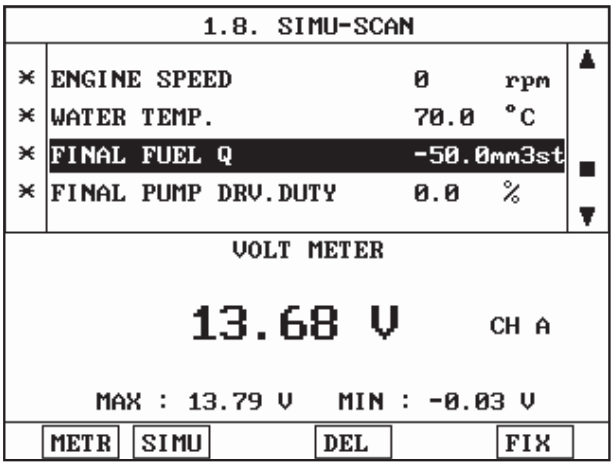
TERMINAL & CONNECTOR INSPECTION E80D992D

Refer to DTC P0112.

POWER SUPPLY INSPECTION E77254C9

1. Power Supply Voltage Inspection
   1) Leave injector #3 connector(E11-3) installed.
   2) Turn the ignition ON. The engine stops.
   3) Measure voltage between terminal 1 of the injector #3 and chassis ground.





▶ With injector #3 connector disconnected/connected (At IG ON)

SUDFL8192L

■ Specification: Injector #3 signal power approx. 13.57 V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

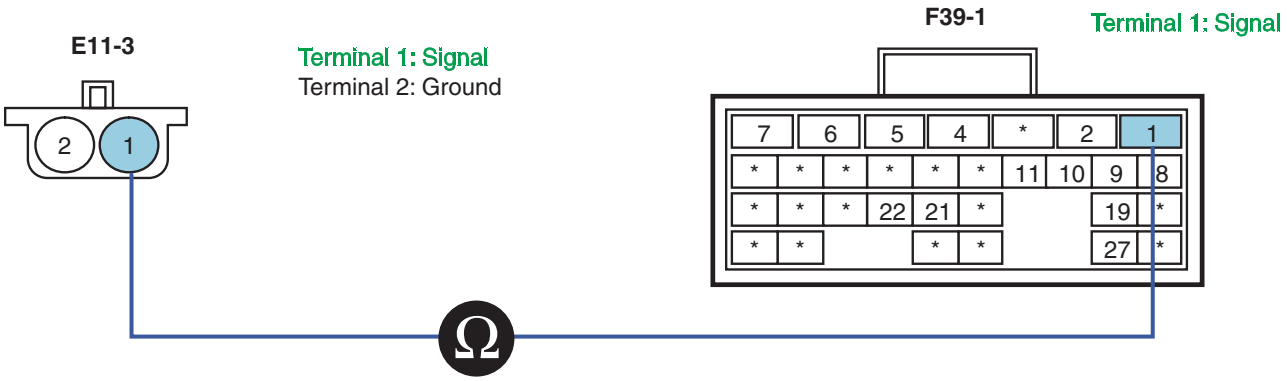
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn ignition OFF.

2) Disconnect injector #3 connector(E11-3) and ECM connector(F39-1).

3) Measure resistance between terminal 1 of injector #3 harness connector(E11-3) and terminal 1 of ECM connector(F39-1).



SNBFL8084L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

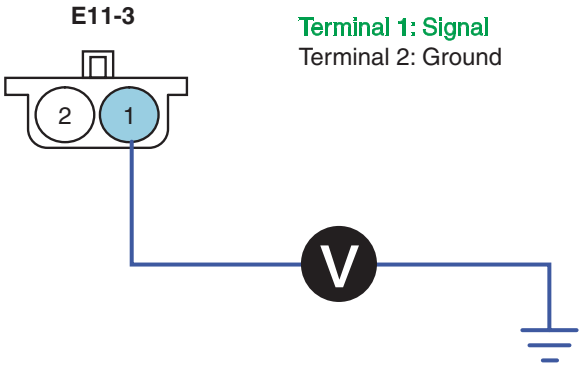
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

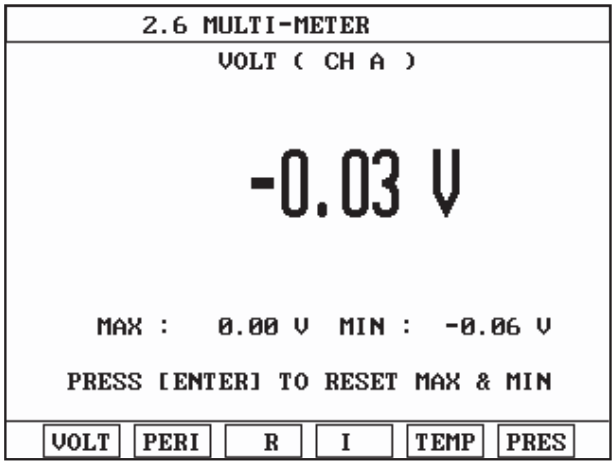
3. Power Supply Short to Power Inspection

1) Disconnect injector #3 connector(E11-3) and ECM connector(F39-1).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of injector #3 harness connector(E11-3) and chassis ground.





SUDFL8194L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

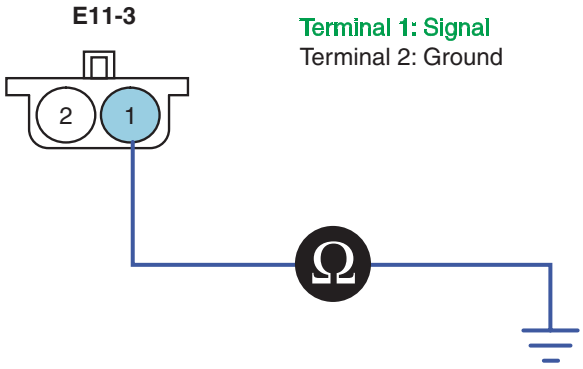
▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

4. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect injector #3 connector(E11-3) and ECM connector(F39-1).

3) Measure resistance between terminal 1 of injector #3 harness connector(E11-3) and chassis ground.



SUDFL8195L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

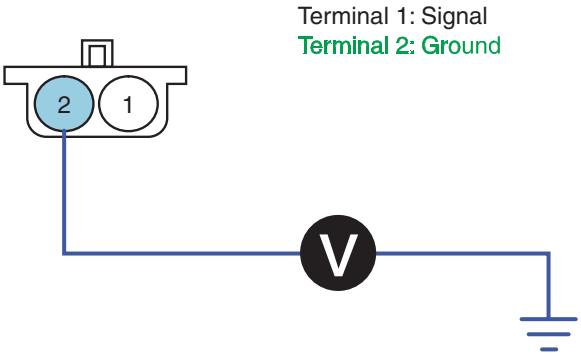
GROUND CIRCUIT INSPECTION E79615A1

1. Ground Voltage Drop Inspection

1) Disconnect injector #3 connector(E11-3).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 2 of injector #3 harness connector(E11-3) and chassis ground.



■ Specification: Ground voltage drop-Within 200mV

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

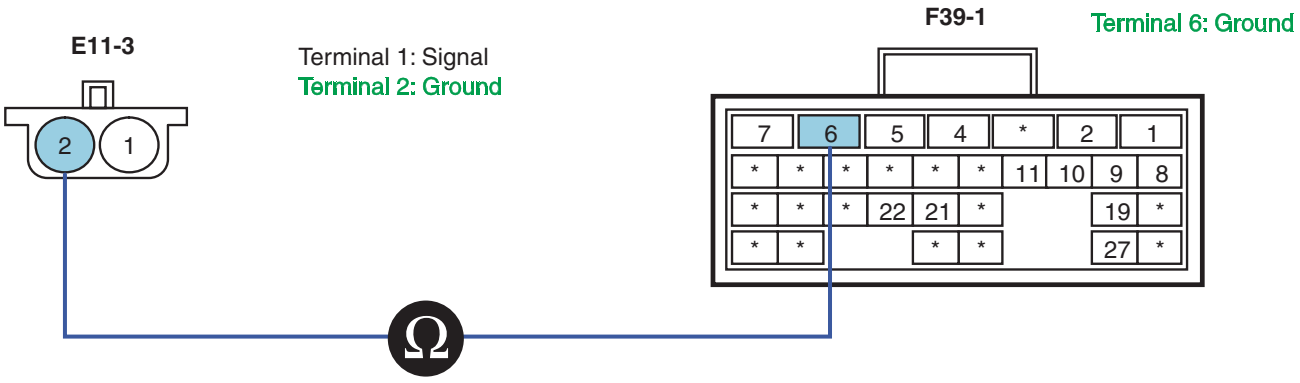
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect injector #3 connector(E11-3) and ECM connector(F39-1).

3) Measure resistance between terminal 2 of injector #3 harness connector(E11-3) and terminal 6 of ECM connector(F39-1).



SNBFL8085L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

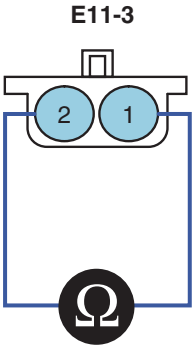
COMPONENT INSPECTION E8448240

1. Injector Component Inspection

1) Turn ignition OFF.

2) Disconnect injector#3 connector(E11-3).

3) Measure resistance between terminal 1 and 2 of injector#3 connector.



■ Specification

Item	Specification
Resistance	0.45 Ω(20˚C)

SUDFL8337L

4) Is the resistance measured within specification?

YES

▶ Go to "High Pressure Fuel Supply System Visual Inspection" procedure.

NO

▶ Replace the injector and then go to "Verification of Vehicle Repair" procedure.

2. High Pressure Fuel Supply System Visual Inspection

1) Turn the ignition OFF.

2) Check high pressure fuel pipe and fuel system for crack, bending and leaks.

3) Start the engine and check high pressure fuel line for leaks.

4) Check flow damper for damage and leaks.

5) Check fuel.

6) Is there any problem for fuel and high pressure fuel supply system?

YES

▶ If problem, repair as required and then go to "Verification of Vehicle Repair".

NO

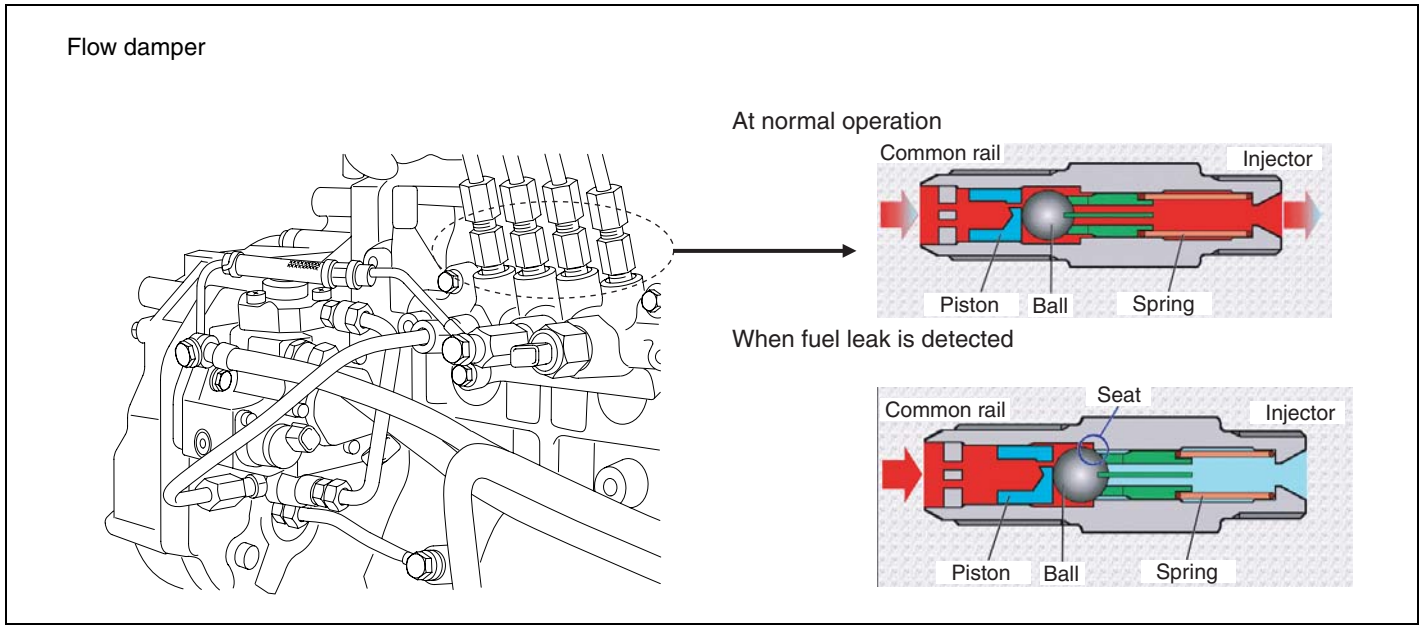
▶ Go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E6308504

Refer to DTC P0112.

DTC P1094 FUEL SYSTEM #4 CYLINDER LEAK DETECT

COMPONENT LOCATION E914BD60



SUDFL8333L

DESCRIPTION E173B8FD

1. GENERAL DESCRIPTION
   The flow damper is located in the upper of common rail, and plays a role to reduce high pressure pulse between injector and common rail and stabilizes fuel to send to injector. If pressure difference between injector and common rail occurs, the flow damper plays a role to cut off fuel to send to high pressure pipe and injector.
   When there is a leak of an excessive fuel, flow damper is activated and the engine is unstable and engine power is restricted due to unstable fuel flow by blocking fuel passage.
   Release condition of flow damper elapses 30sec. or more after the engine is OFF. If pressure difference between injector and common rail is even, normal fuel supply is possible.
   The electric signal is not necessary to operate flow damper to open and close check valve since the ECM judges with cylinder angular speed.

2. DTC DESCRIPTION
   If change of time axis by cylinder due to fuel leak of high pressure system is detected for 0ms or more, ECM judges this as a fault and DTC is set. The possible cause is leak in cylinder #4 injector and fuel line. At this moment, the engine is unstable and the engine power is restricted since the flow damper #4 of rail is operated and closed.
   Try to restart the engine after elapse of certain time as it takes a certain time to return after flow damper is operated.

DTC DETECTING CONDITION E02BAB3E

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Check cylinder injector #4 and high pressure in fuel line.
Enable Conditions	• Running			
Threshold Value	• When the change of time axis by cylinder is detected			
Diagnosis Time	• 0ms or more			
Fail Safe	Fuel Cut	No	• Engine is unstable and power is restricted.	
	Fuel Limit	Yes		
	MIL	OFF		

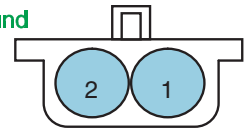
SPECIFICATION E5796A08

Injector resistance(terminal-to-terminal)

Item	Specification
Resistance	0.45Ω(At 20˚C)

Injector driving voltage	135V
Injector driving current	20A
Injector control type	Current control

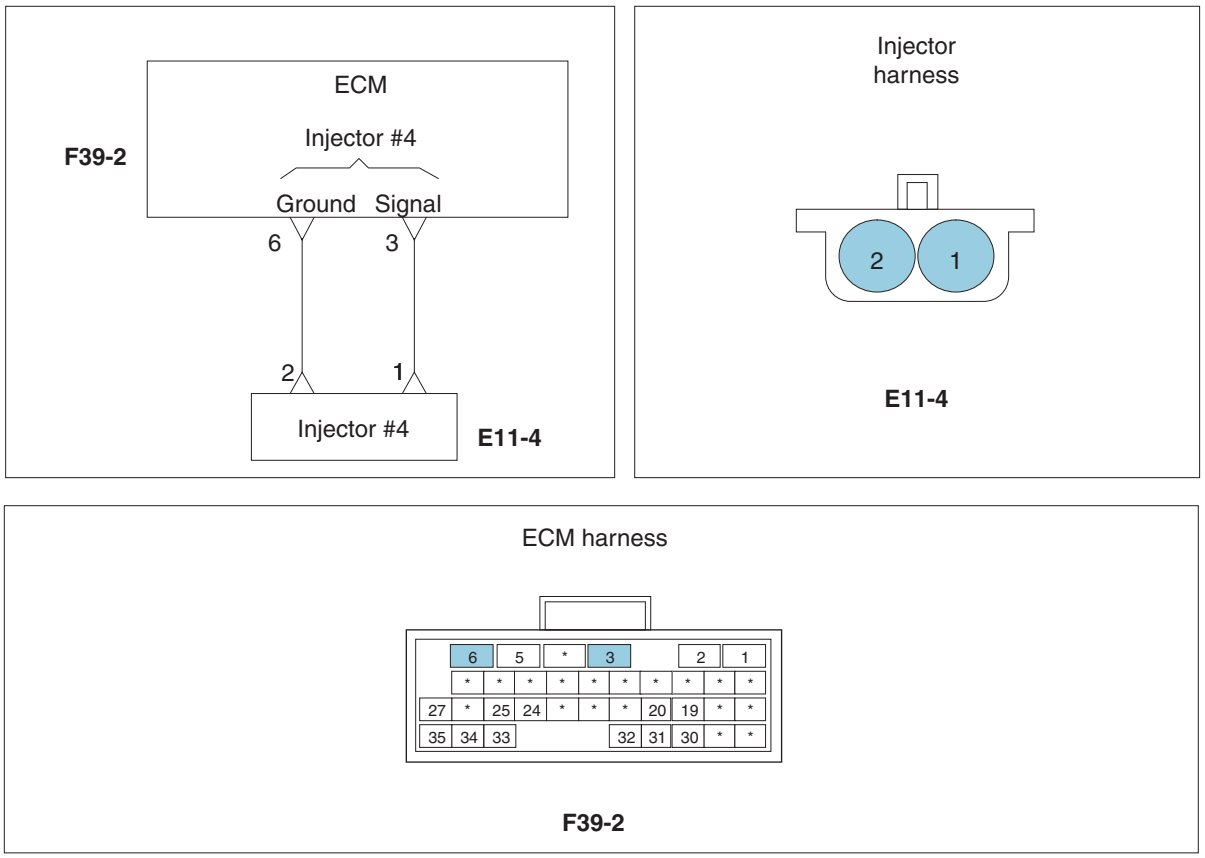
Terminal 1: Signal
Terminal 2: Ground



Sensor connector

SUDFL8334L

SCHEMATIC DIAGRAM E30063EA



SNBFL8123L

SIGNAL WAVEFORM EBB7E340

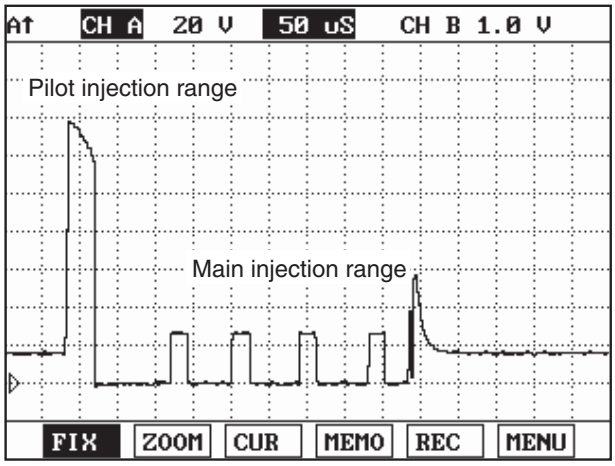


Fig. 1 Low side waveform when activating injector(Ground side)

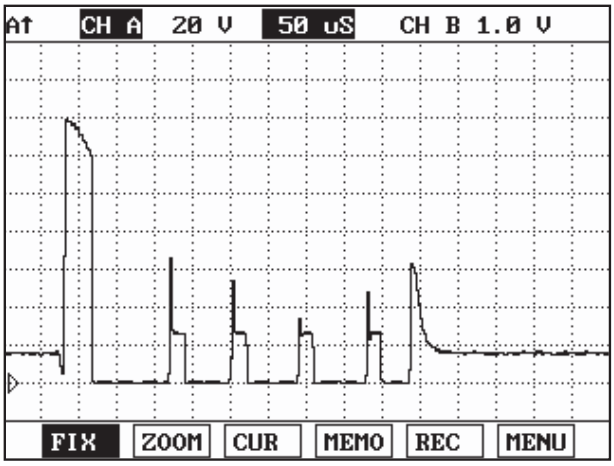


Fig. 2 High side injector power waveform(Signal side)

Fig.1) is divided into pilot injection range and main injection range as low side waveform when activating injector.
Fig.2) is high side injector power waveform.

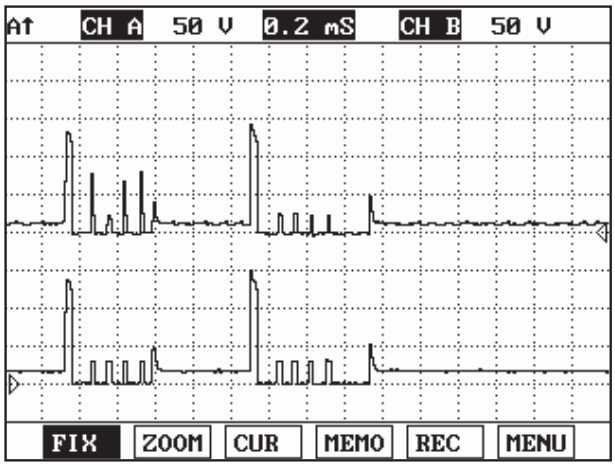


Fig. 3 Injector power waveform combined with High/Low side

SUDFL8101L

NOTE

Waveforms of Fig.1) and Fig.2) are displayed by turns in the course of checking injector waveform in LOW side. The reason that the waveform like a Fig.2) is displayed is used in LOW side in common the power of HIGH side of injector #4, #4 or injector #2, #3 which is not activated.

MONITOR SCAN TOOL DATA E96ADD92

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Fuel injection amount" parameter on the scan tool.

■ Specification: Fuel amount - Approx. 9.0~10.5 mm³/st at idle

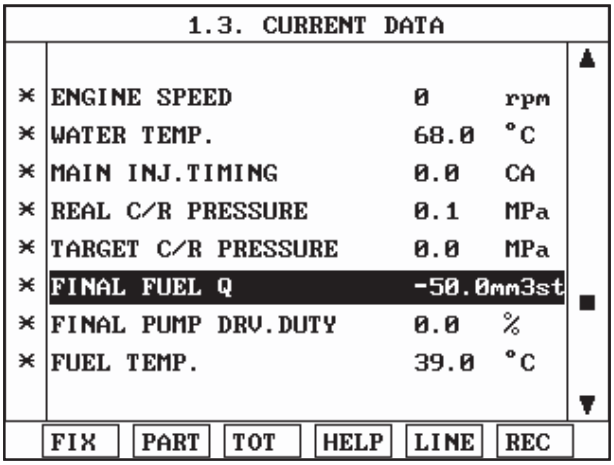


Fig. 1 Fuel injection amount data at ignition ON

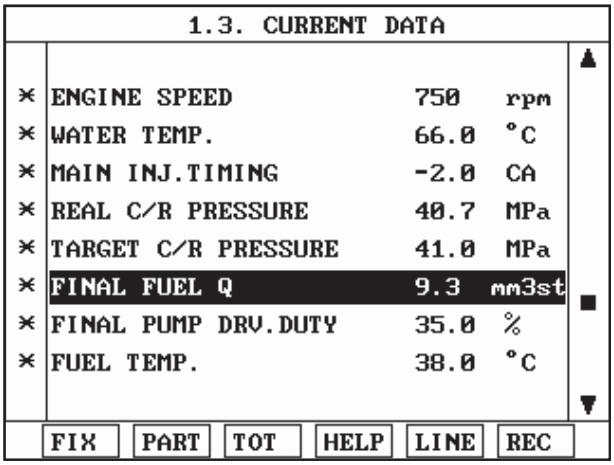


Fig. 2 Fuel injection amount data at idle

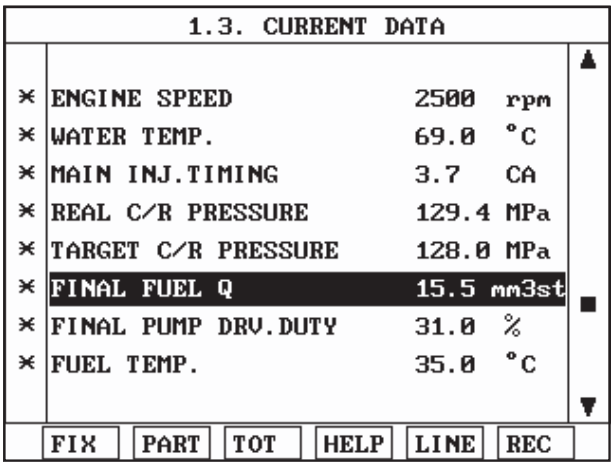


Fig. 3 Fuel injection amount data at 2,500rpm

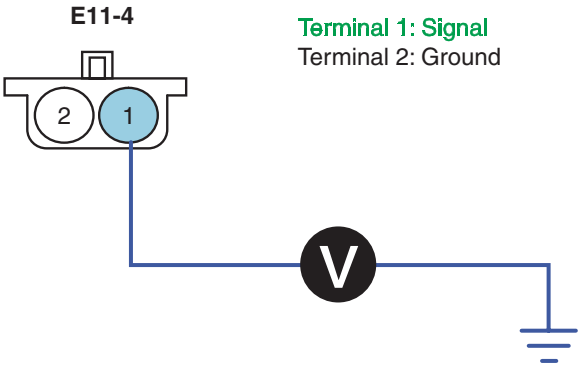
SUDFL8102L

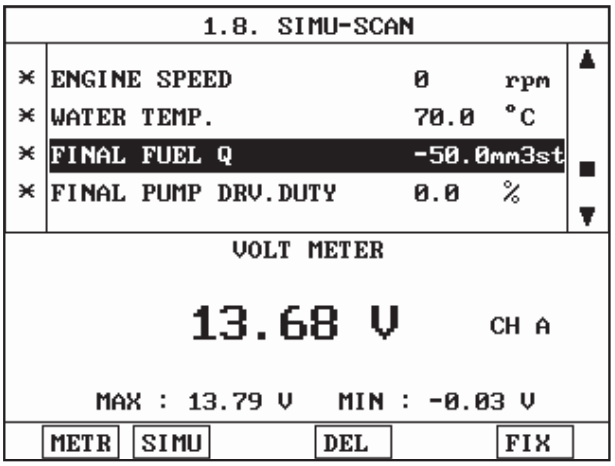
TERMINAL & CONNECTOR INSPECTION EB834CF2

Refer to DTC P0112.

POWER SUPPLY INSPECTION EF6AB284

1. Power Supply Voltage Inspection
   1) Leave injector #4 connector(E11-4) installed.
   2) Turn the ignition ON. The engine stops.
   3) Measure voltage between terminal 1 of the injector #4 and chassis ground.





▶ With injector #4 connector disconnected/connected (At IG ON)

SUDFL8199L

■ Specification: Injector #4 signal power approx. 13.57 V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

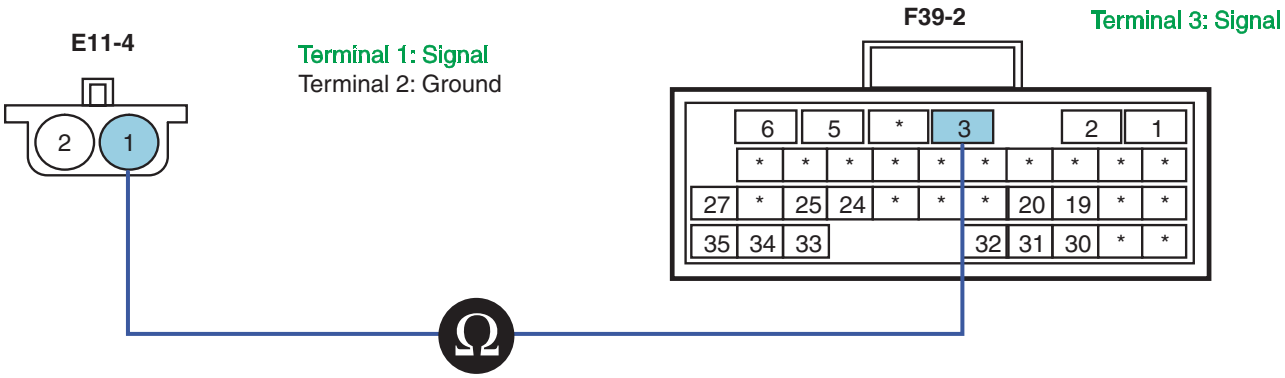
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn ignition OFF.

2) Disconnect injector #4 connector(E11-4) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of injector #4 harness connector(E11-4) and terminal 3 of ECM connector(F39-2).



SNBFL8086L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

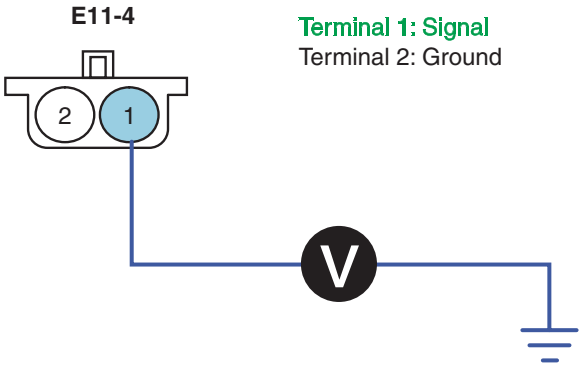
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

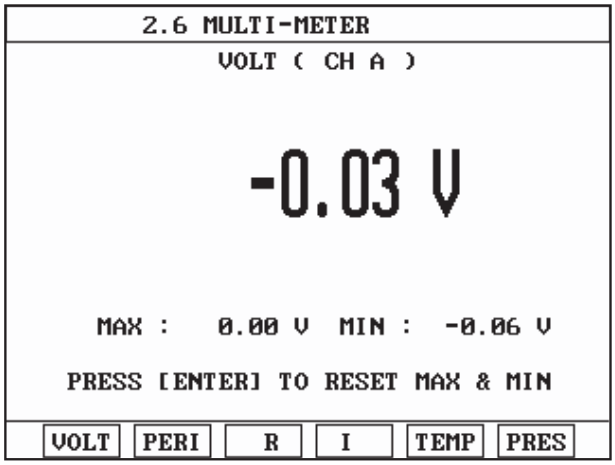
3. Power Supply Short to Power Inspection

1) Disconnect injector #4 connector(E11-4) and ECM connector(F39-2).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of injector #4 harness connector(E11-4) and chassis ground.





SUDFL8201L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

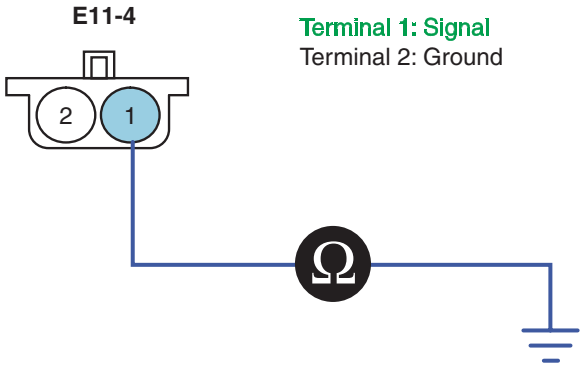
▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

4. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect injector #4 connector(E11-4) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of injector #4 harness connector(E11-4) and chassis ground.



SUDFL8202L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

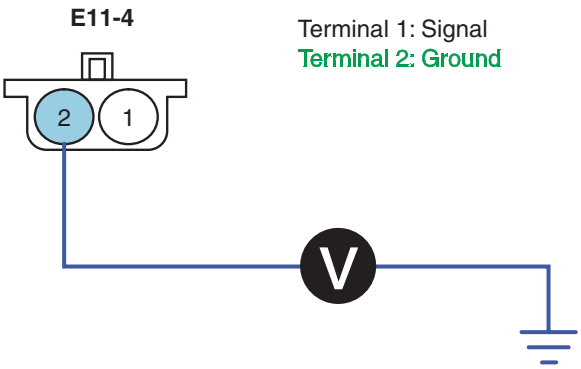
GROUND CIRCUIT INSPECTION E92F6652

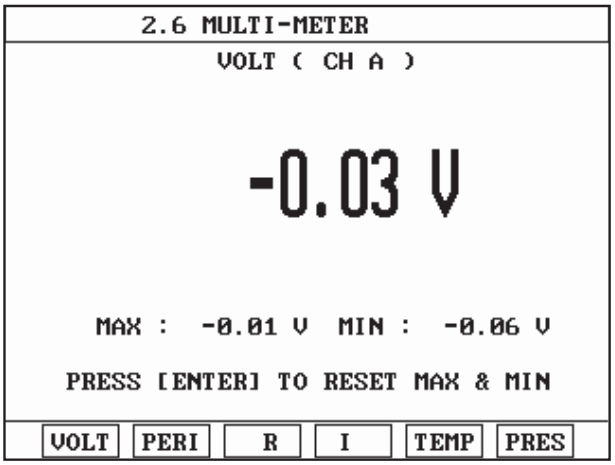
1. Ground Voltage Drop Inspection

1) Disconnect injector #4 connector(E11-4).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 2 of injector #4 harness connector(E11-4) and chassis ground.





SUDFL8203L

■ Specification: Ground voltage drop-Within 200mV

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

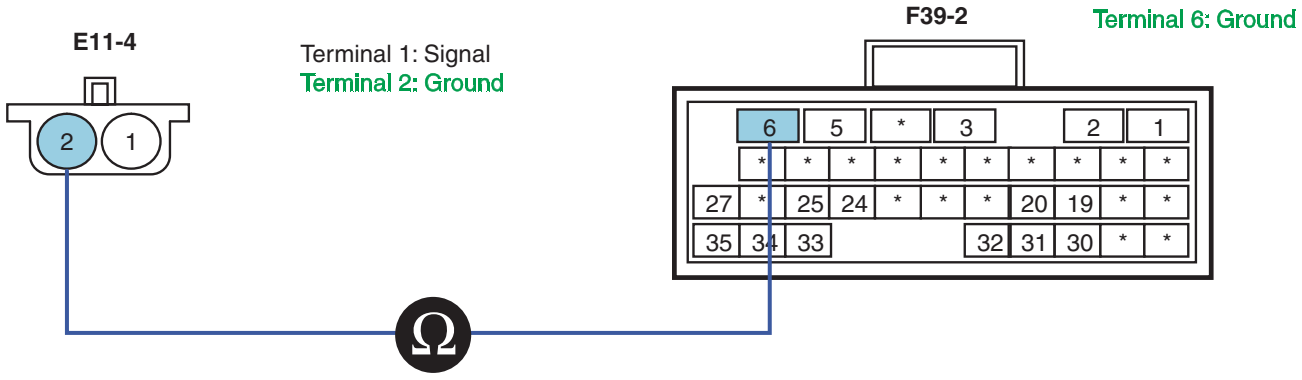
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect injector #4 connector(E11-4) and ECM connector(F39-2).

3) Measure resistance between terminal 2 of injector #4 harness connector(E11-4) and terminal 6 of ECM connector(F39-2).



SNBFL8087L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

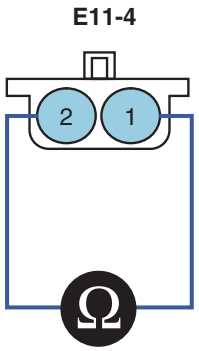
COMPONENT INSPECTION EDBBFF60

1. Injector Component Inspection

1) Turn ignition OFF.

2) Disconnect injector#4 connector(E11-4).

3) Measure resistance between terminal 1 and 2 of injector#4 connector.



■ Specification

Item	Specification
Resistance	0.45 Ω(20˚C)

SUDFL8399L

4) Is the resistance measured within specification?

YES

▶ Go to "High Pressure Fuel Supply System Visual Inspection" procedure.

NO

▶ Replace the injector and then go to "Verification of Vehicle Repair" procedure.

2. High Pressure Fuel Supply System Visual Inspection

1) Turn the ignition OFF.

2) Check high pressure fuel pipe and fuel system for crack, bending and leaks.

3) Start the engine and check high pressure fuel line for leaks.

4) Check flow damper for damage and leaks.

5) Check fuel.

6) Is there any problem for fuel and high pressure fuel supply system?

YES

▶ If problem, repair as required and then go to "Verification of Vehicle Repair".

NO

▶ Go to "Verification of Vehicle Repair" procedure.

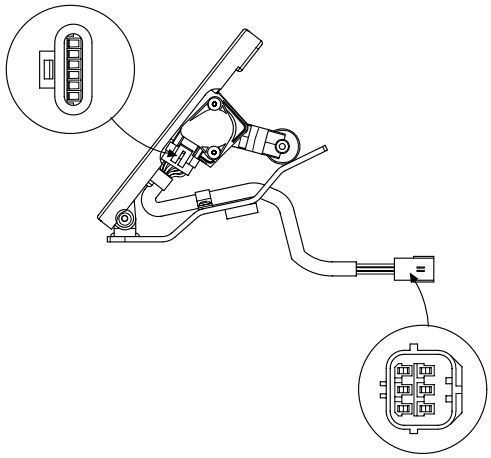
VERIFICATION OF VEHICLE REPAIR EECCFDB1

Refer to DTC P0112.

DTC P1120 PEDAL SENSOR SIGNAL INVALID

COMPONENT LOCATION E6B8326C

Accelerator pedal position sensor



SUDFL8271L

DESCRIPTION E0784832

1. GENERAL DESCRIPTION
   The electronic fuel injection is accomplished by various factors in the ECM including accelerator pedal position. The accelerator pedal position sensor detects pedal position and sends signal to ECM. It is composed of two potentiometers(dual variable resistor type). Power supply is provided separately to detect acceleration condition exactly. The voltage of accelerator pedal position sensor is generated by potentiometer and the position of accelerator pedal is calculated by using characteristic curve programmed beforehand.

2. DTC DESCRIPTION
   The accelerator pedal sensor indicates idle state in spite of idle switch OFF when the vehicle is being driven. When the accelerator pedal sensors "1" and "2" have problem simultaneously for more than 524.3ms, the ECM judges this as a fault and DTC is set. The possible causes are open or short to terminal 21,22 of ECM connector, defective sensor, wiring problem etc.

DTC DETECTING CONDITION E87B853E

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="5">• Open or short to terminal 21,22 of ECM connector
• Faulty wiring or sensor</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• IG ON/ Running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• When the accelerator pedal sensors "1" and "2" have problem simultaneously</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 524.3ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• Limp home
• Idle switch OFF(When depressing accelerator pedal)
• When keeping accelerator opening 50% signal stationary</td></tr>
<tr><td>Fuel Limit</td><td>Yes</td></tr>
<tr><td>MIL</td><td>ON</td></tr>
</table>

SPECIFICATION EBE39C66

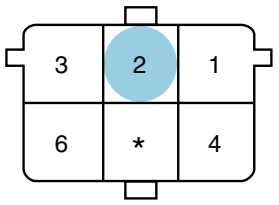
Resistance between terminals of accelerator pedal position sensor

Terminals 1-2(Not operating)	Terminals 1-2(Operating)	Terminals 1-3(Not operating)	Terminals 1-3(Operating)
Approx. 2.67kΩ	Approx. 1.06kΩ	Approx. 2.64kΩ	Approx. 2.64kΩ

Terminals 2-3(Not operating)	Terminals 2-3(Operating)
Approx. 0.732kΩ	Approx. 2.59kΩ

Accelerator pedal position sensor track "1", "2"	Specification	
	Idle state((0%)	Wide open(100%)
Output voltage	0.65V	3.85V

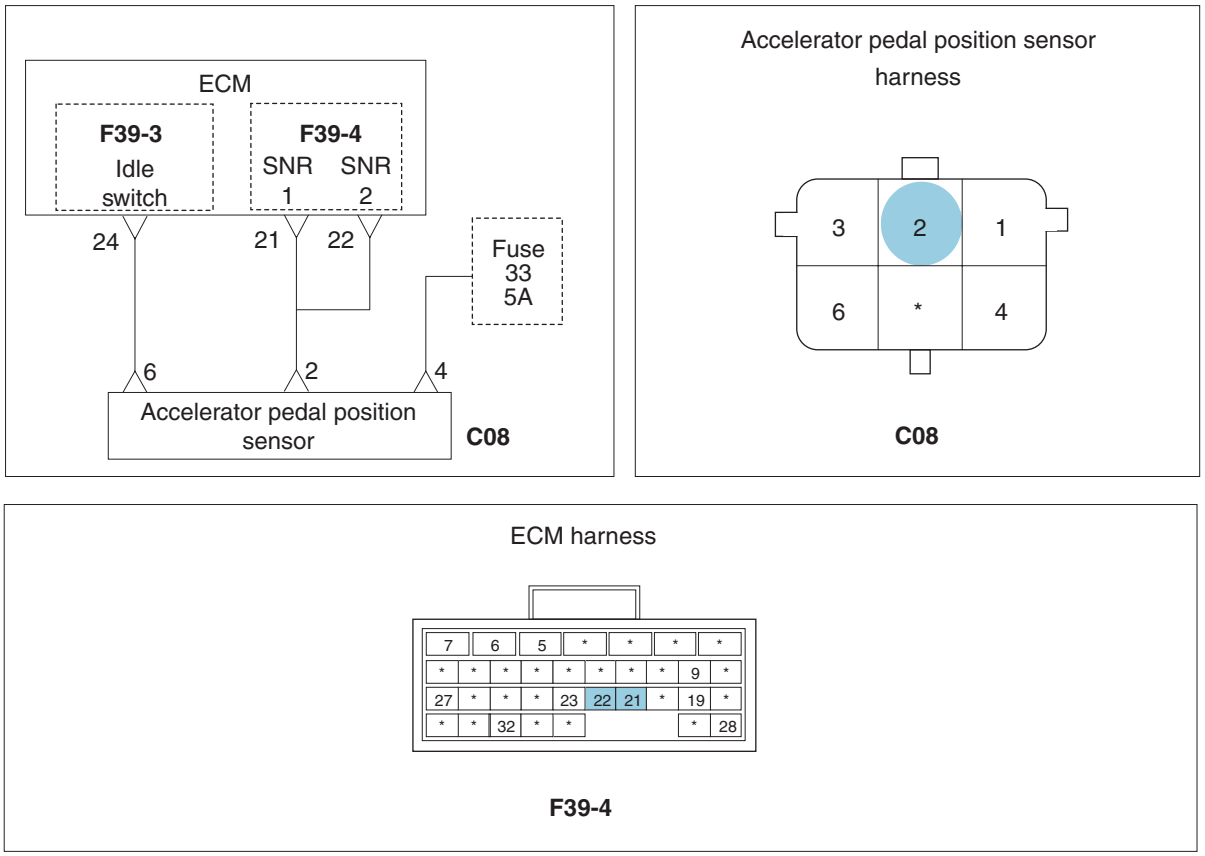
Terminal 2: Sensor "1", "2"



Sensor connector

SUDFL8065L

SCHEMATIC DIAGRAM E59AFAF2



SNBFL8124L

MONITOR SCAN TOOL DATA EDF5F8B5

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Accelerator Pedal Position" parameter on the scan tool.

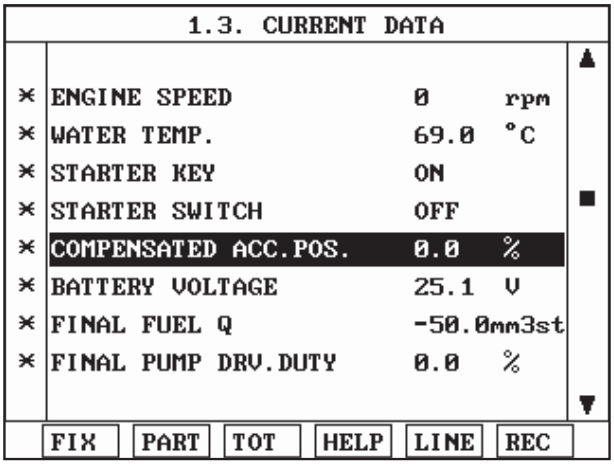


Fig. 1 Accelerator pedal position sensor data at ignition ON

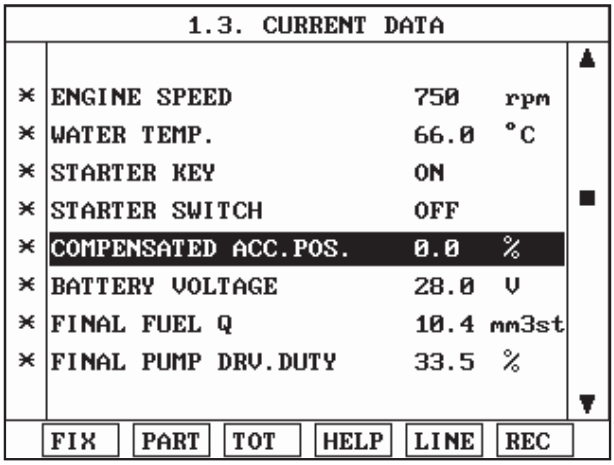


Fig. 2 Accelerator pedal position sensor data at idle

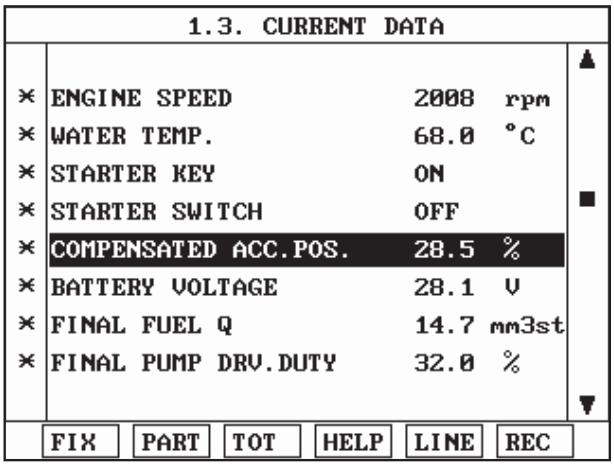


Fig. 3 Accelerator pedal position sensor data at 2,000rpm

SUDFL8049L

TERMINAL & CONNECTOR INSPECTION E11F8CA7

Refer to DTC P0112.

SIGNAL INSPECTION EA163F4C

1. Signal Voltage Inspection

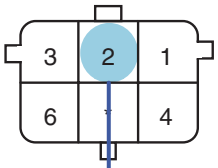
   1) Leave the accelerator pedal sensor connector(C08) and ECM(F39-4) installed.

   2) Turn the ignition ON. The engine stops.

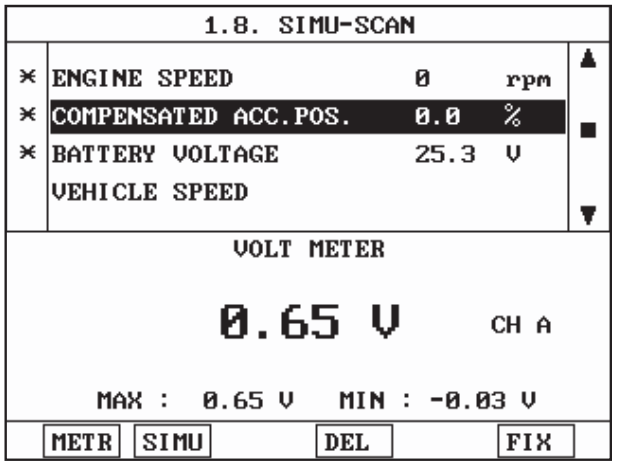
   3) Measure voltage between terminal 2 of accelerator pedal position sensor harness connector and chassis ground.

[Sensor side]

C08



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W



▶ With accelerator pedal position sensor connector installed (At IG ON)

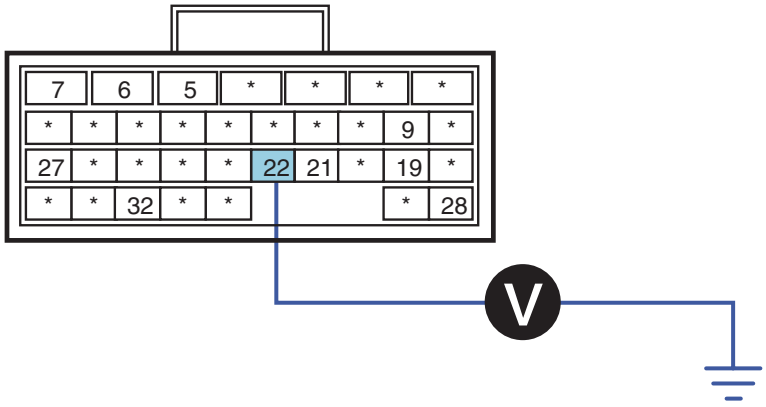
SNBFL8021L

4) Measure voltage between terminal 22 of ECM connector and chassis ground.

[ECM]

F39-4

Terminal 22: SNR2



SNBFL8064L

■ Specification: Accelerator pedal position signal power approx.0.13V(When not operating)

5) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

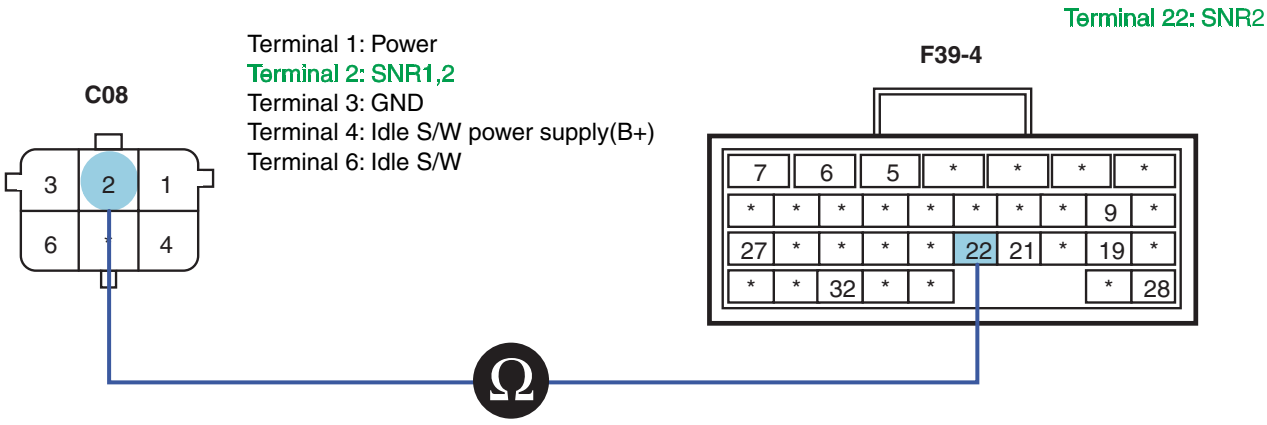
▶ Go to "Signal Open Inspection" procedure.

2. Signal Open Inspection

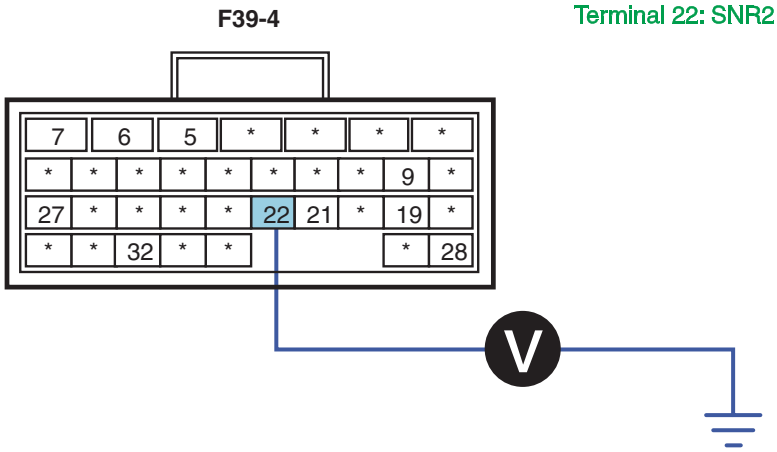
1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 2 of accelerator pedal position sensor harness connector(C08) and terminal 22 of ECM connector(F39-4).


Terminal 22: SNR2
Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W
C08
F39-4
3
2
1
6
4
7
6
5
9
27
22
21
19
32
28
Ω

[ECM]



SNBFL8064L

■ Specification: Below 0~0.1V

5) Is the voltage measured within specification?

YES

▶ Go to "Signal Short to Ground Inspection" procedure.

NO

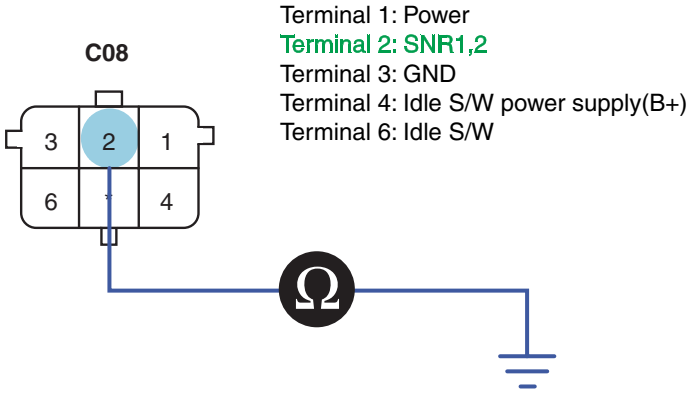
▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

4. Signal Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

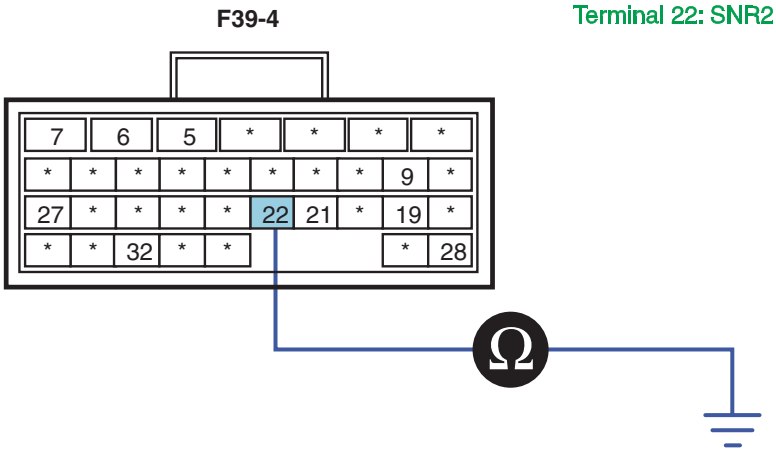
3) Measure resistance between terminal 2 of accelerator pedal position sensor harness connector(C08) and chassis ground.



SNBFL8025L

4) Measure resistance between terminal 22 of ECM connector and chassis ground.

[ECM]



SNBFL8066L

■ Specification: Infinite

5) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

POWER SUPPLY INSPECTION EB80CF10

1. Power Supply Voltage Inspection

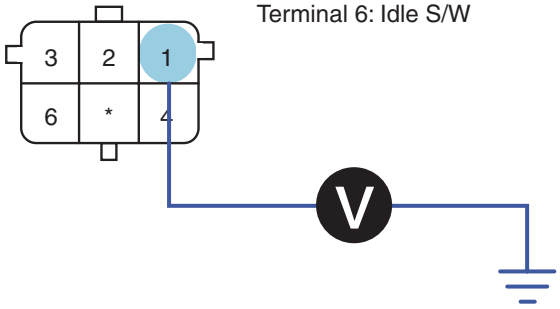
   1) Leave accelerator pedal position sensor connector(C08) and ECM connector(F39-2) installed.

   2) Turn the ignition ON. The engine stops.

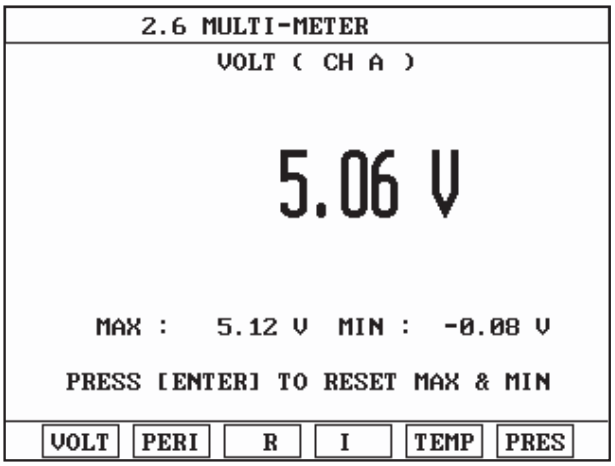
   3) Measure voltage between terminal 1 of accelerator pedal position sensor harness connector(C08) and chassis ground.

[Sensor side]

C08



Terminal 1: Power
Terminal 2: SNR1,2
Terminal 3: GND
Terminal 4: Idle S/W power supply(B+)
Terminal 6: Idle S/W



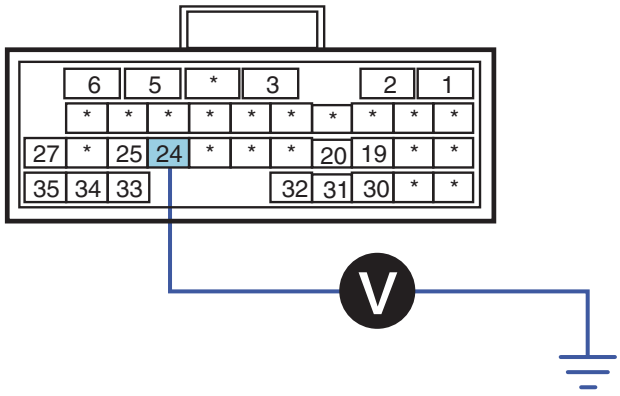
▶ With accelerator pedal position sensor connector disconnected/connected(At IG ON)

SNBFL8027L

4) Measure voltage between terminals 24 of ECM connector and chassis ground.

[ECM]

F39-2



Terminal 24: Power

SNBFL8028L

■ Specification: Accelerator pedal position sensor signal power approx. 5.21V

5) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

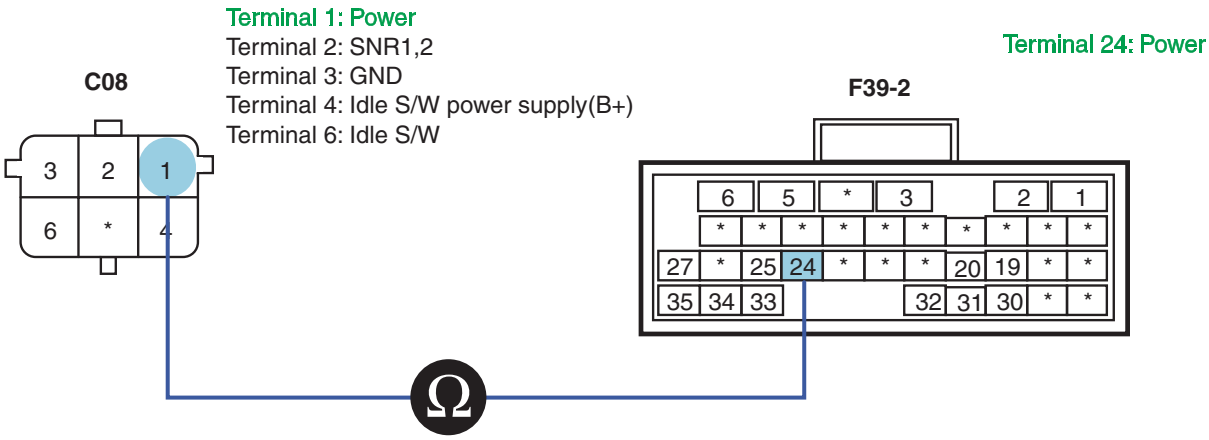
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 1 of accelerator pedal position sensor harness connector(C08) and terminals 24 of ECM connector(F39-2).



SNBFL8029L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Power Inspection" procedure.

NO

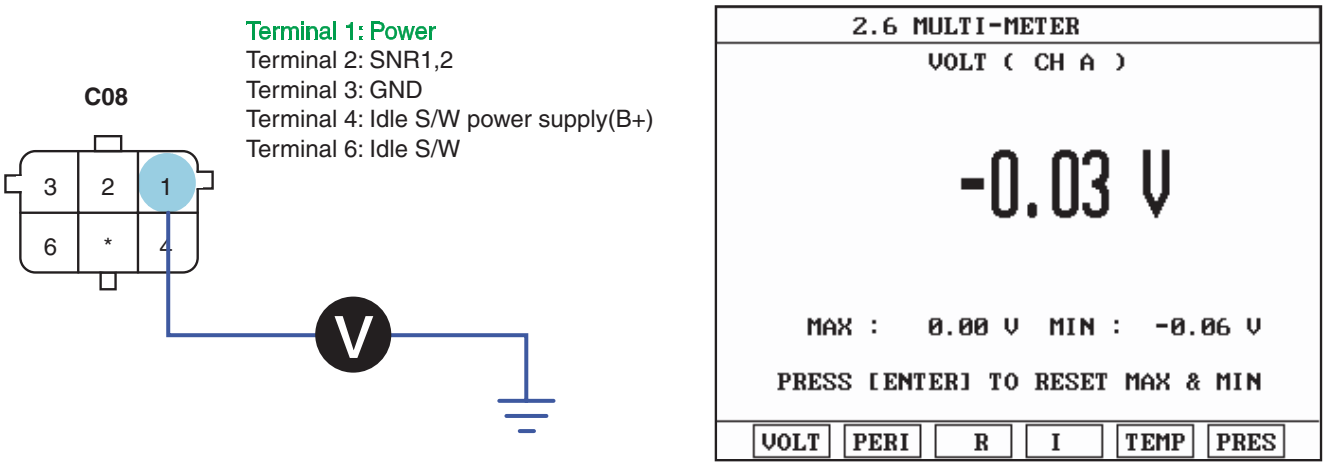
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Power Supply Short to Power Inspection

1) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

2) Turn the ignition ON. The engine stops.

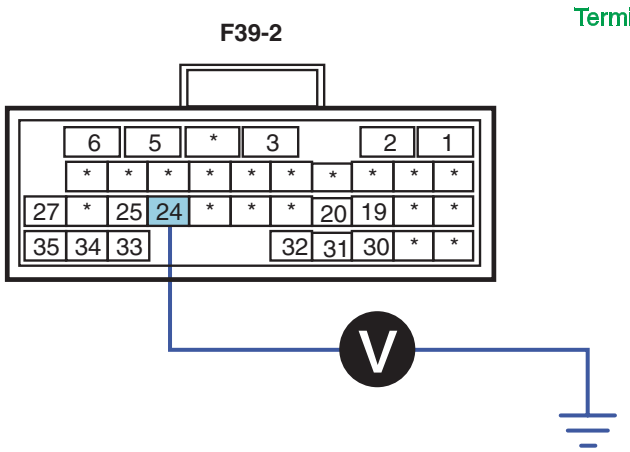
3) Measure voltage between terminal 1 of accelerator pedal position sensor harness connector and chassis ground.



SNBFL8030L

4) Measure voltage between terminals 24 of ECM connector and chassis ground.

[ECM]



SNBFL8028L

■ Specification: Below 0~0.1V

5) Is the voltage measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

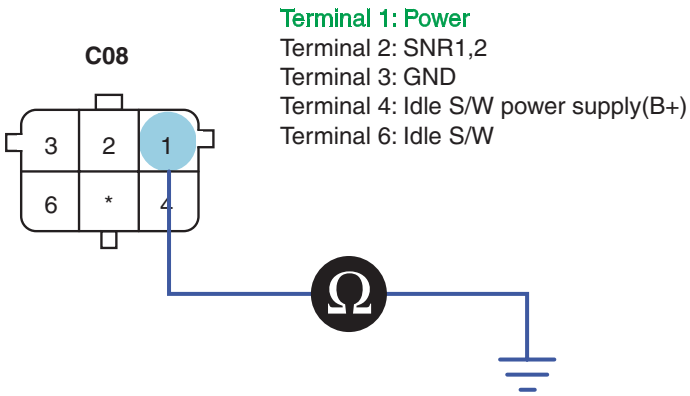
▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

4. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

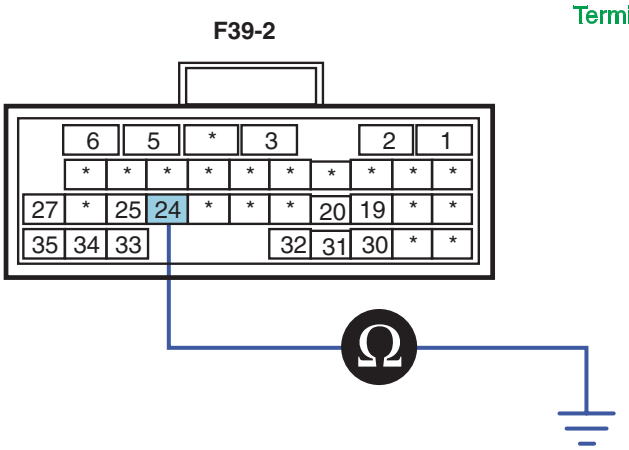
3) Measure voltage between terminal 1 of accelerator pedal position sensor harness connector and chassis ground.



SNBFL8031L

4) Measure resistance between terminals 24 of ECM connector and chassis ground.

[ECM]



SNBFL8032L

■ Specification: Infinite

5) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

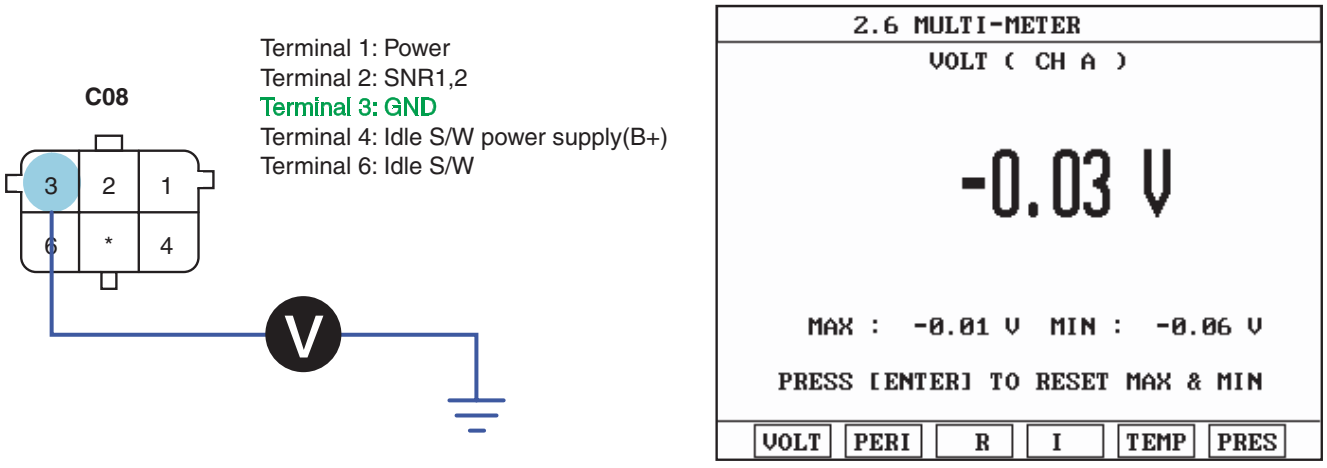
GROUND CIRCUIT INSPECTION E957294A

1. Ground Voltage Drop Inspection

   1) Disconnect accelerator pedal position sensor connector(C08).

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage drop between terminal 3 of accelerator pedal position sensor harness connector and chassis ground.



SNBFL8033L

■ Specification: Ground Voltage Drop - Within 200mV

4) Is the ground voltage drop measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

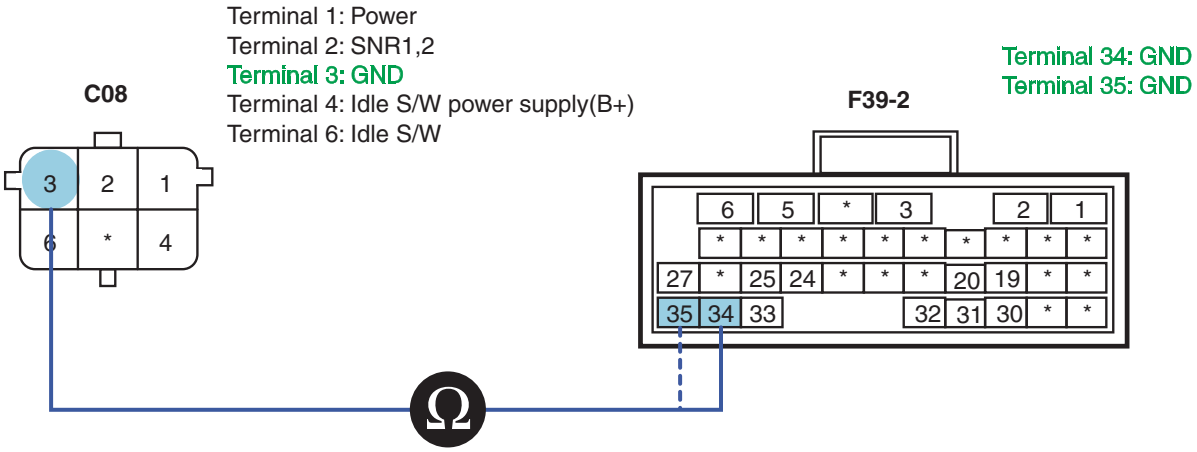
▶ Repair poor connection or the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08) and ECM connector(F39-4, F39-2).

3) Measure resistance between terminal 3 of accelerator pedal position sensor harness connector and terminals 34,35 of ECM connector(F39-2).



SNBFL8034L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

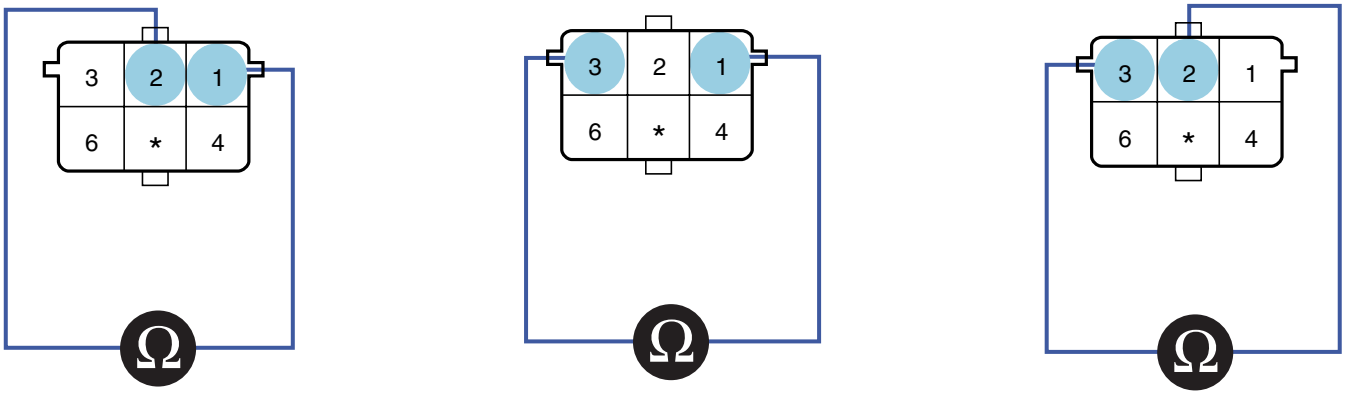
COMPONENT INSPECTION ECEFD641

1. Accelerator Pedal Position Sensor Inspection

1) Turn the ignition OFF.

2) Disconnect accelerator pedal position sensor connector(C08).

3) Measure resistance between terminals 1-2, 2-3, 1-3 of accelerator pedal position sensor connector.



Resistance between terminals of accelerator pedal position sensor

Terminals 1-2(Not operating)	Terminals 1-2(Operating)	Terminals 1-3(Not operating)	Terminals 1-3(Operating)
Approx. 2.67kΩ	Approx. 1.06kΩ	Approx. 2.64kΩ	Approx. 2.64kΩ

Terminals 2-3(Not operating)	Terminals 2-3(Operating)
Approx. 0.732kΩ	Approx. 2.59kΩ

SUDFL8064L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace accelerator pedal position sensor and then go to "Verification of Vehicle Repair" procedure.

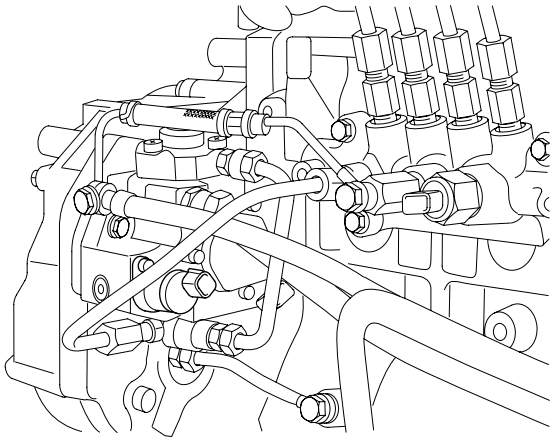
VERIFICATION OF VEHICLE REPAIR EE58A62B

Refer to DTC P0112.

DTC P1190 SUPPLY PUMP CONTROL VALVE(SCV) STUCK

COMPONENT LOCATION E34363F5

Supply control valve(SCV)



SUDFL8246L

DESCRIPTION EF903DFE

1. Supply control valve(SCV) is solenoid type. The ECM controls time to open/close valve, controls pump fuel amount by controlling current to be supplied to SCV to adjust target rail pressure. When the SCV is closed, fuel passage is cut off and fuel is compressed. The compressed fuel is supplied to common rail. If fuel pressure is decreased, the SCV is opened and then fuel is inhaled for next pumping.
   Fuel pump relay is supplied power to low fuel pump by the ECM. At the ignition key ON, the fuel pump relay works for about 1.5sec. and stops to diagnose fuel pump relay. If the engine rpm is detected above 45rpm, the ECM makes relay turn ON and feeds fuel to high pressure pump.
   Low pressure fuel pump which is vane pump to be driven by electric motor is installed in the fuel tank and feeds fuel to high pressure.

2. DTC DESCRIPTION
   If the difference between target fuel pressure and real fuel pressure of the SCV is detected above 100 bar for 20,164.6ms or more, the ECM judges this as a fault and DTC is set. The probable cause may be the SCV stuck.

DTC DETECTING CONDITION E8EBBFEF

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Check the SCV for stuck.
Enable Conditions	• At IG ON			
Threshold Value	• When the difference between target fuel pressure and real fuel pressure of the SCV is detected above 100 bar			
Diagnosis Time	• 20,164.6ms or more			
Fail Safe	Fuel Cut	No		
	Fuel Limit	No		
	MIL	ON		

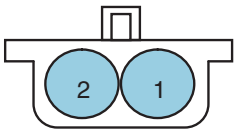
SPECIFICATION EB5C0541

Item	Specification
Resistance	7.9 ± 0.25 Ω

SCV driving frequency	SCV control type
200 Hz	Current control

SCV driving voltage	SCV driving current
16 ~ 32 V	Below 1.29A at operating
	Below 1.16A(within 270sec.) at stop

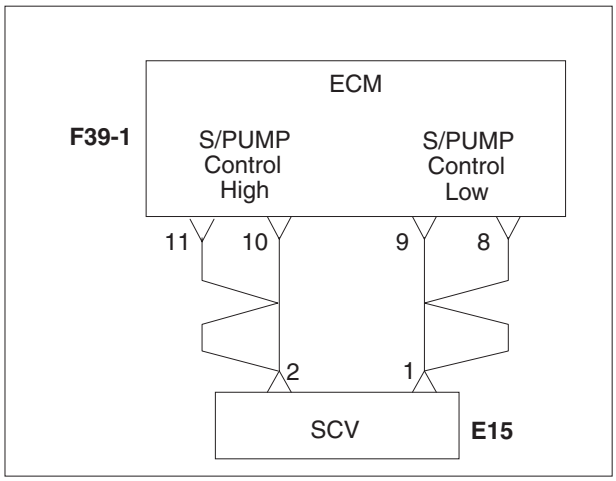
Terminal 1: S/pump control Low
Terminal 2: S/pump control High

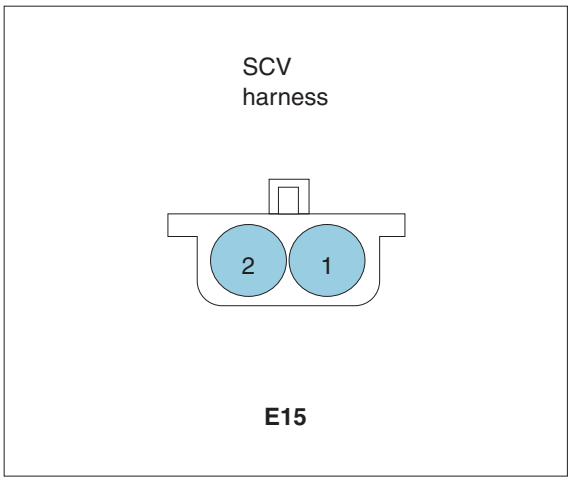


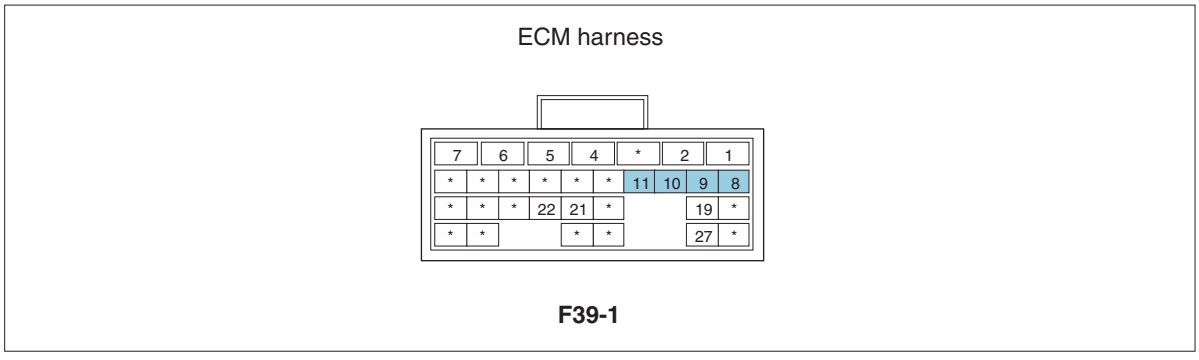
Sensor connector

SUDFL8247L

SCHEMATIC DIAGRAM EB48CD6B







SNBFL8109L

WAVEFORM E3AA1754

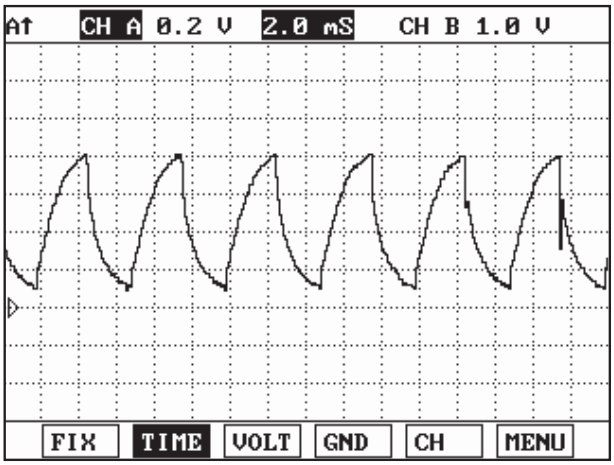


Fig. 1 SCV waveform of LOW side

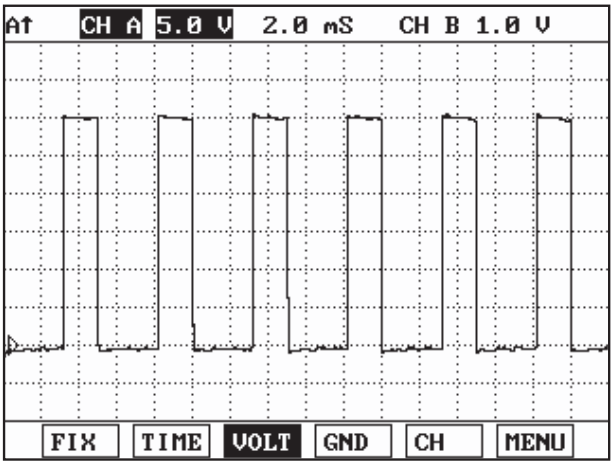


Fig. 2 SCV waveform of HIGH side

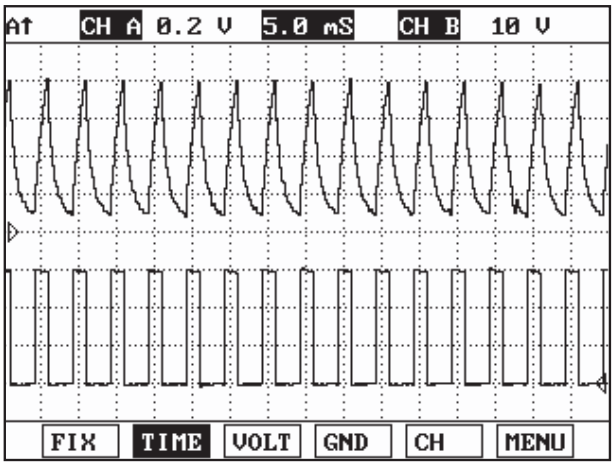


Fig. 3 SCV both waveforms of LOW/HIGH

SUDFL8249L

MONITOR SCAN TOOL DATA E90236C3

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Pump control duty" parameter on the scan tool.

NOTE

"Pump control duty" changes depending on operating condition according to DTC detecting condition. In case of fail safe. be sure to check since engine output(common rail pressure limit) is limited.

■ Specification

Pump control duty: About 37% at idle

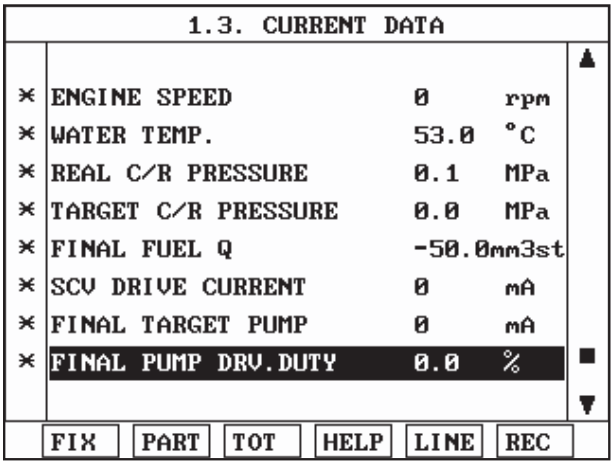


Fig. 1 "Pump control duty" data at IG ON

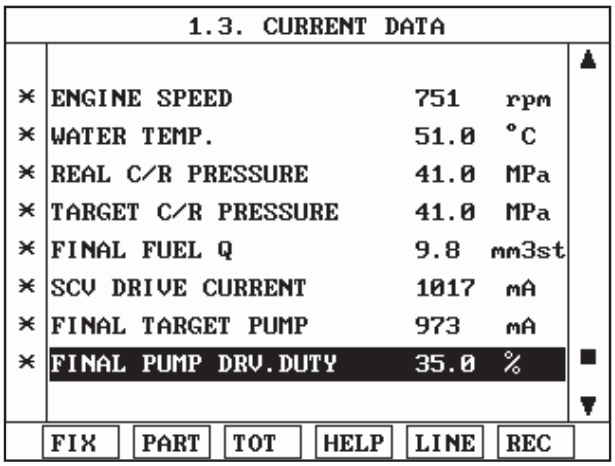


Fig. 2 "Pump control duty" data at idle

SUDFL8250L

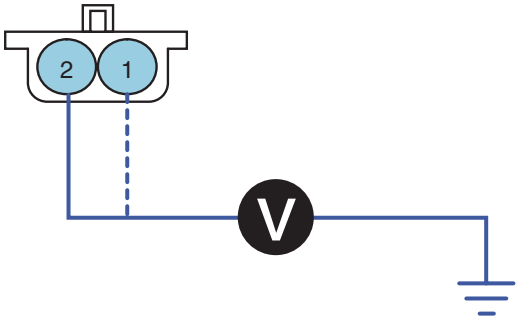
TERMINAL & CONNECTOR INSPECTION EB16DD5F

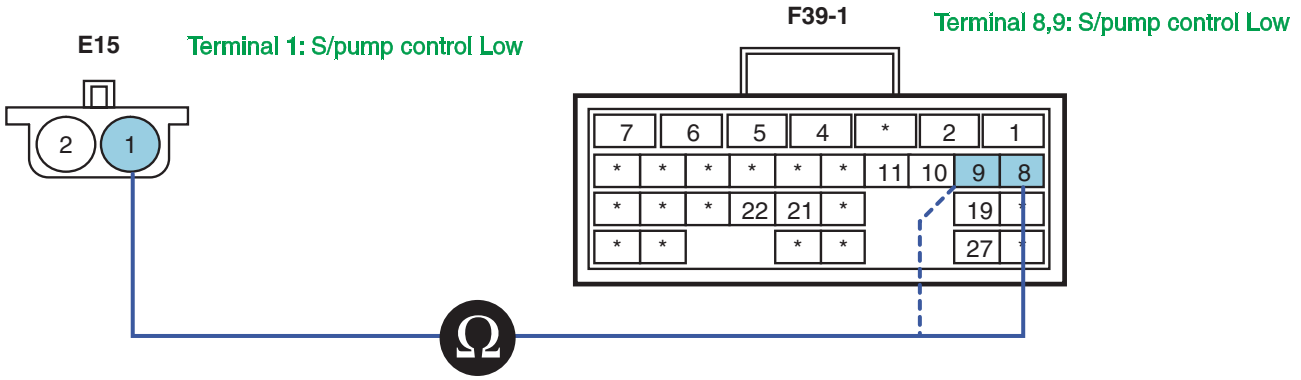
Refer to DTC P0112.

SIGNAL CIRCUIT INSPECTION EFFECC33

1. Signal Voltage(LOW/HIGH) Inspection
   1) Leave the SCV connector(E15) connected.
   2) Turn the ignition ON. The engine stops.
   3) Monitor waveform between terminal 1, 2 of SCV harness connector and chassis ground.

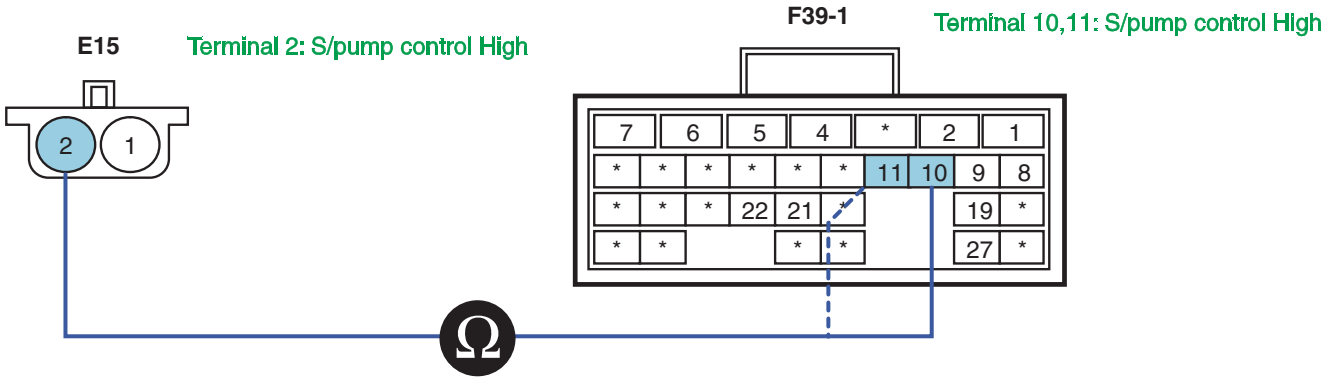
Terminal 1: S/pump control low
Terminal 2: S/pump control high





SNBFL8110L

4) Measure resistance between terminal 2 of SCV harness connector and terminals 10,11 of ECM connector(F39-1).



SNBFL8111L

■ Specification: Continuity(Below 1.0Ω)

5) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Power(LOW/HIGH) Inspection" procedure.

NO

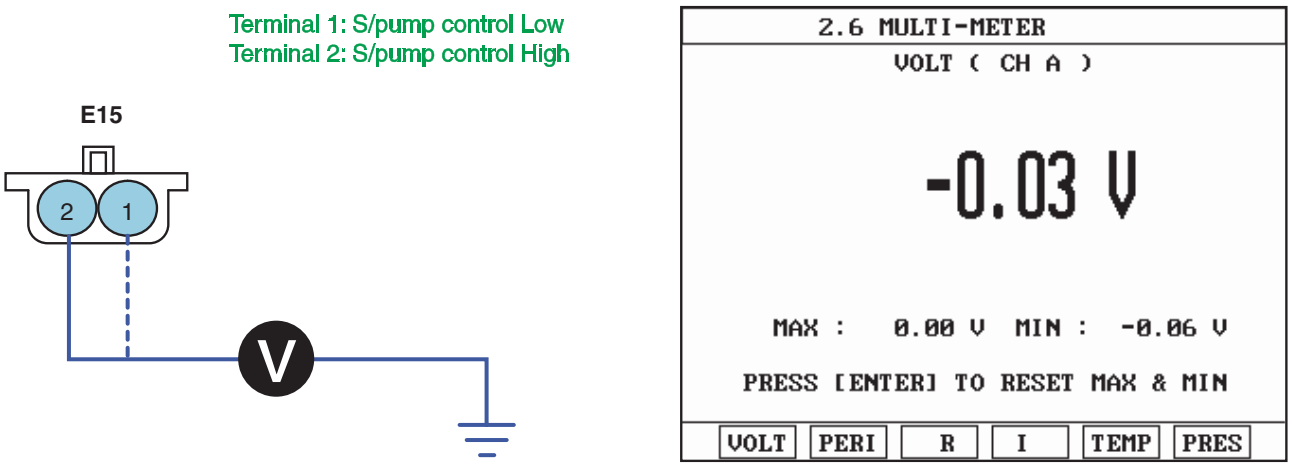
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. Signal Short to Power(LOW/HIGH) Inspection

1) Disconnect SCV connector(E15) and ECM connector(F39-1).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminals 1,2 of SCV harness connector and chassis ground.



SUDFL8254L

■ Specification: Below 0~0.1 V

4) Is the voltage measured within specification?

YES

▶ Go to "Signal Short to Ground(LOW/HIGH) Inspection" procedure.

NO

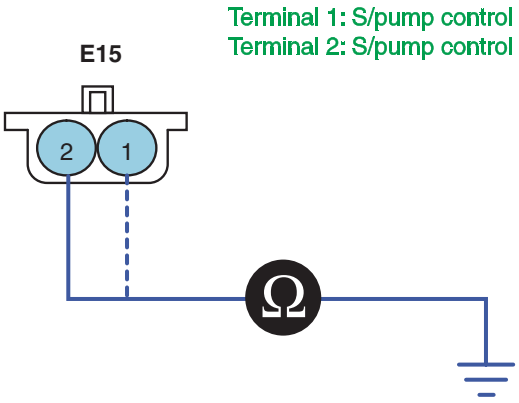
▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

4. Signal Short to Ground(LOW/HIGH) Inspection

1) Turn the ignition OFF.

2) Disconnect SCV connector(E15) and ECM connector(F39-1).

3) Measure resistance between terminals 1,2 of SCV harness connector and chassis ground.



SUDFL8255L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

COMPONENT INSPECTION E7B4C287

1. SCV Visual Inspection

   1) Turn the ignition OFF.

   2) Disconnect SCV connector(E15).

   3) Check terminal of the SCV connector for corrosion, contamination.

   4) Check the SCV for torque and fuel leaks.

   5) Is there any problem for SCV?

   YES

   ▶ Replace the SCV if necessary and then go to "Verification of Vehicle Repair" procedure.

   NO

   ▶ Go to "SCV Waveform Inspection" procedure

2. SCV Waveform Inspection

   1) Turn the ignition OFF.

   2) Disconnect SCV connector(E15).

   3) Connect oscilloscope to terminal 2 of SCV connector(E15).

   4) Check the waveform for normal operation at idle and acceleration state.
   ■ Specification: Refer to "Standard waveform" in the general information.

   5) Is the SCV waveform normal?

   YES

   ▶ Go to "Verification of Vehicle Repair" procedure.

   NO

   ▶ Go to "SCV Resistance Inspection" procedure.

3. SCV Resistance Inspection

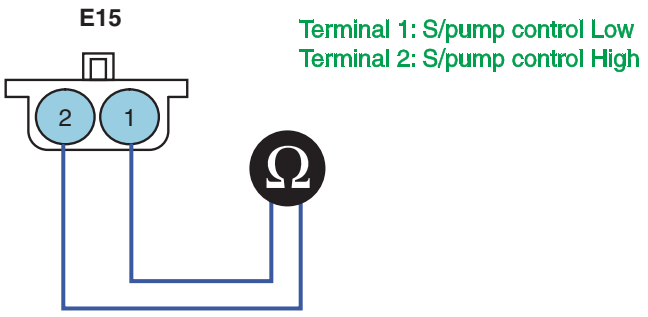
   1) Turn ignition OFF.

   2) Disconnect SCV connector(E15).

   3) Measure resistance between terminal 1 and 2 of SCV connector.

■ Specification

Item	Specification
Resistance	7.9 ± 0.25 Ω



SUDFL8256L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the SCV and then go to "Verification of Vehicle Repair" procedure.

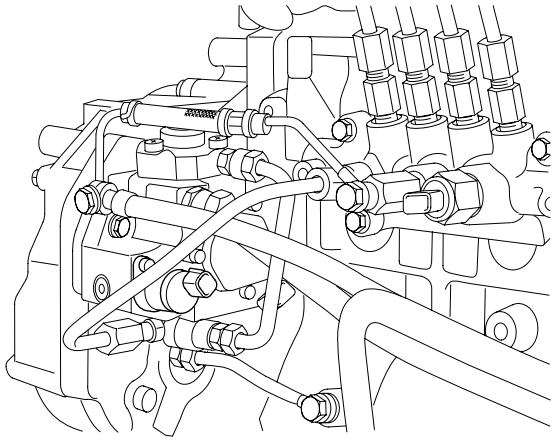
VERIFICATION OF VEHICLE REPAIR EB369E8B

Refer to DTC P0112.

DTC P1217 SUPPLY PUMP PROTECTION

COMPONENT LOCATION E7993598

Supply control valve(SCV)



SUDFL8246L

DESCRIPTION E8D47F21

1. Supply control valve(SCV) is solenoid type. The ECM controls time to open/close valve, controls pump fuel amount by controlling current to be supplied to SCV to adjust target rail pressure. When the SCV is closed, fuel passage is cut off and fuel is compressed. The compressed fuel is supplied to common rail. If fuel pressure is decreased, the SCV is opened and then fuel is inhaled for next pumping.
   Fuel pump relay is supplied power to low fuel pump by the ECM. At the ignition key ON, the fuel pump relay works for about 1.5sec. and stops to diagnose fuel pump relay. If the engine rpm is detected above 45rpm, the ECM makes relay turn ON and feeds fuel to high pressure pump.
   Low pressure fuel pump which is vane pump to be driven by electric motor is installed in the fuel tank and feeds fuel to high pressure.

2. DTC DESCRIPTION
   If pump pressure is detected above a limit value for 32ms or more continuously, the ECM judges this as a fault and DTC is set.
   The probable causes may be SCV stuck, bad learning or open in SCV wiring circuit.
   In case of fail safe, a care should be taken due to causing a damage to common rail system.
   Therefore, the ECM limits engine power and abnormal high pressure is made if there is open circuit of fuel pump at starting and pressure limiter is operated etc.

DTC DETECTING CONDITION EAEB6394

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Check the SCV for stuck. • Bad learning in the SCV • Open in SCV wiring
Enable Conditions	• Running			
Threshold Value	• When pump pressure is detected above a limit value for a certain time or more continuously			
Diagnosis Time	• 32ms or more			
Fail Safe	Fuel Cut	Yes	• The engine stops.	
	Fuel Limit	No		
	MIL	ON		

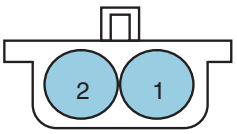
SPECIFICATION E331FA3B

Item	Specification
Resistance	7.9 ± 0.25 Ω

SCV driving frequency	SCV control type
200 Hz	Current control

SCV driving voltage	SCV driving current
16 ~ 32 V	Below 1.29A at operating
	Below 1.16A(within 270sec.) at stop

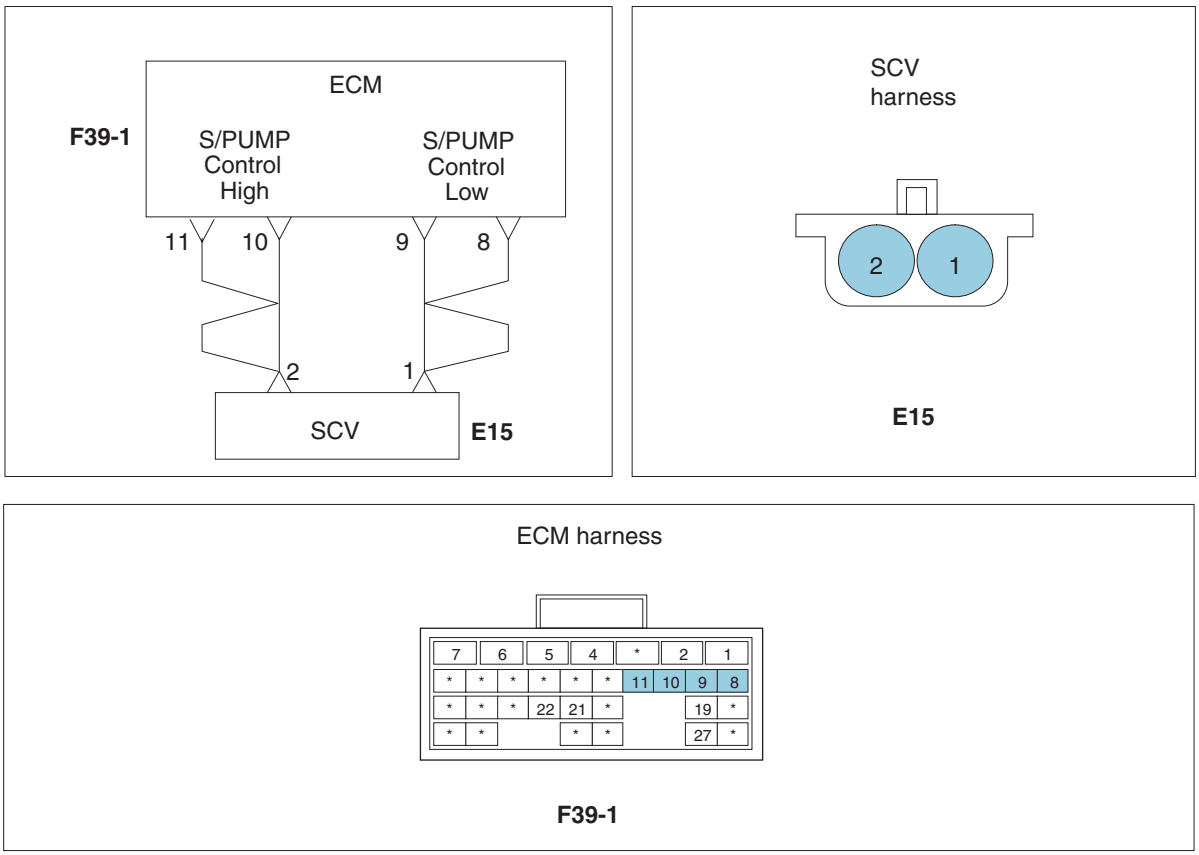
Terminal 1: S/pump control Low
Terminal 2: S/pump control High



Sensor connector

SUDFL8247L

SCHEMATIC DIAGRAM E0293CFF



SNBFL8109L

WAVEFORM E89232E0

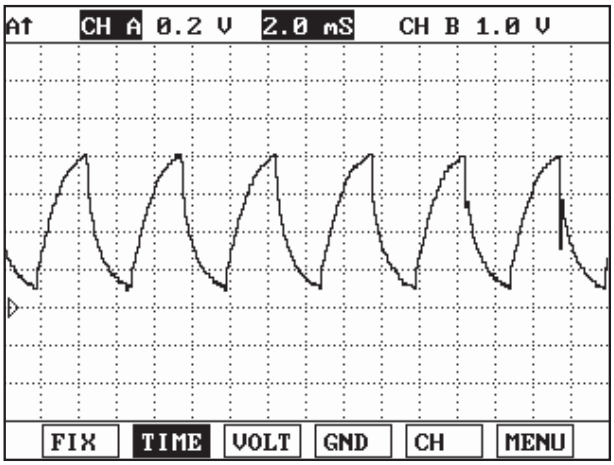


Fig. 1 SCV waveform of LOW side

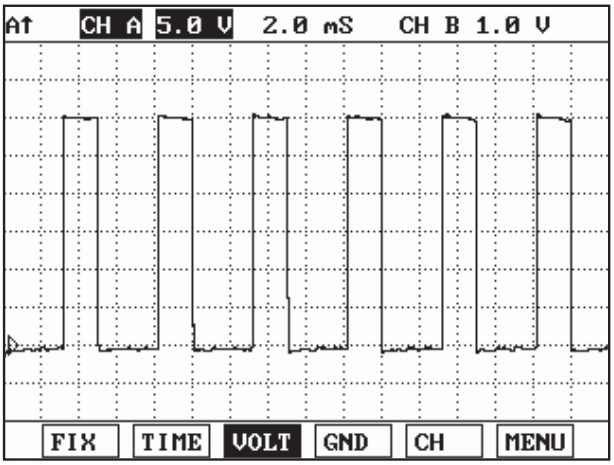


Fig. 2 SCV waveform of HIGH side

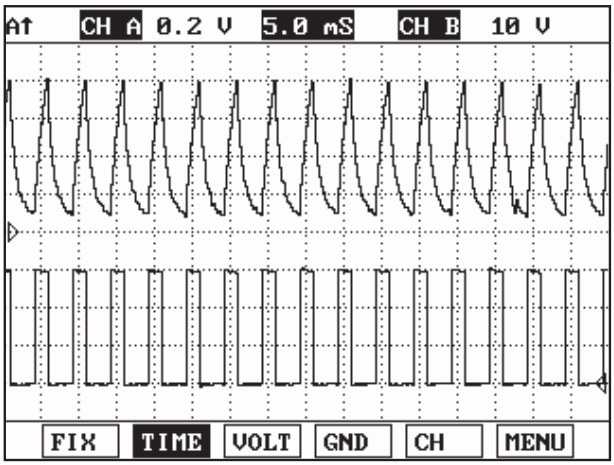


Fig. 3 SCV both waveforms of LOW/HIGH

SUDFL8249L

MONITOR SCAN TOOL DATA E511CEB6

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Pump control duty" parameter on the scan tool.

■ Specification
Pump control duty: About 37% at idle

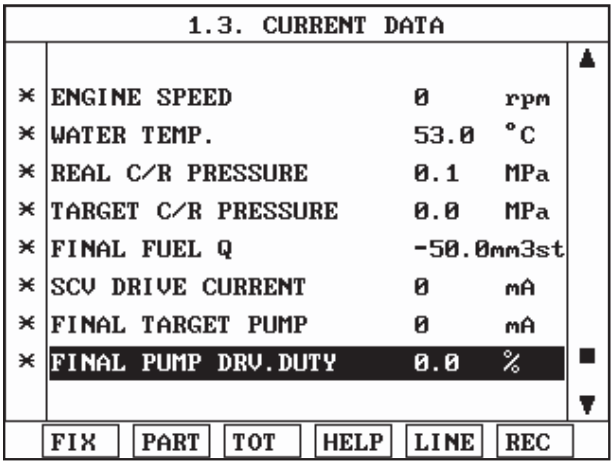


Fig. 1 "Pump control duty" data at IG ON

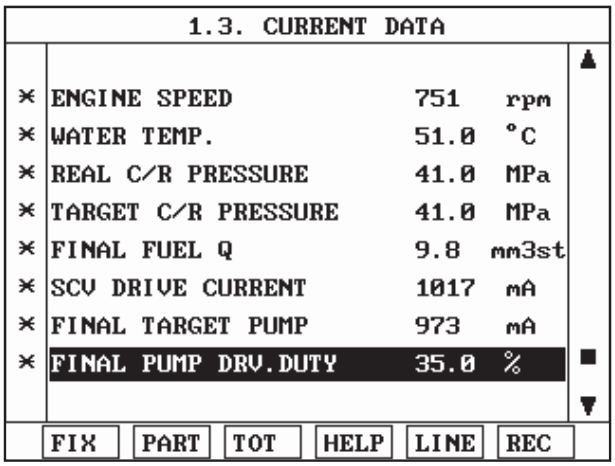


Fig. 2 "Pump control duty" data at idle

SUDFL8250L

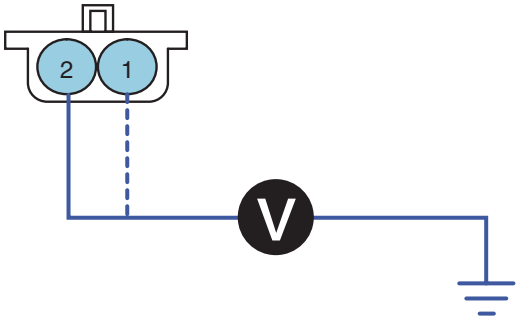
TERMINAL & CONNECTOR INSPECTION E574FF2F

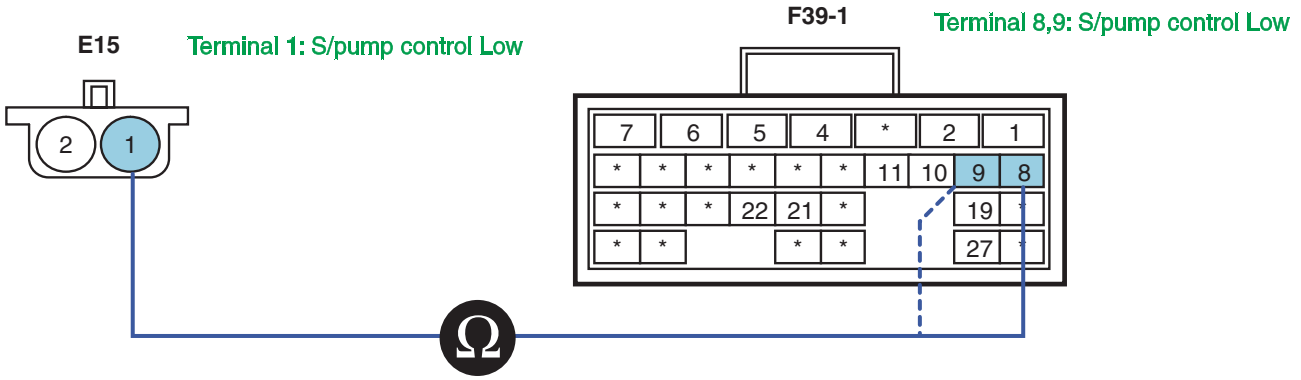
Refer to DTC P0112.

SIGNAL CIRCUIT INSPECTION E72271D7

1. Signal Voltage(LOW/HIGH) Inspection
   1) Leave the SCV connector(E15) connected.
   2) Turn the ignition ON. The engine stops.
   3) Monitor waveform between terminal 1, 2 of SCV harness connector and chassis ground.

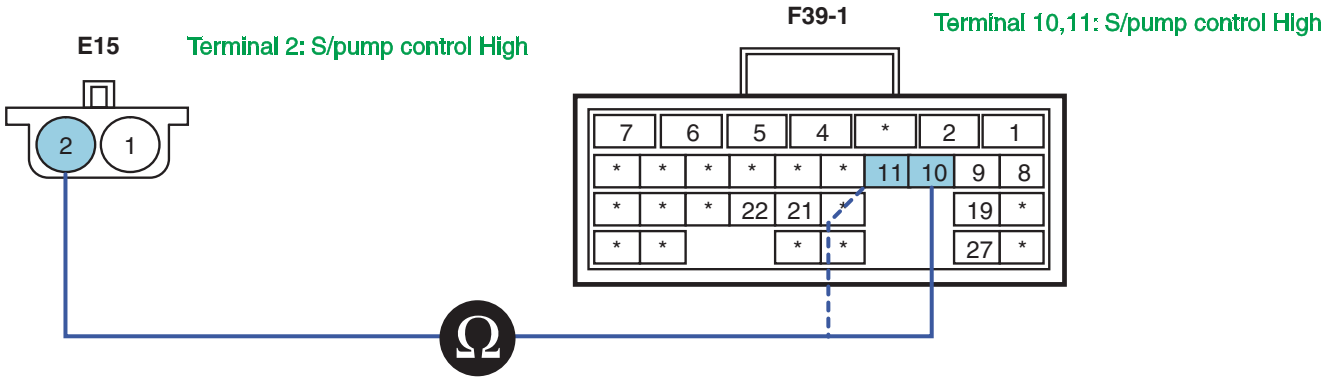
Terminal 1: S/pump control low
Terminal 2: S/pump contro





SNBFL8110L

4) Measure resistance between terminal 2 of SCV harness connector and terminals 10,11 of ECM connector(F39-1).



SNBFL8111L

■ Specification: Continuity(Below 1.0Ω)

5) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Power(LOW/HIGH) Inspection" procedure.

NO

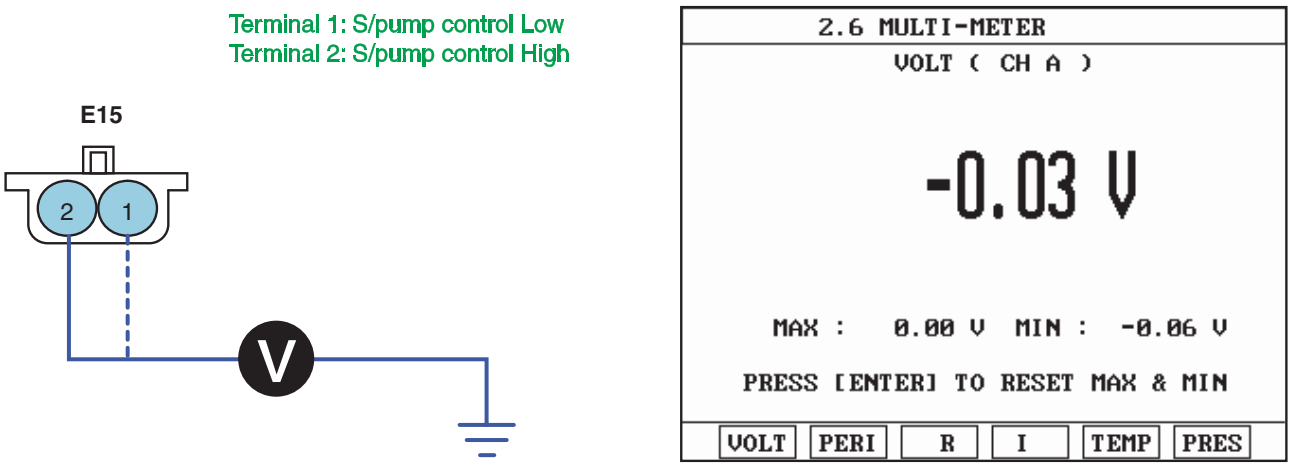
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. Signal Short to Power(LOW/HIGH) Inspection

1) Disconnect SCV connector(E15) and ECM connector(F39-1).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminals 1,2 of SCV harness connector and chassis ground.



SUDFL8254L

■ Specification: Below 0~0.1 V

4) Is the voltage measured within specification?

YES

▶ Go to "Signal Short to Ground(LOW/HIGH) Inspection" procedure.

NO

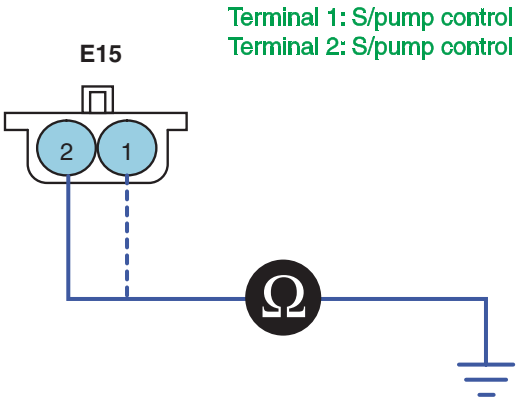
▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

4. Signal Short to Ground(LOW/HIGH) Inspection

1) Turn the ignition OFF.

2) Disconnect SCV connector(E15) and ECM connector(F39-1).

3) Measure resistance between terminals 1,2 of SCV harness connector and chassis ground.



SUDFL8255L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

COMPONENT INSPECTION EE10D689

1. SCV Visual Inspection

   1) Turn the ignition OFF.

   2) Disconnect SCV connector(E15).

   3) Check terminal of the SCV connector for corrosion, contamination.

   4) Check the SCV for torque and fuel leaks.

   5) Is there any problem for SCV?

   YES

   ▶ Replace the SCV if necessary and then go to "Verification of Vehicle Repair" procedure.

   NO

   ▶ Go to "SCV Waveform Inspection" procedure

2. SCV Waveform Inspection

   1) Turn the ignition OFF.

   2) Disconnect SCV connector(E15).

   3) Connect oscilloscope to terminal 2 of SCV connector(E15).

   4) Check the waveform for normal operation at idle and acceleration state.
   ■ Specification: Refer to "Standard waveform" in the general information.

   5) Is the SCV waveform normal?

   YES

   ▶ Go to "Verification of Vehicle Repair" procedure.

   NO

   ▶ Go to "SCV Resistance Inspection" procedure.

3. SCV Resistance Inspection

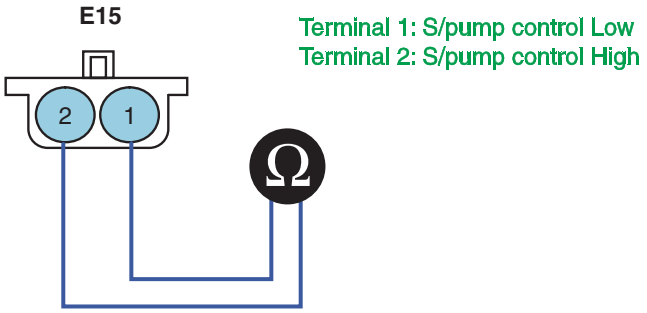
   1) Turn ignition OFF.

   2) Disconnect SCV connector(E15).

   3) Measure resistance between terminal 1 and 2 of SCV connector.

■ Specification

Item	Specification
Resistance	7.9 ± 0.25 Ω



SUDFL8256L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the SCV and then go to "Verification of Vehicle Repair" procedure.

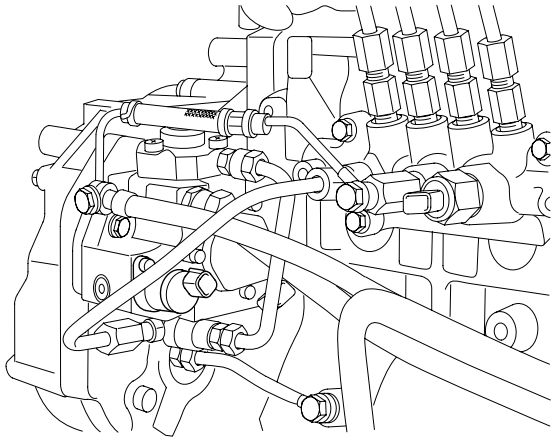
VERIFICATION OF VEHICLE REPAIR EAC549DC

Refer to DTC P0112.

DTC P1218 SUPPLY PUMP EXCHANGE

COMPONENT LOCATION E033ECF1

Supply control valve(SCV)



SUDFL8246L

DESCRIPTION EC98C3A1

1. Supply control valve(SCV) is solenoid type. The ECM controls time to open/close valve, controls pump fuel amount by controlling current to be supplied to SCV to adjust target rail pressure. When the SCV is closed, fuel passage is cut off and fuel is compressed. The compressed fuel is supplied to common rail. If fuel pressure is decreased, the SCV is opened and then fuel is inhaled for next pumping.
   Fuel pump relay is supplied power to low fuel pump by the ECM. At the ignition key ON, the fuel pump relay works for about 1.5sec. and stops to diagnose fuel pump relay. If the engine rpm is detected above 45rpm, the ECM makes relay turn ON and feeds fuel to high pressure pump.
   Low pressure fuel pump which is vane pump to be driven by electric motor is installed in the fuel tank and feeds fuel to high pressure.

2. DTC DESCRIPTION
   If pump pressure is detected above a limit value for 32ms or more continuously, the ECM judges this as a fault and DTC is set.
   The probable causes may be SCV stuck, bad learning or open in SCV wiring circuit.
   In case of fail safe, a care should be taken due to causing a damage to common rail system.
   Therefore, the ECM limits engine power and abnormal high pressure is made if there is open circuit of fuel pump at starting and pressure limiter is operated etc.

DTC DETECTING CONDITION ECEDCB81

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Check the SCV for stuck. • Bad learning in the SCV • Open in SCV wiring
Enable Conditions	• Running			
Threshold Value	• When pump pressure is detected above a limit value for a certain time or more continuously			
Diagnosis Time	• 32ms or more			
Fail Safe	Fuel Cut	Yes	• The engine stops.	
	Fuel Limit	No		
	MIL	ON		

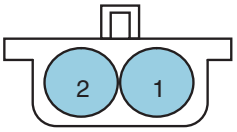
SPECIFICATION EEA7F473

Item	Specification
Resistance	7.9 ± 0.25 Ω

SCV driving frequency	SCV control type
200 Hz	Current control

SCV driving voltage	SCV driving current
16 ~ 32 V	Below 1.29A at operating
	Below 1.16A(within 270sec.) at stop

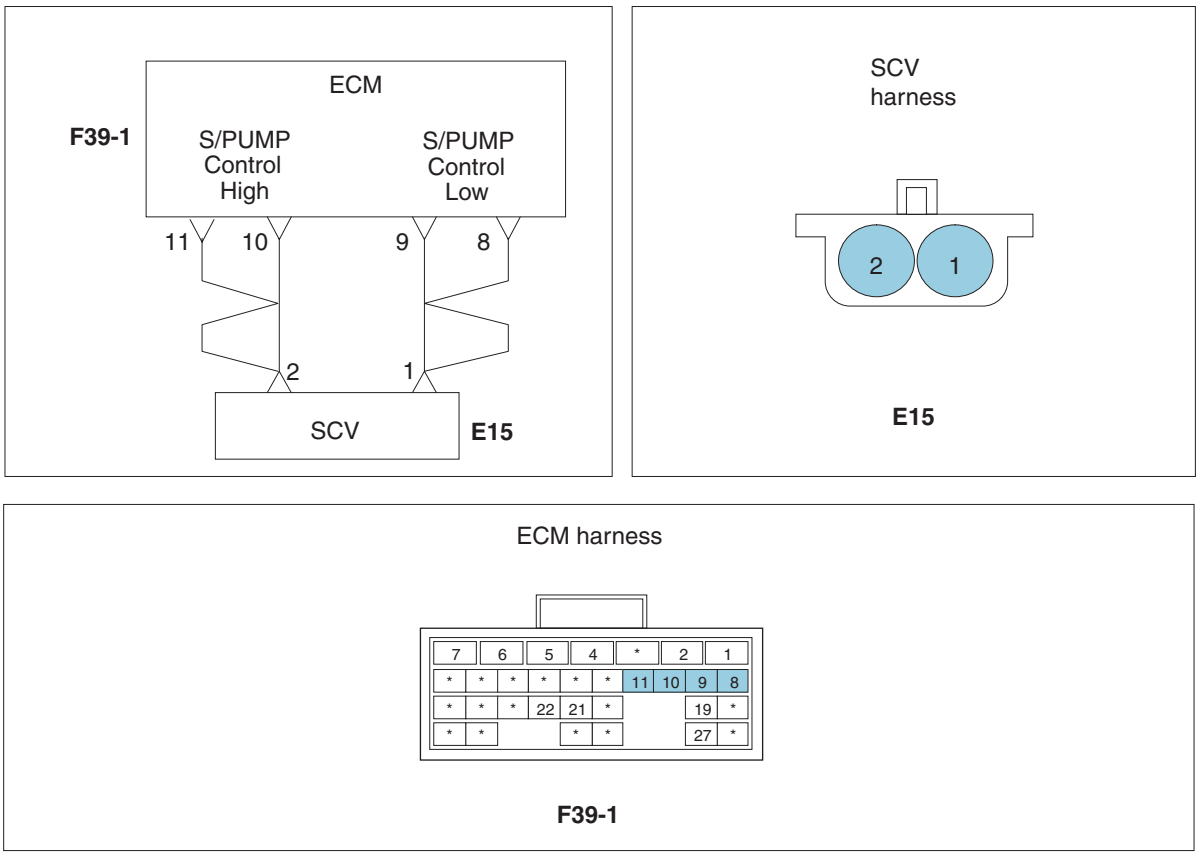
Terminal 1: S/pump control Low
Terminal 2: S/pump control High



Sensor connector

SUDFL8247L

SCHEMATIC DIAGRAM E3282CA8



SNBFL8109L

WAVEFORM ED4734B8

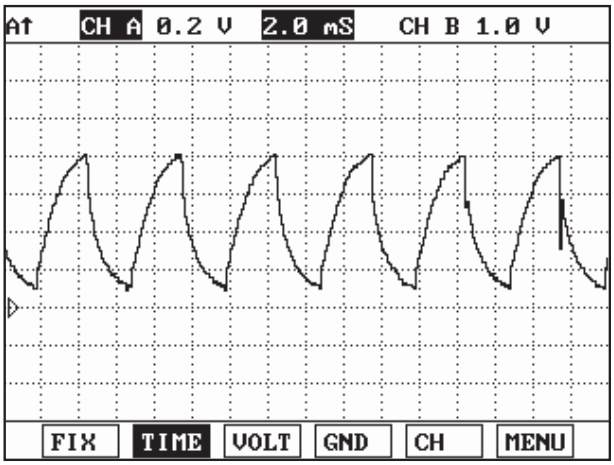


Fig. 1 SCV waveform of LOW side

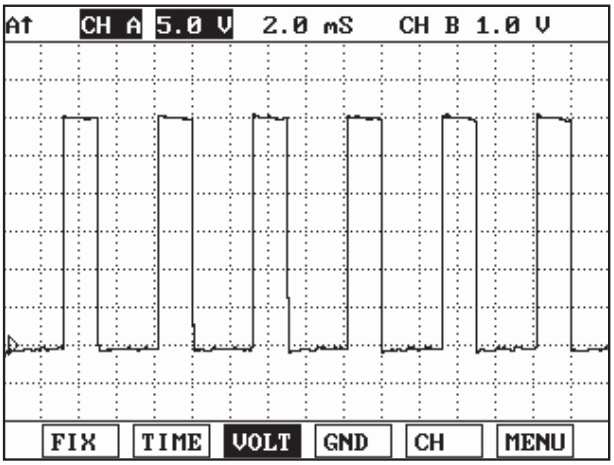


Fig. 2 SCV waveform of HIGH side

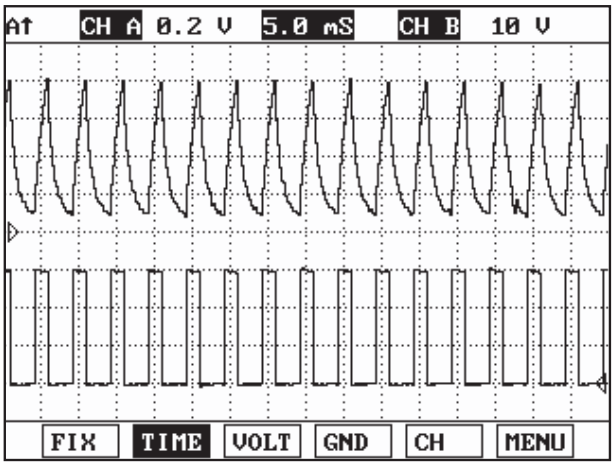


Fig. 3 SCV both waveforms of LOW/HIGH

SUDFL8249L

MONITOR SCAN TOOL DATA E7B50289

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Pump control duty" parameter on the scan tool.

■ Specification
Pump control duty: About 37% at idle

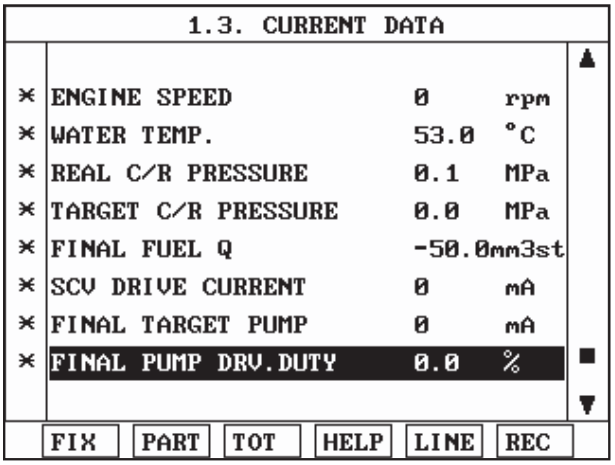


Fig. 1 "Pump control duty" data at IG ON

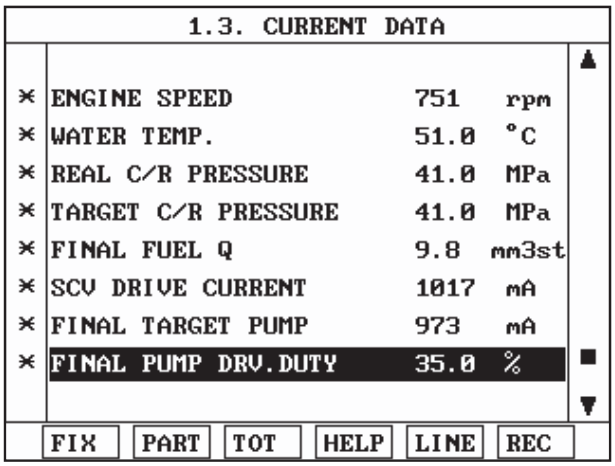


Fig. 2 "Pump control duty" data at idle

SUDFL8250L

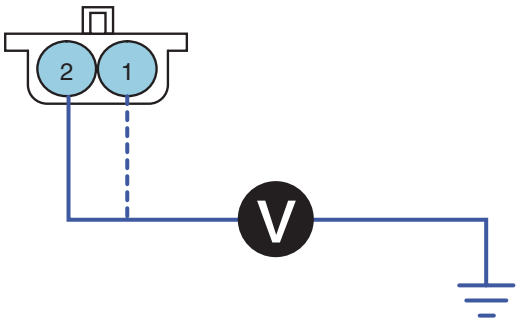
TERMINAL & CONNECTOR INSPECTION EB0BF009

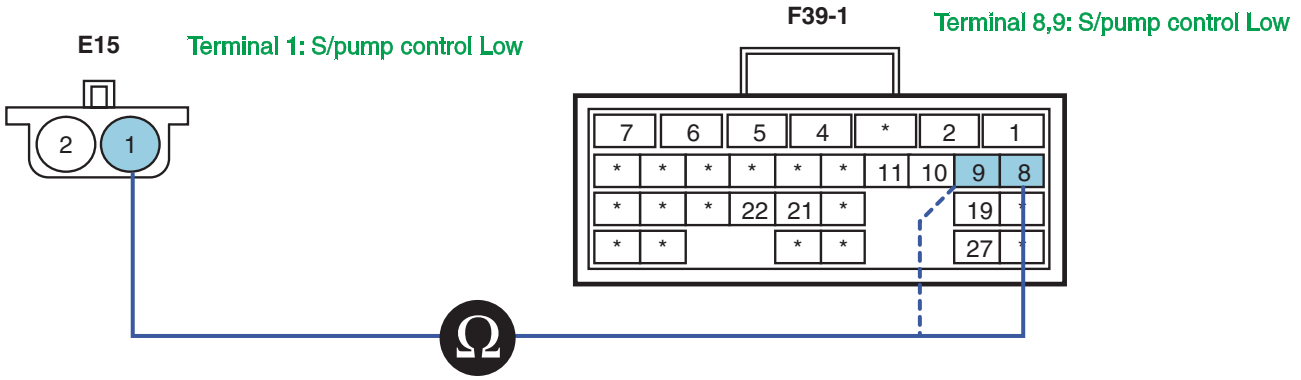
Refer to DTC P0112.

SIGNAL CIRCUIT INSPECTION E5C30381

1. Signal Voltage(LOW/HIGH) Inspection
   1) Leave the SCV connector(E15) connected.
   2) Turn the ignition ON. The engine stops.
   3) Monitor waveform between terminal 1, 2 of SCV harness connector and chassis ground.

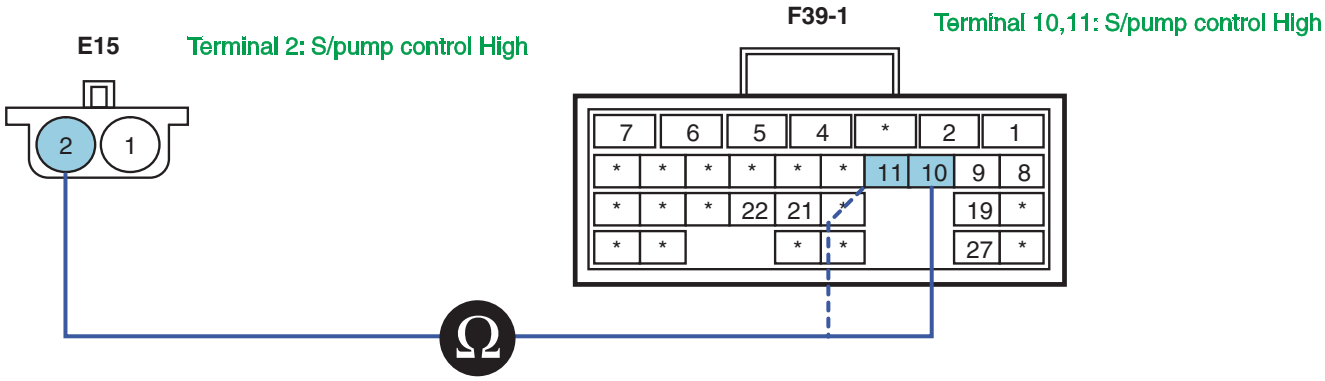
Terminal 1: S/pump control lo





SNBFL8110L

4) Measure resistance between terminal 2 of SCV harness connector and terminals 10,11 of ECM connector(F39-1).



SNBFL8111L

■ Specification: Continuity(Below 1.0Ω)

5) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Power(LOW/HIGH) Inspection" procedure.

NO

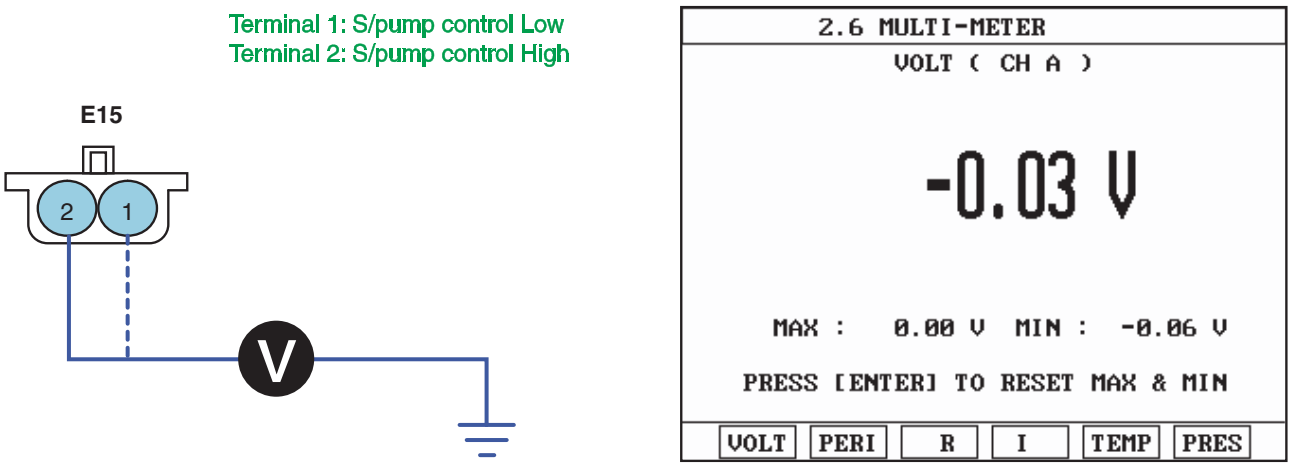
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. Signal Short to Power(LOW/HIGH) Inspection

1) Disconnect SCV connector(E15) and ECM connector(F39-1).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminals 1,2 of SCV harness connector and chassis ground.



SUDFL8254L

■ Specification: Below 0~0.1 V

4) Is the voltage measured within specification?

YES

▶ Go to "Signal Short to Ground(LOW/HIGH) Inspection" procedure.

NO

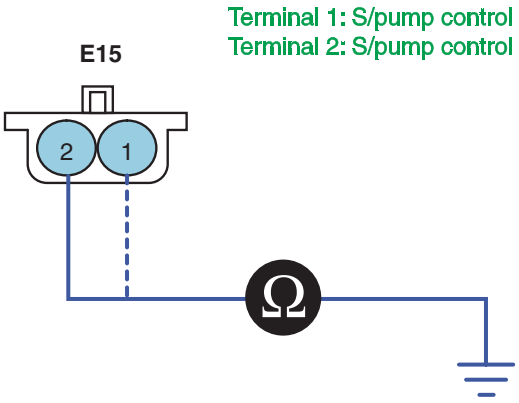
▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

4. Signal Short to Ground(LOW/HIGH) Inspection

1) Turn the ignition OFF.

2) Disconnect SCV connector(E15) and ECM connector(F39-1).

3) Measure resistance between terminals 1,2 of SCV harness connector and chassis ground.



SUDFL8255L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

COMPONENT INSPECTION EB7403F2

1. SCV Visual Inspection

   1) Turn the ignition OFF.

   2) Disconnect SCV connector(E15).

   3) Check terminal of the SCV connector for corrosion, contamination.

   4) Check the SCV for torque and fuel leaks.

   5) Is there any problem for SCV?

   YES

   ▶ Replace the SCV if necessary and then go to "Verification of Vehicle Repair" procedure.

   NO

   ▶ Go to "SCV Waveform Inspection" procedure

2. SCV Waveform Inspection

   1) Turn the ignition OFF.

   2) Disconnect SCV connector(E15).

   3) Connect oscilloscope to terminal 2 of SCV connector(E15).

   4) Check the waveform for normal operation at idle and acceleration state.
   ■ Specification: Refer to "Standard waveform" in the general information.

   5) Is the SCV waveform normal?

   YES

   ▶ Go to "Verification of Vehicle Repair" procedure.

   NO

   ▶ Go to "SCV Resistance Inspection" procedure.

3. SCV Resistance Inspection

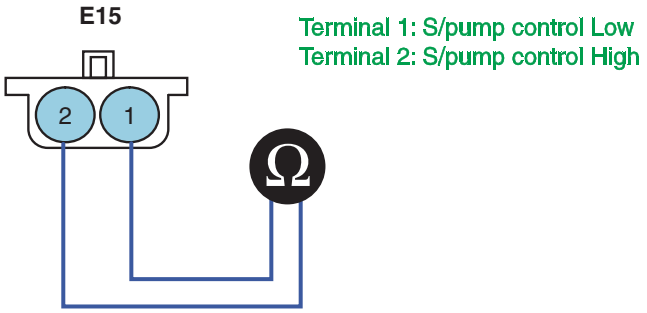
   1) Turn ignition OFF.

   2) Disconnect SCV connector(E15).

   3) Measure resistance between terminal 1 and 2 of SCV connector.

■ Specification

Item	Specification
Resistance	7.9 ± 0.25 Ω



SUDFL8256L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the SCV and then go to "Verification of Vehicle Repair" procedure.

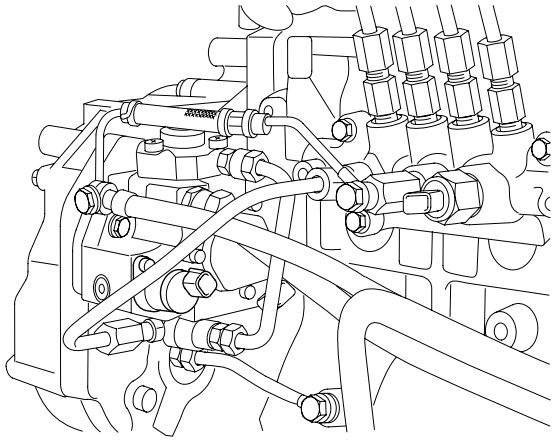
VERIFICATION OF VEHICLE REPAIR E89E7386

Refer to DTC P0112.

DTC P1219 SUPPLY PUMP MULFUNCTION

COMPONENT LOCATION EDE07821

Supply control valve(SCV)



SUDFL8246L

DESCRIPTION EEAA8467

1. Supply control valve(SCV) is solenoid type. The ECM controls time to open/close valve, controls pump fuel amount by controlling current to be supplied to SCV to adjust target rail pressure. When the SCV is closed, fuel passage is cut off and fuel is compressed. The compressed fuel is supplied to common rail. If fuel pressure is decreased, the SCV is opened and then fuel is inhaled for next pumping.
   Fuel pump relay is supplied power to low fuel pump by the ECM. At the ignition key ON, the fuel pump relay works for about 1.5sec. and stops to diagnose fuel pump relay. If the engine rpm is detected above 45rpm, the ECM makes relay turn ON and feeds fuel to high pressure pump.
   Low pressure fuel pump which is vane pump to be driven by electric motor is installed in the fuel tank and feeds fuel to high pressure.

2. DTC DESCRIPTION
   If the pump discharge pressure of SCV is detected lowly(100mm³/st, 1000bar) for 42CA or more, the ECM judges this as a fault and DTC is set.
   There may be damage to high pressure plunger in the pump by forming abnormal high pressure. If abnormal high pressure in the pump is formed, the probable causes are open circuit in SCV, clogging for fuel line and fuel filter.
   If the DTC comes on and the reduced output and the engine stop occur, the pump assembly should be replaced.

DTC DETECTING CONDITION EB1D1595

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Faulty pump inside
Enable Conditions	• Running			
Threshold Value	• When SCV pump discharge pressure is detected lowly(100㎟/st, 1000bar)			
Diagnosis Time	• 42CA or more			
Fail Safe	Fuel Cut	Yes	• The engine stops.	
	Fuel Limit	No		
	MIL	ON		

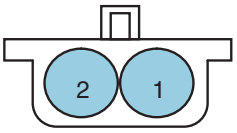
SPECIFICATION E3ED1F8A

Item	Specification
Resistance	7.9 ± 0.25 Ω

SCV driving frequency	SCV control type
200 Hz	Current control

SCV driving voltage	SCV driving current
16 ~ 32 V	Below 1.29A at operating
	Below 1.16A(within 270sec.) at stop

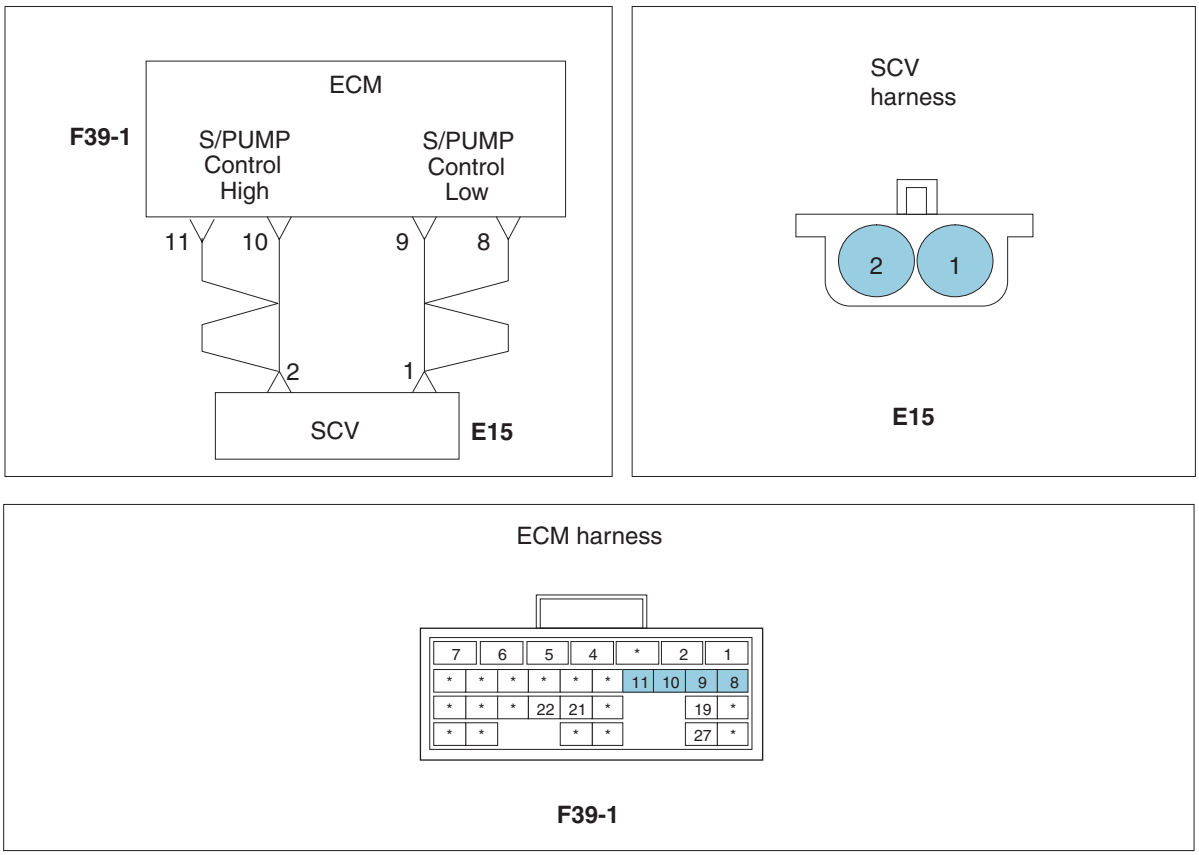
Terminal 1: S/pump control Low
Terminal 2: S/pump control High



Sensor connector

SUDFL8247L

SCHEMATIC DIAGRAM E5555883



SNBFL8109L

WAVEFORM ED906EDB

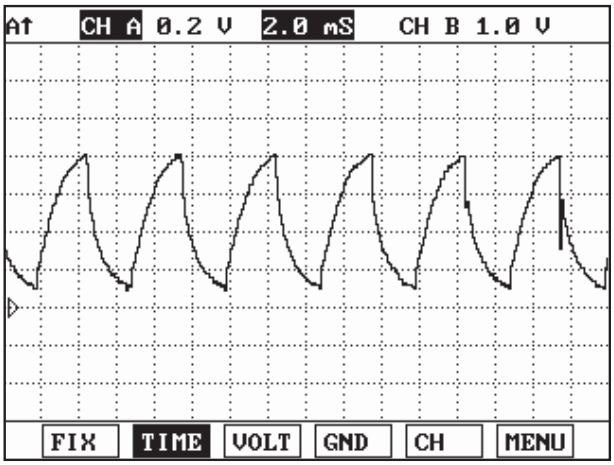


Fig. 1 SCV waveform of LOW side

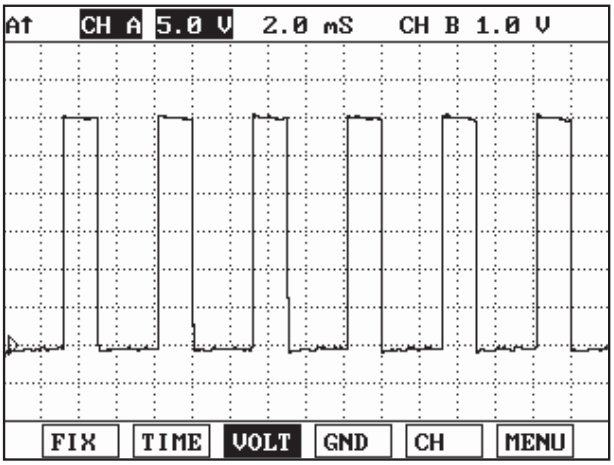


Fig. 2 SCV waveform of HIGH side

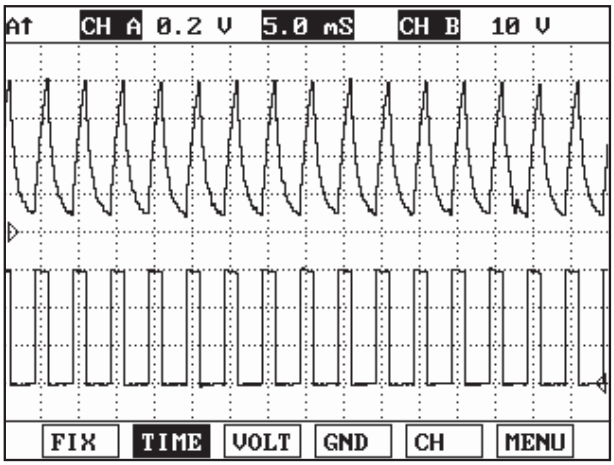


Fig. 3 SCV both waveforms of LOW/HIGH

SUDFL8249L

MONITOR SCAN TOOL DATA E7C65E93

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Pump control duty" parameter on the scan tool.

NOTE

"Pump control duty" changes depending on operating condition according to DTC detecting condition. In case of fail safe. be sure to check since engine output(common rail pressure limit) is limited.

■ Specification

Pump control duty: About 37% at idle

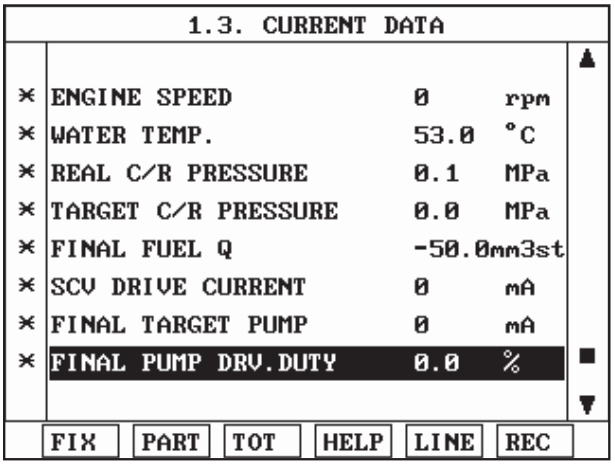


Fig. 1 "Pump control duty" data at IG ON

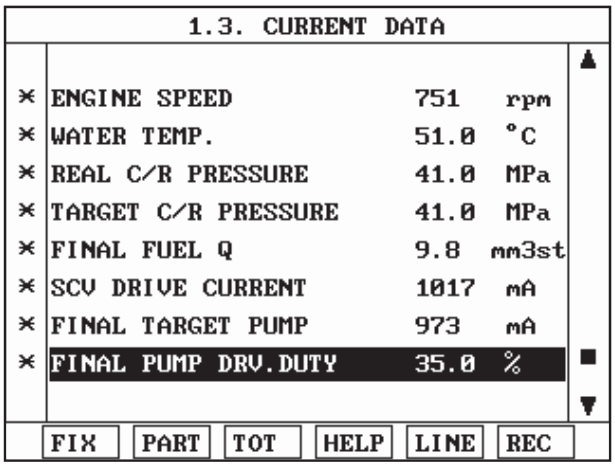


Fig. 2 "Pump control duty" data at idle

SUDFL8250L

TERMINAL & CONNECTOR INSPECTION E5167F0C

Refer to DTC P0112.

COMPONENT INSPECTION E0734E26

1. Fuel Supply System Visual Inspection
   1) Turn the ignition OFF.
   2) Check fuel hose, pipe for crack, bending, deformation, burned or clogging etc.
   3) Check fuel filter for clogging, damage or contamination.
   4) Check fuel.
   5) Is there any problem in fuel and fuel supply system?

      YES

      ▶ Repair if there is problem and then go to "Verification of Vehicle Repair" procedure.

      NO

      ▶ Go to "Supply Pump Inspection" procedure

2. Supply Pump Inspection
   1) Turn the ignition OFF.
   2) Check supply pump around and high fuel supply system for leaks.
   3) Check high pressure fuel line for leaks while the engine is operating.
   4) Check supply pump for noise or vibration.
   5) Is there any problem for supply pump?

YES

▶ Check supply pump inside and replace if there is problem and then go to "Verification of Vehicle Repair" procedure.

NO

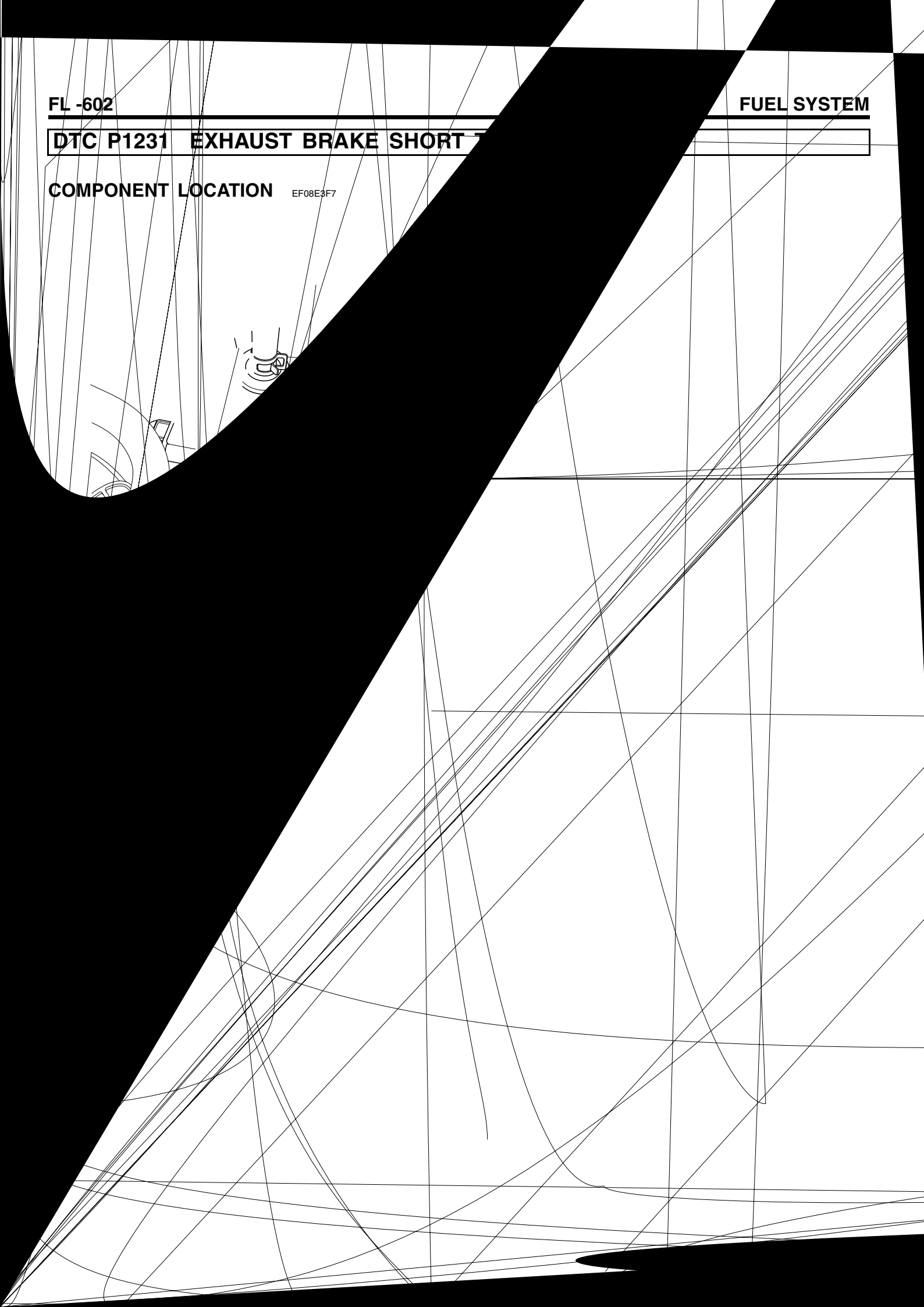
▶ Go to "Verification of Vehicle Repair" procedure.

VERIFICATION OF VEHICLE REPAIR E1DE2BD5

Refer to DTC P0112.

DTC P1231 EXHAUST BRAKE SHORT T

COMPONENT LOCATION EF08E3F7

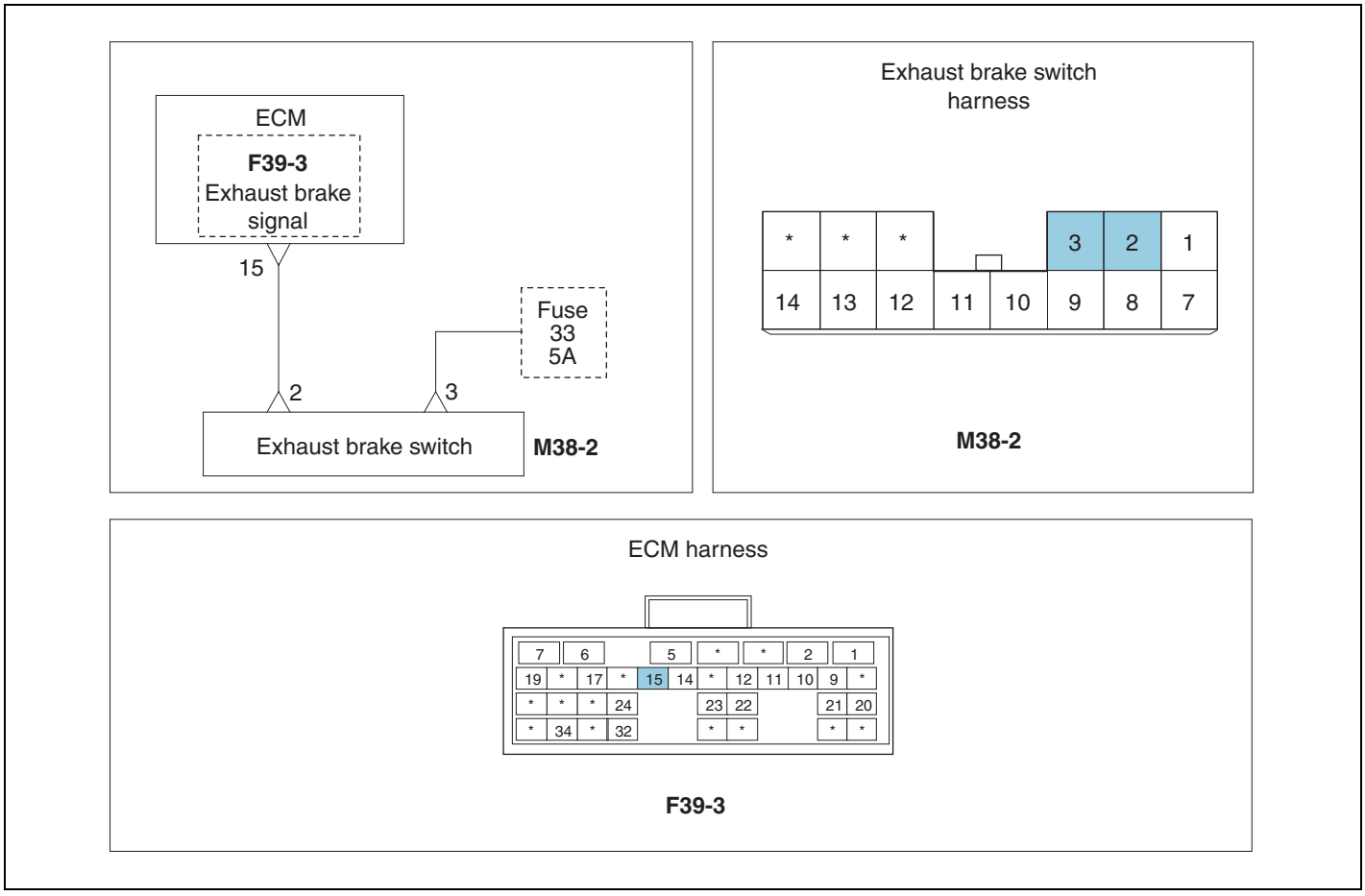


2. DTC DESCRIPTION
Under exhaust brake operating conditions, if the exhaust brake is detected as non-operation for 3,004.5ms or more, the ECM judges this as a fault and DTC is set. The possible causes are short to terminal 15 of ECM connector(F39-3), short to ground and wiring problem etc.

DTC DETECTING CONDITION E77230E4

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Open or ground in terminal 15 of ECM connector(F39-3) • Wiring problem
Enable Conditions	• Running			
Threshold Value	• When exhaust brake is not operated under exhaust brake operation conditions			
Diagnosis Time	• 3,004.5ms or more			
Fail Safe	Fuel Cut	No	• Exhaust brake is not operated. • Normal driving	
	Fuel Limit	No		
	MIL	OFF		

SCHEMATIC DIAGRAM EAFA5E85



SNBFL8125L

MONITOR SCAN TOOL DATA E595A21E

1. Connect scan tool to the self-diagnosis connector.

2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Exhaust brake switch" parameter on the scan tool.

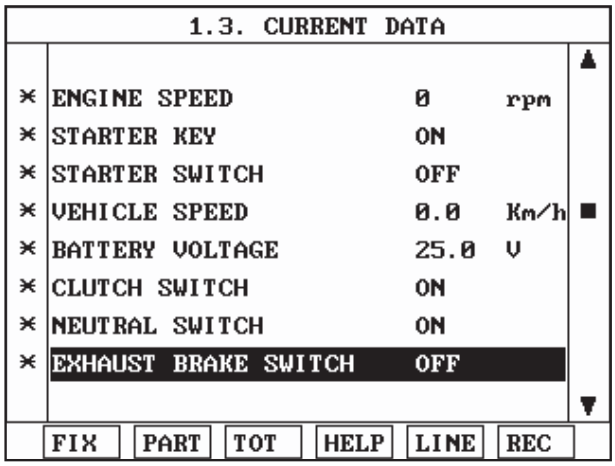


Fig. 1 Exhaust brake switch "OFF" data when it is not operated

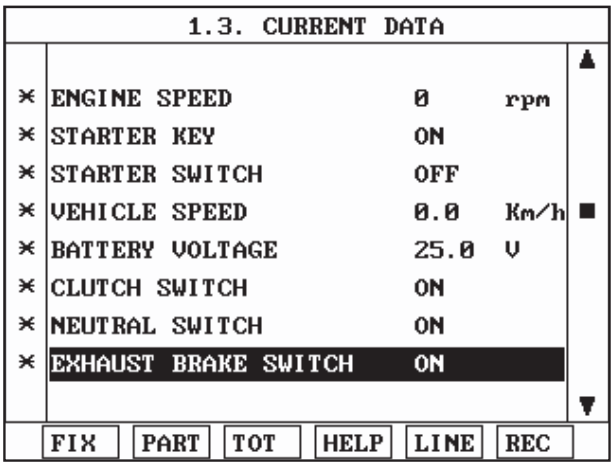
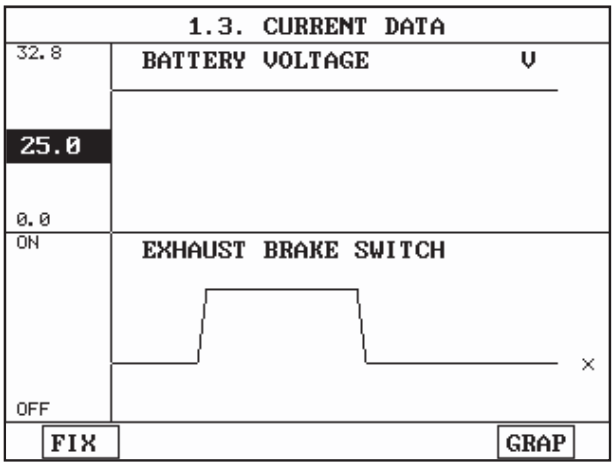


Fig. 2 Exhaust brake switch "ON" data when it is operated



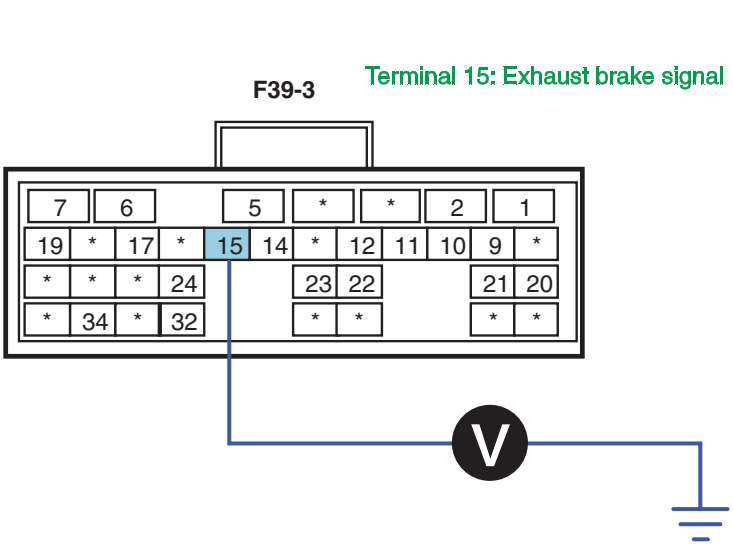
SUDFL8274L

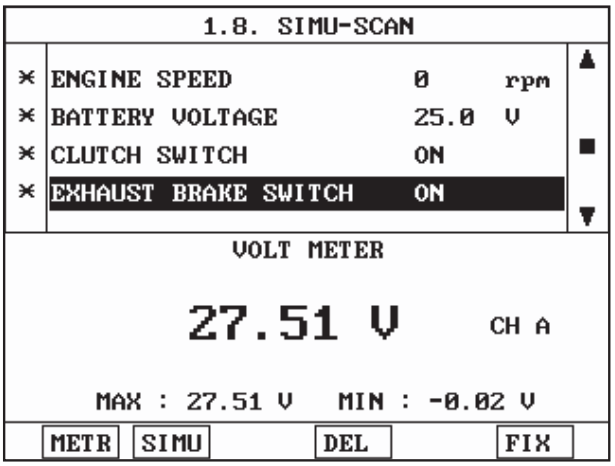
TERMINAL & CONNECTOR INSPECTION E8EFBA9D

Refer to DTC P0112.

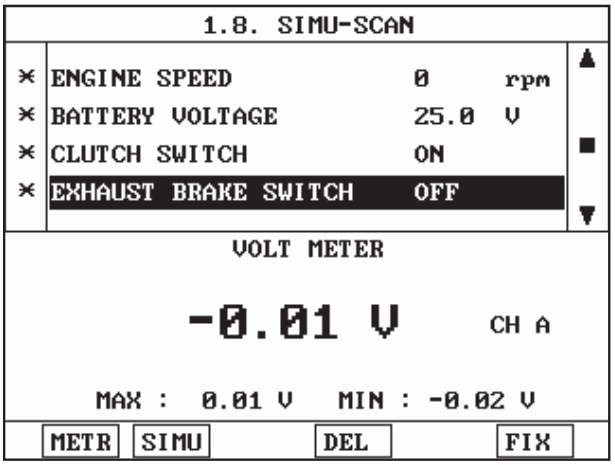
SIGNAL INSPECTION E3C560D4

1. Signal Voltage Inspection
   1) Leave the exhaust brake switch connector(M38-2) installed.
   2) Turn the ignition ON. The engine stops.
   3) Measure voltage between terminal 15 of ECM connector(F39-3) and chassis ground.





▶ Exhaust brake switch (At IG ON)



▶ Exhaust brake switch (At IG OFF)

SNBFL8126L

■ Specification
Exhaust brake switch signal power : Approx. 0V(When the switch is OFF)
Exhaust brake switch signal power : Approx. B+V(When the switch is ON)

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

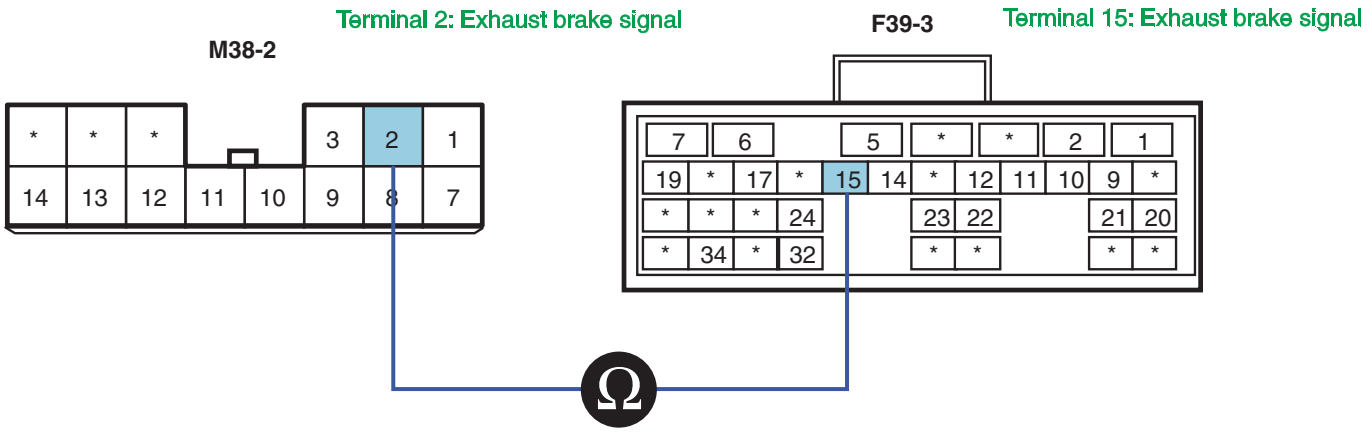
▶ Go to "Signal Open Inspection" procedure.

2. Signal Open Inspection

1) Turn the ignition OFF.

2) Disconnect exhaust brake switch connector(M38-2) and ECM connector(F39-3).

3) Measure resistance between terminal 2 of exhaust brake switch harness connector(M38-2) and terminal 15 of ECM connector(F39-3).



SNBFL8127L

■ Specification: Continuity(Below1.0Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Signal Short to Ground Inspection" procedure.

NO

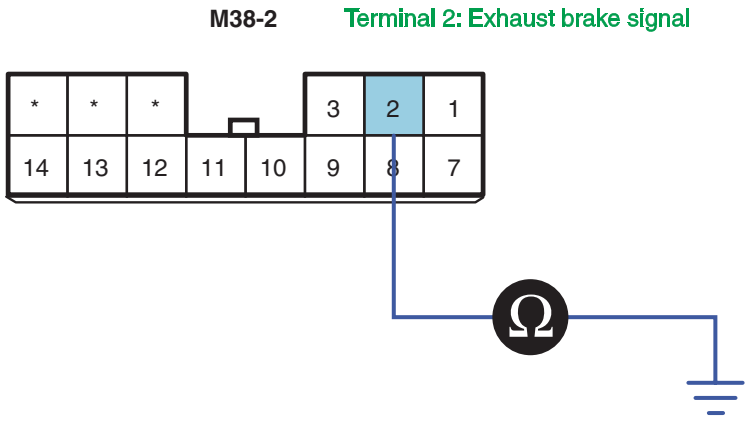
▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

3. Signal Short to Ground Inspection

1) Disconnect exhaust brake switch connector(M38-2) and ECM connector(F39-3).

2) Turn the ignition ON. The engine stops and the exhaust brake switch is OFF.

3) Measure resistance between terminal 2 of exhaust brake switch harness connector(M38-2) and chassis ground.



SNBFL8128L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EF4713B6

1. Exhaust Brake Switch Visual Inspection

   1) Turn the ignition OFF.

   2) Disconnect exhaust brake switch connector(M38-2).

   3) Check terminal of the exhaust brake switch connector for corrosion, contamination.

   4) Is there any problem for the exhaust brake switch?

YES

▶ Replace the exhaust brake switch if necessary and then go to "Verification of Vehicle Repair" procedure.

NO

▶ Go to "Exhaust Brake Resistance Inspection" procedure

2. Exhaust Brake Resistance Inspection

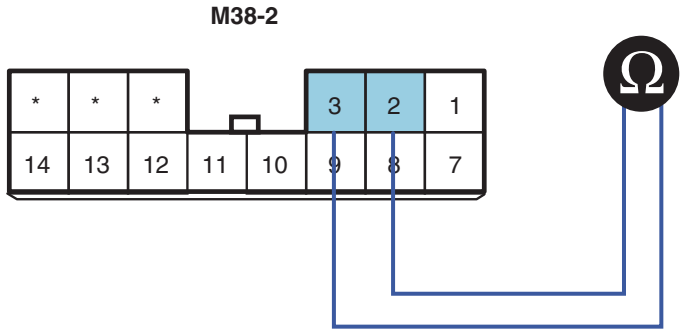
   1) Turn the ignition OFF.

   2) Disconnect exhaust brake switch connector(M38-2).

   3) Measure resistance between terminal 2 and 3 of exhaust brake switch connector.

■ SPECIFICATION

Condition	Resistance between terminal 2 and 3(Ω)
When the switch is not operated	0
When the switch is operated	Infinite



Terminal 3: Exhaust brake signal
Terminal 2: Battery power

SNBFL8129L

   4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the exhaust brake switch and then go to "Verification of Vehicle Repair" procedure.

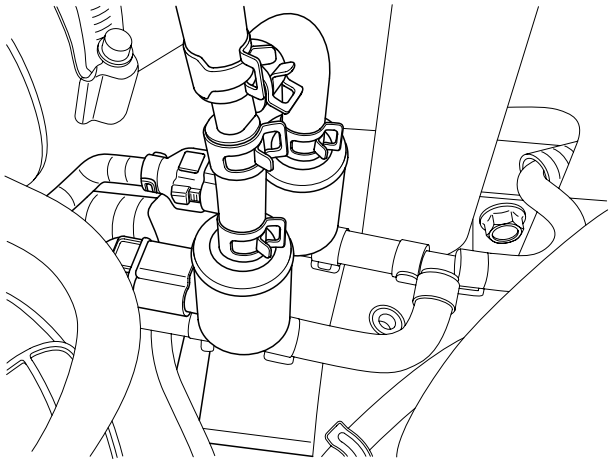
VERIFICATION OF VEHICLE REPAIR ECDD0C8D

Refer to DTC P0112.

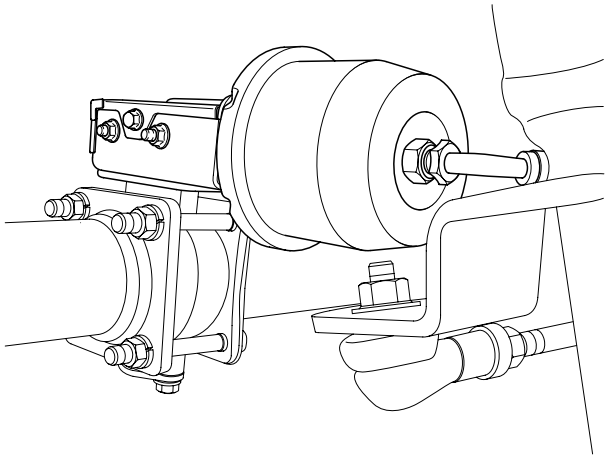
DTC P1232 EXHAUST BRAKE SHORT TO BATTERY

COMPONENT LOCATION EE08B0A6

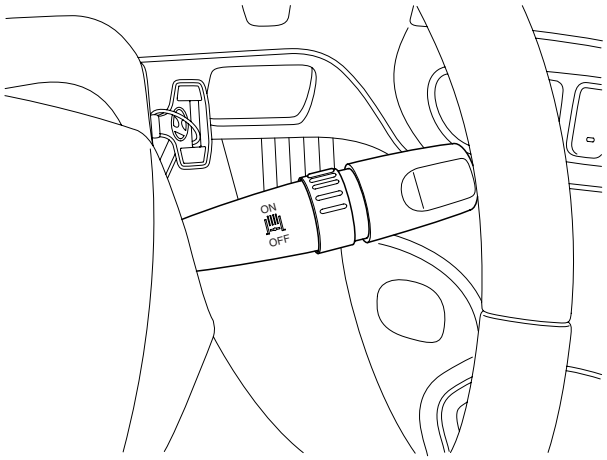
Exhaust brake valve and exhaust brake switch



3-way valve



Exhaust brake valve



Exhaust brake switch

SUDFL8506L

DESCRIPTION EA8E9550

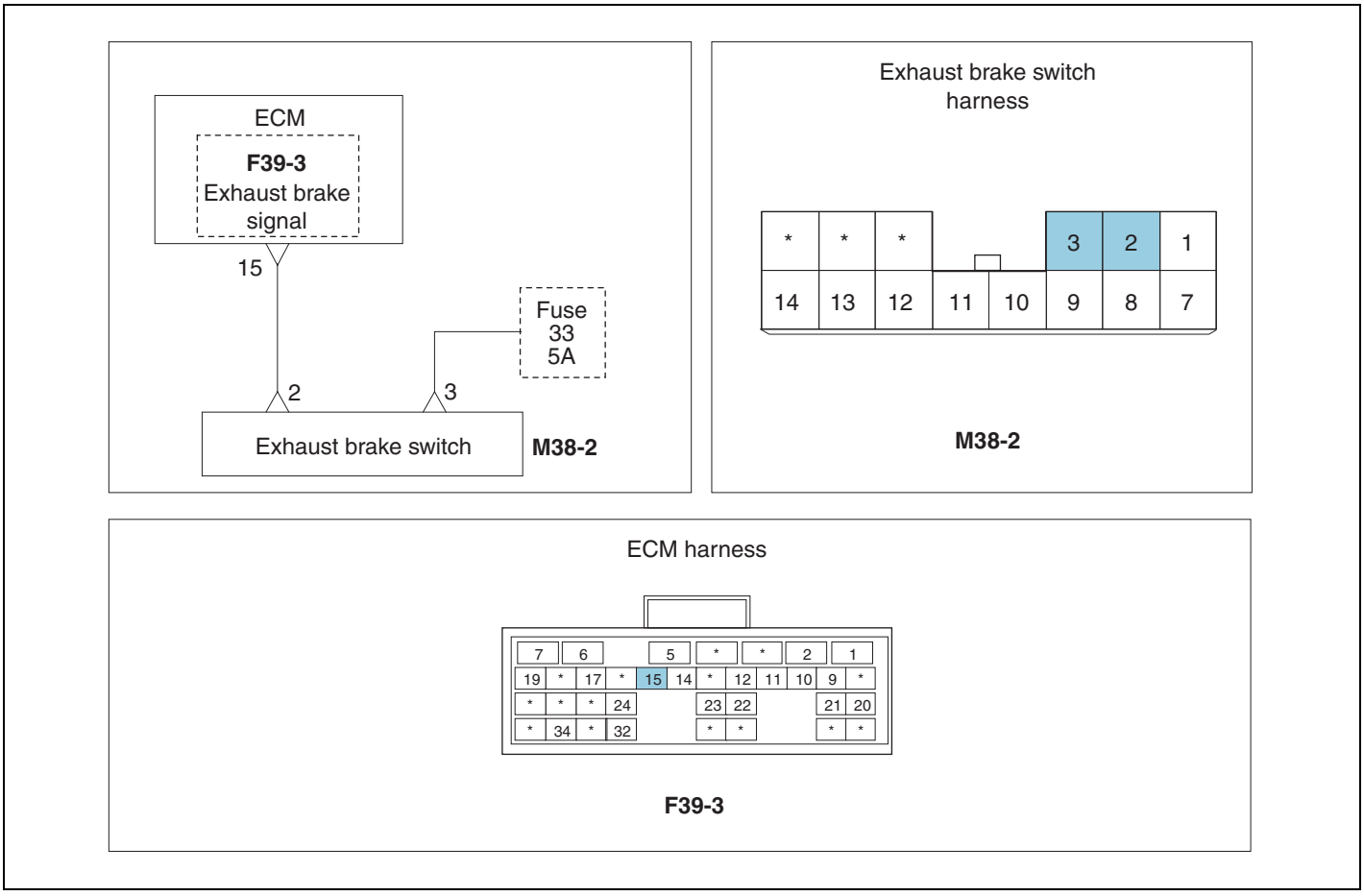
1. GENERAL DESCRIPTION
   The exhaust brake system which is the service brake(auxiliary device) is the vacuum type to use negative pressure. The exhaust brake system is composed of exhaust brake valve in the middle of exhaust pipe, exhaust brake switch of multi-function switch, 3-way magnet valve, vacuum tank and intake shutter equipped in the intake manifold to reduce intake noise.
   When the exhaust brake switch is operated under exhaust brake operating conditions, if the exhaust brake valve closes butterfly valve, pressure in the exhaust pipe rises and this pressure is applied to piston head and obtains brake force. At this moment, the intake shutter is also closed.
   If clutch pedal, accelerator pedal or exhaust brake switch is released, the electric circuit is cut off and exhaust brake is released.

2. DTC DESCRIPTION
Under exhaust brake non-operation conditions, if the exhaust brake is detected as operation for 3,004.5ms or more, the ECM judges this as a fault and DTC is set. The possible causes are short to terminal 15 of ECM connector(F39-3) and short to ground. In case of fail safe, the vehicle is possible to drive normally but the exhaust brake is not operated.

DTC DETECTING CONDITION E819E63C

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Check short to terminal 15(power) of ECM(F39-3).
Enable Conditions	• At IG ON			
Threshold Value	• When exhaust brake is operated under exhaust brake non-operation conditions			
Diagnosis Time	• 3,004.5ms or more			
Fail Safe	Fuel Cut	No	• Exhaust brake is not operated..Normal driving	
	Fuel Limit	No		
	MIL	OFF		

SCHEMATIC DIAGRAM ED68D48E



SNBFL8125L

MONITOR SCAN TOOL DATA EAFCB28A

1. Connect scan tool to the self-diagnosis connector.

2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Exhaust brake switch" parameter on the scan tool.

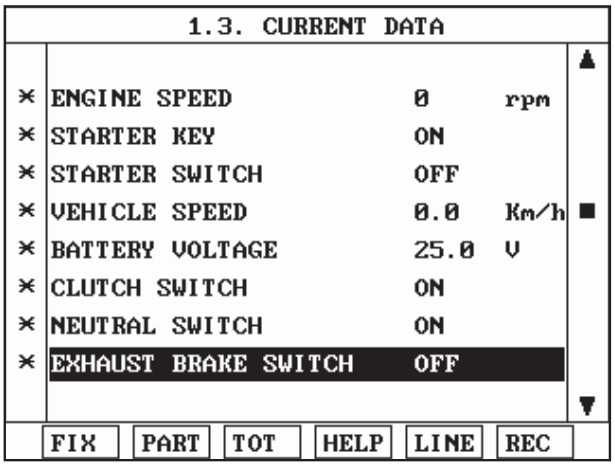


Fig. 1 Exhaust brake switch "OFF" data when it is not operated

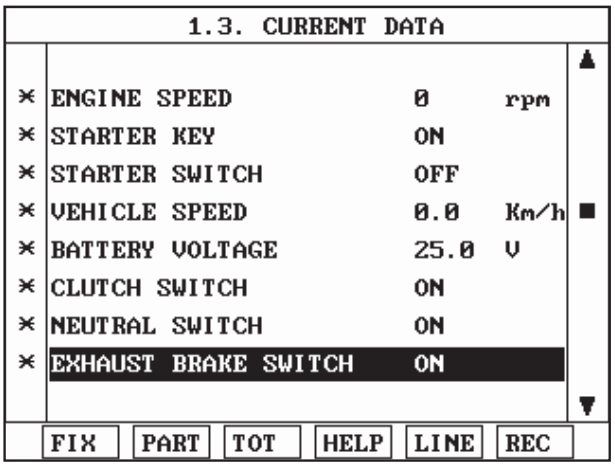
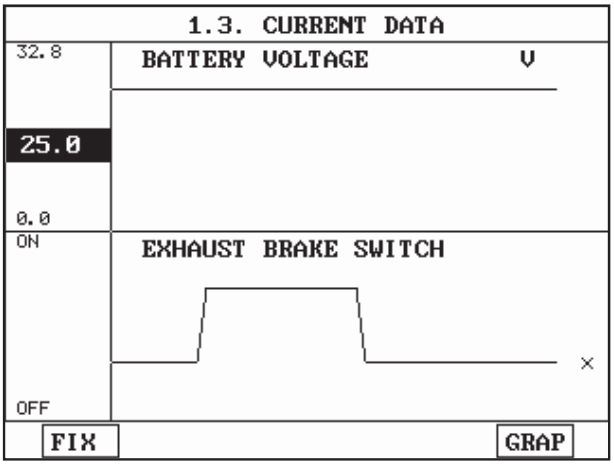


Fig. 2 Exhaust brake switch "ON" data when it is operated



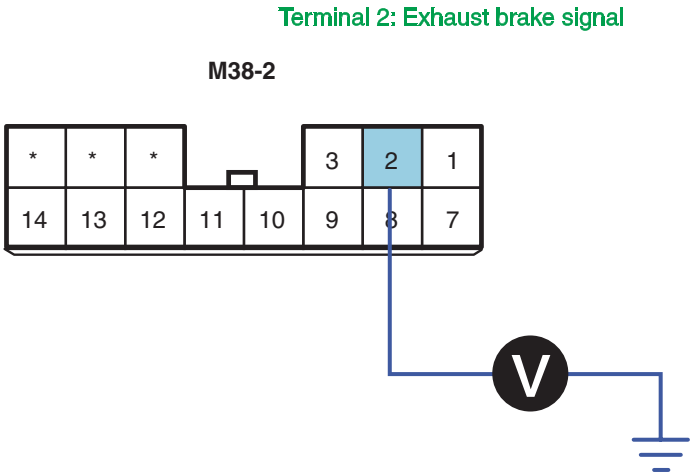
SUDFL8274L

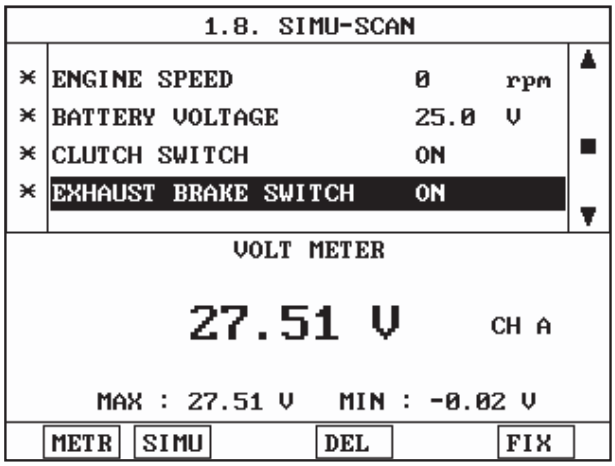
TERMINAL & CONNECTOR INSPECTION E1A50858

Refer to DTC P0112.

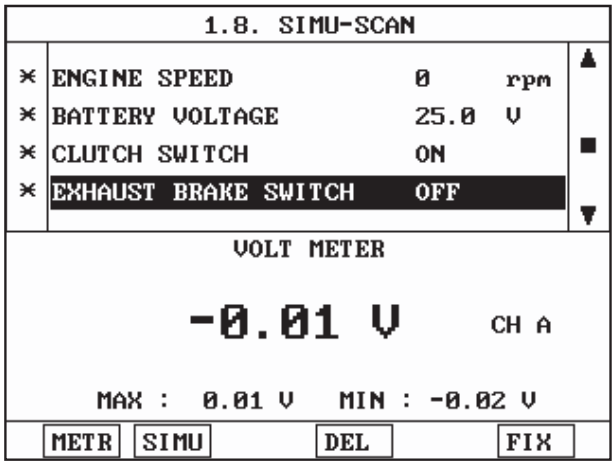
SIGNAL INSPECTION EFEEB0C7

1. Signal Voltage Inspection
   1) Leave the exhaust brake switch connector(M38-2) installed.
   2) Turn the ignition ON. The engine stops and the exhaust brake switch turns OFF.
   3) Measure voltage between terminal 2 of the exhaust brake switch harness connector and chassis ground.





▶ Exhaust brake switch (At IG ON)



▶ Exhaust brake switch (At IG OFF)

SNBFL8130L

■ Specification
Exhaust brake switch signal power : Approx. 0V(When the switch is OFF)
Exhaust brake switch signal power : Approx. B+V(When the switch is ON)

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

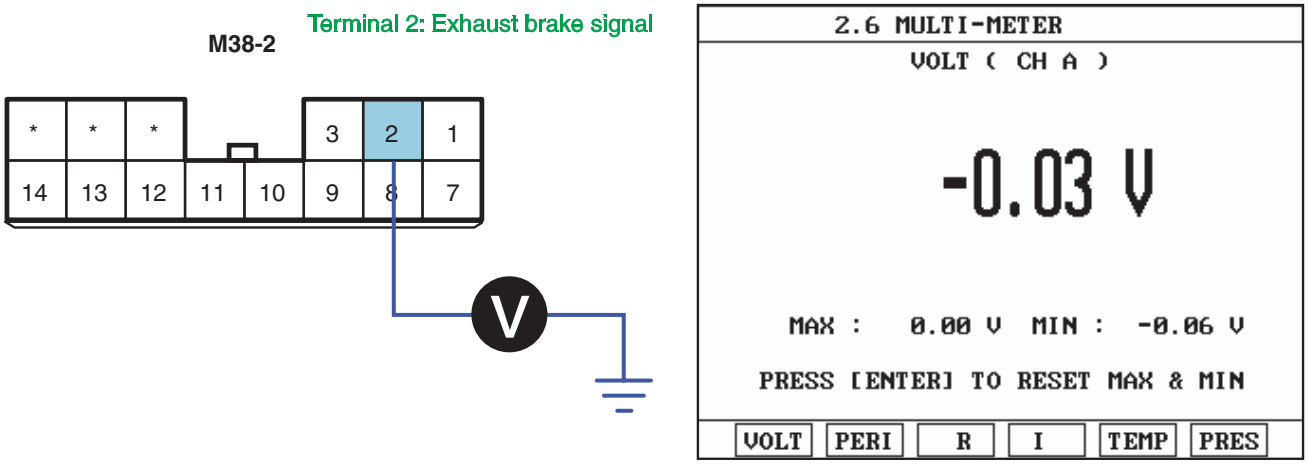
▶ Go to "Signal Short to Power Inspection" procedure.

2. Signal Short to Power Inspection

1) Disconnect exhaust brake switch connector(M38-2) and ECM connector(F39-3).

2) Turn the ignition ON. The engine stops and the exhaust brake switch turns OFF.

3) Measure voltage between terminal 2 of exhaust brake switch harness connector(M38-2) and chassis ground.



SNBFL8131L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION EC312EF4

1. Exhaust Brake Switch Visual Inspection

   1) Turn the ignition OFF.

   2) Disconnect exhaust brake switch connector(M38-2).

   3) Check terminal of the exhaust brake switch connector for corrosion, contamination.

   4) Is there any problem for the exhaust brake switch?

   YES

   ▶ Replace the exhaust brake switch if necessary and then go to "Verification of Vehicle Repair" procedure.

   NO

   ▶ Go to "Exhaust Brake Resistance Inspection" procedure

2. Exhaust Brake Resistance Inspection

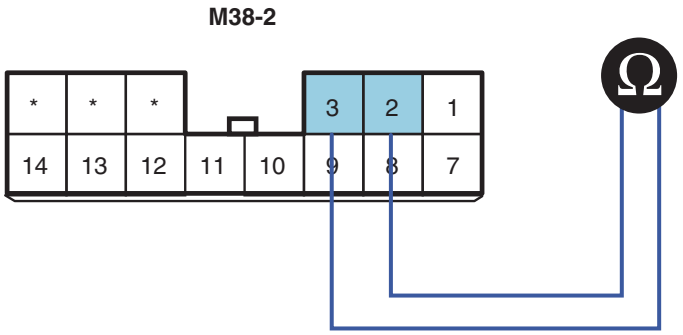
   1) Turn the ignition OFF.

   2) Disconnect exhaust brake switch connector(M38-2).

   3) Measure resistance between terminal 2 and 3 of exhaust brake switch connector.

■ SPECIFICATION

Condition	Resistance between terminal 2 and 3(Ω)
When the switch is not operated	0
When the switch is operated	Infinite



Terminal 3: Exhaust brake signal
Terminal 2: Battery power

SNBFL8129L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the exhaust brake switch and then go to "Verification of Vehicle Repair" procedure.

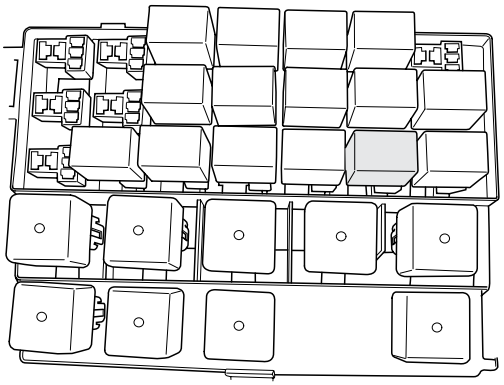
VERIFICATION OF VEHICLE REPAIR E23B140B

Refer to DTC P0112.

DTC P1383 GLOW RELAY SHORT TO POWER

COMPONENT LOCATION E4DD8CBB

Start relay



SPECIFICATION E11E7A6E

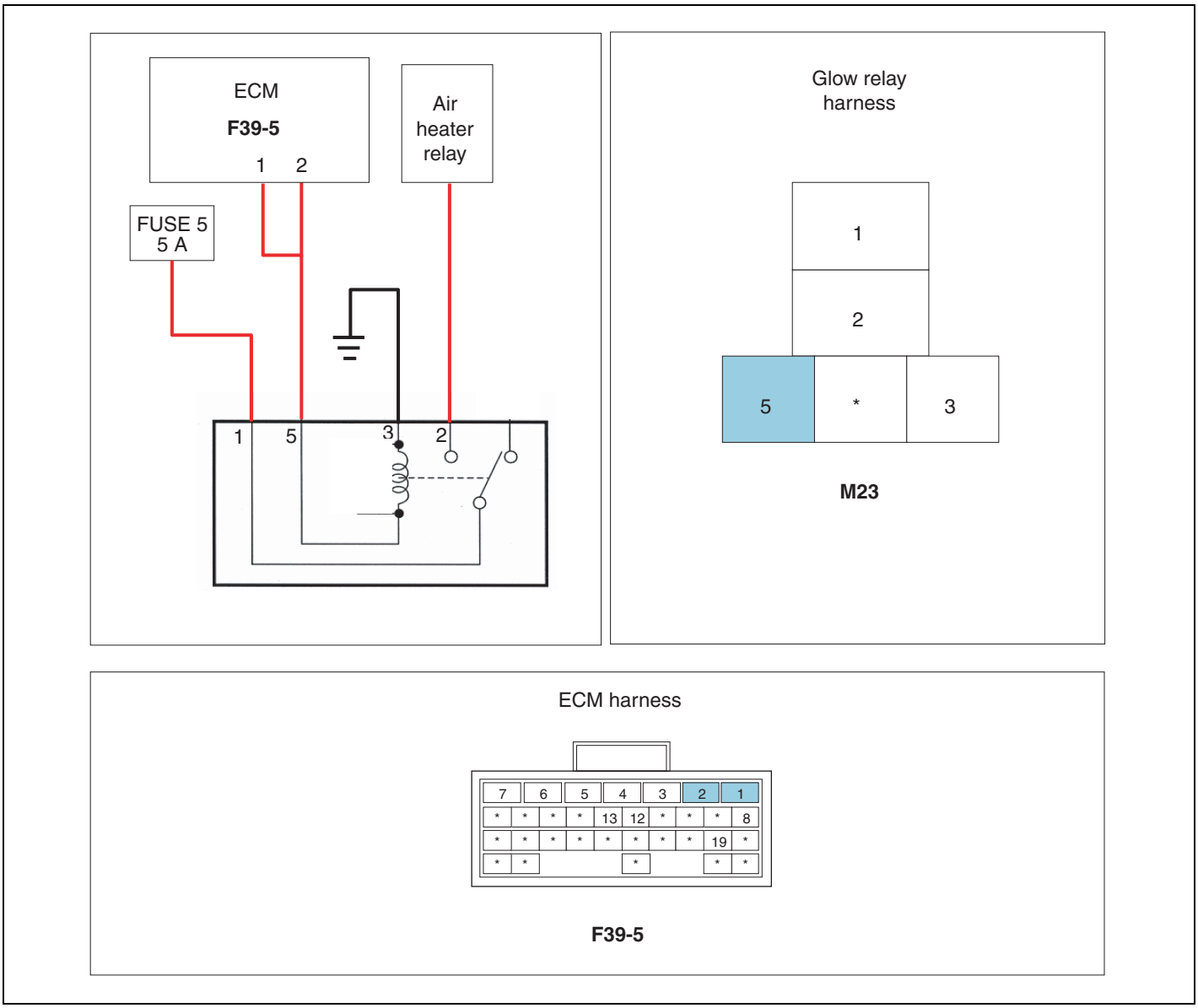
1. Specified resistance between relay terminals

Terminal 85-86 resistance(20℃)	Terminal 30-87a resistance	Terminal 85-86 when applying power
400Ω ±10%	0Ω (Continuity)	Terminal 30-87 0Ω (Continuity)

2. Specified voltage between relay connector terminals(At IG ON)

Terminal 86 voltage	Terminal 87a voltage	Terminal 30 voltage
B+ V	B+ V	B+ V

SCHEMATIC DIAGRAM E0281626



SNBFL8132L

TERMINAL & CONNECTOR INSPECTION EEDF12C3

Refer to DTC P0112.

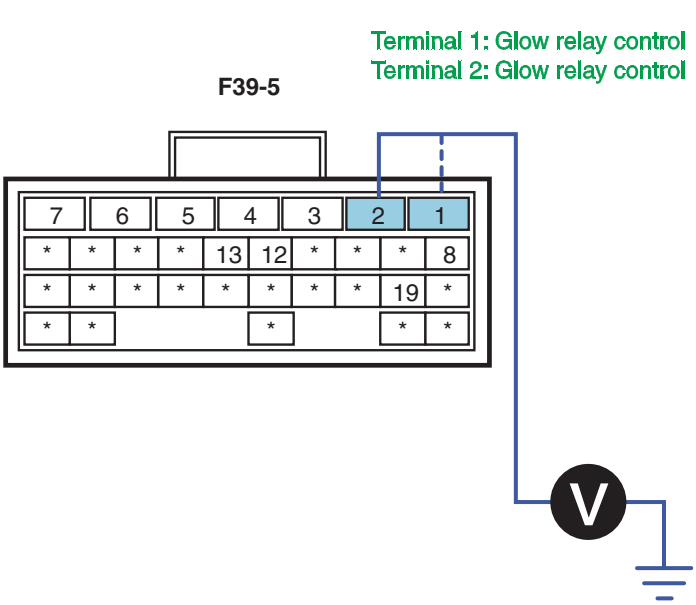
POWER SUPPLY VOLTAGE INSPECTION E0378AD4

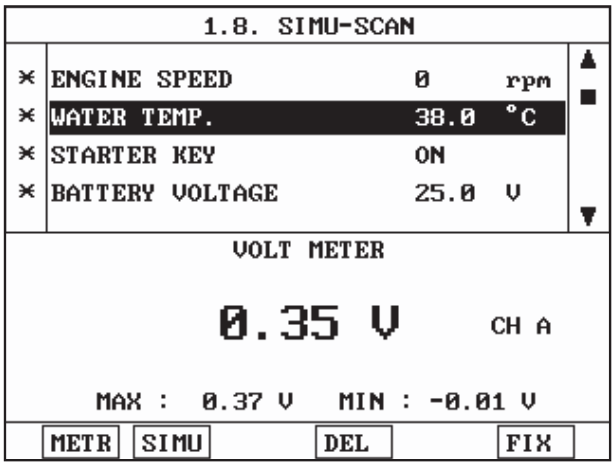
1. Power Supply Voltage Inspection

   1) Disconnect the glow relay(M23) and the engine temperature sensor(E07).

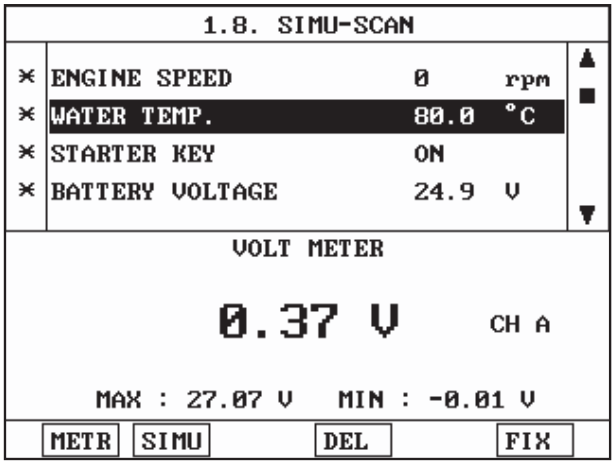
   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 1 and 2 of ECM connector(F39-5).





▶ With the engine coolant temperature sensor connected (Approx. 0.4V)



▶ With the engine coolant temperature sensor disconnected (Temperature: 80℃ fixing)

SNBFL8133L

■ Specification:
Glow relay control power approx. B+ V
Note) B+ V power detecting, approx. 0.4V power detecting after elapse of about 50 sec.

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

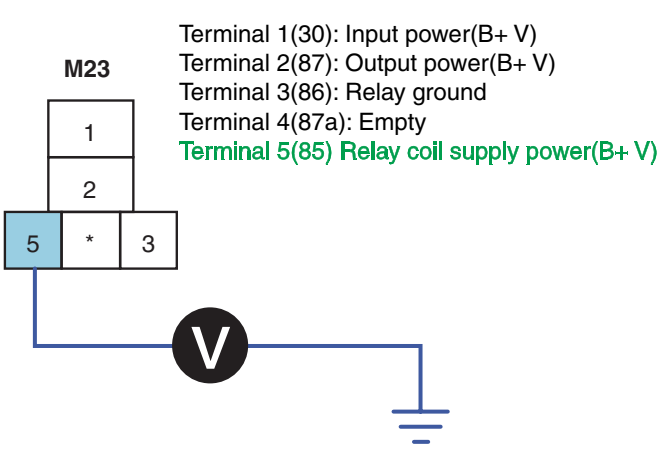
▶ Go to "Power Supply Short to Power Inspection" procedure.

2. Power Supply Short to Power Inspection

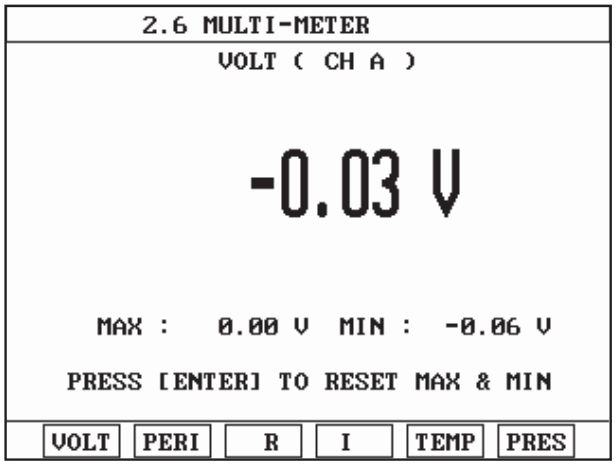
1) Disconnect glow relay(M23) and ECM connector(F39-5).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 5(85) of glow relay harness connector and chassis ground.



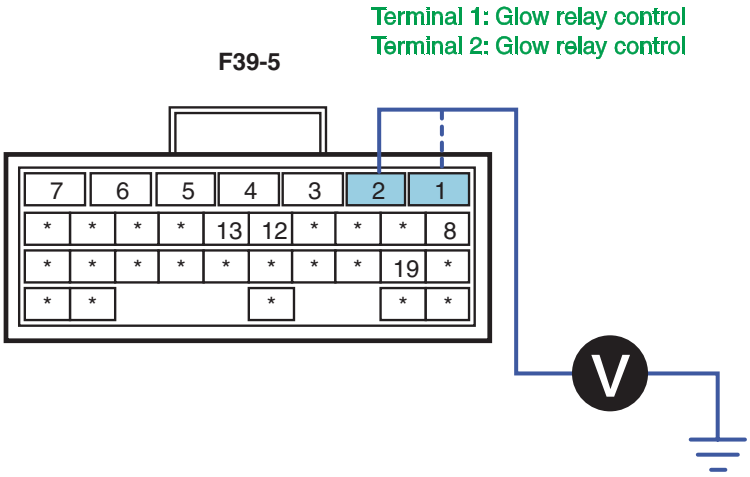
Terminal 1(30): Input power(B+ V)
Terminal 2(87): Output power(B+ V)
Terminal 3(86): Relay ground
Terminal 4(87a): Empty
Terminal 5(85) Relay coil supply power(B+ V)



SNBFL8134L

4) Measure terminals 1, 2 of ECM connector(F39-5) and chassis ground.

Terminal 1: Glow relay control
Terminal 2: Glow relay control



SNBFL8135L

■ Specification: Below 0~0.1V

5) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

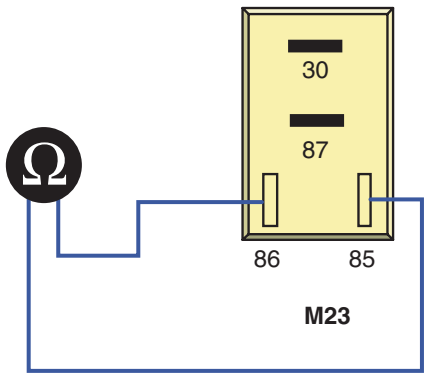
COMPONENT INSPECTION EB93E50A

1. Glow Relay Component Resistance Inspection

   1) Turn ignition OFF.

   2) Disconnect glow relay(M23).

   3) Measure resistance between terminals 85 and 86 of glow relay.



Terminal 1(30): Input power(B+ V)
Terminal 2(87): Output power(B+ V)
Terminal 3(86): Relay ground
Terminal 4(87a): Empty
Terminal 5(85) Relay coil supply power(B+ V)

SNBFL8136L

■ Specification: 400Ω ±10% (At 20℃)

   4) Is the resistance measured within specification?

YES

▶ Go to "Glow Relay Component Operation Inspection" procedure.

NO

▶ Replace the glow relay and then go to "Verification of Vehicle Repair" procedure.

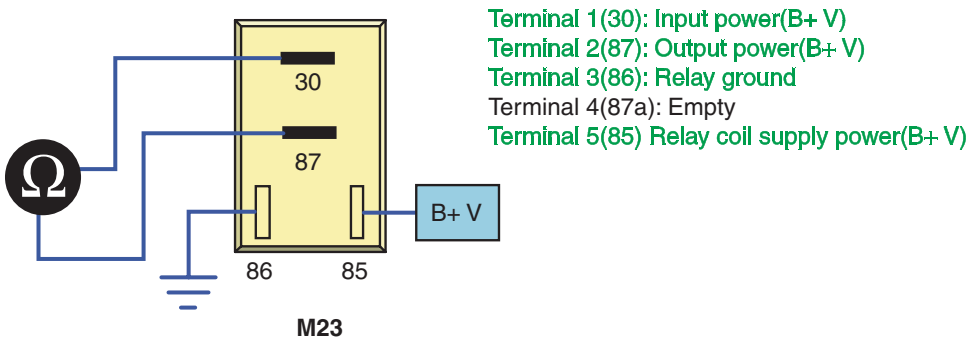
2. Glow Relay Component Operation Inspection

   1) Turn ignition OFF.

   2) Remove glow relay(M23).

   3) Connect B+ power to terminal 85 and - power to terminal 86 of glow relay coil.

   4) Measure resistance between terminal 30 and 87 of glow relay.



SNBFL8137L

■ Specification: Infinite(When applying power)
Continuity(When cutting off power)

5) Is the resistance measured normal according to condition?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the glow relay and then go to "Verification of Vehicle Repair" procedure.

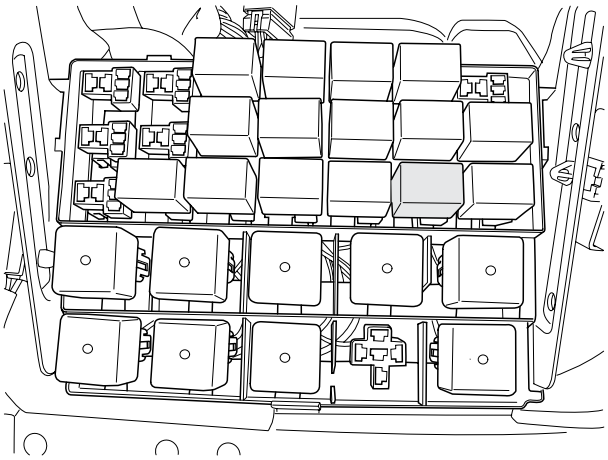
VERIFICATION OF VEHICLE REPAIR E9F023BC

Refer to DTC P0112.

DTC P1384 GLOW RELAY SHORT TO GROUND

COMPONENT LOCATION E7CE40B5

Start relay



SUDFL8340L

DESCRIPTION E637E641

1. Preheater plug(glow plug) heats intake air and makes initial start ability easy and works out well for diesel fuel injection when it is low temperature.
   The ECM controls preheater plug through preheater plug relay and controls preheater time according to engine temperature.

2. DTC DESCRIPTION
   If the glow relay operation is not detected for 3,000.2ms under operation condition of glow relay, the ECM judges this as a fault and DTC is set. The probable causes may be open in terminal 1,2 of ECM connector(F39-5), short to ground or glow relay malfunction.

DTC DETECTING CONDITION EEB5106C

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Check glow relay. • Check open in terminal 1,2 of ECM connector(F39-5) or short to ground.
Enable Conditions	• At IG ON			
Threshold Value	• When glow relay is not operated under operation condition			
Diagnosis Time	• 3,000.2ms or more			
Fail Safe	Fuel Cut	No		
	Fuel Limit	No		
	MIL	OFF		

SPECIFICATION E3ABDE46

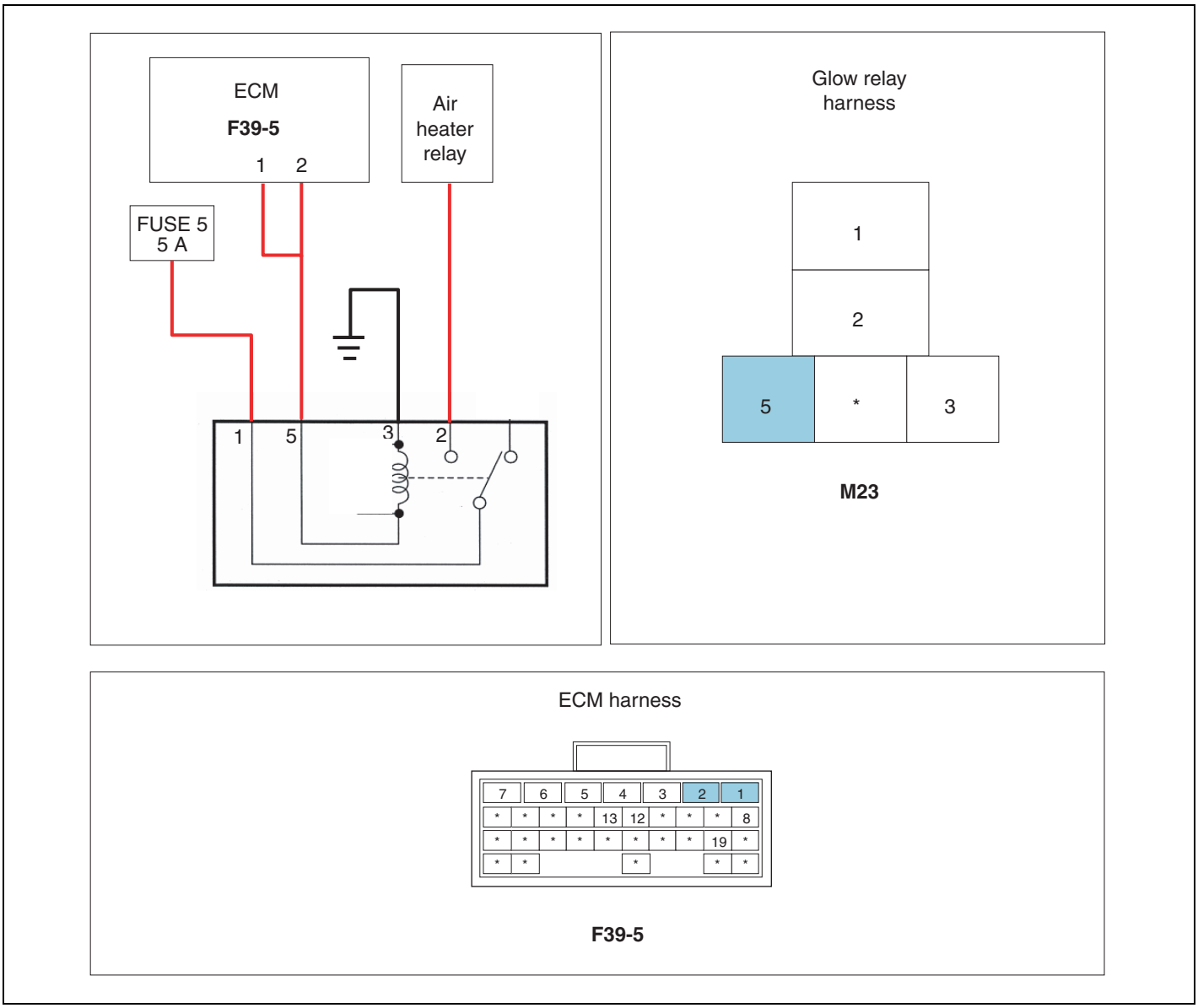
1. Specified resistance between relay terminals

Terminal 85-86 resistance(20℃)	Terminal 30-87a resistance	Terminal 85-86 when applying power
400Ω ±10%	0Ω (Continuity)	Terminal 30-87 0Ω (Continuity)

2. Specified voltage between relay connector terminals(At IG ON)

Terminal 86 voltage	Terminal 87a voltage	Terminal 30 voltage
B+ V	B+ V	B+ V

SCHEMATIC DIAGRAM E272AC34



SNBFL8132L

TERMINAL & CONNECTOR INSPECTION E94033C2

Refer to DTC P0112.

POWER SUPPLY VOLTAGE INSPECTION E389E2BE

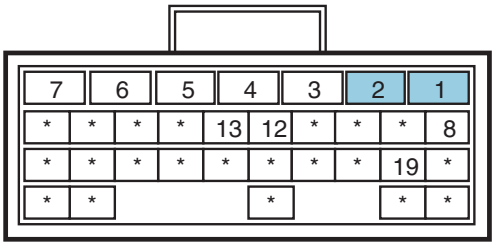
1. Power Supply Voltage Inspection

   1) Disconnect the glow relay(M23) and the engine temperature sensor(E07).

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 1 and 2 of ECM connector(F39-5).

Terminal 1: Glow rela



NO

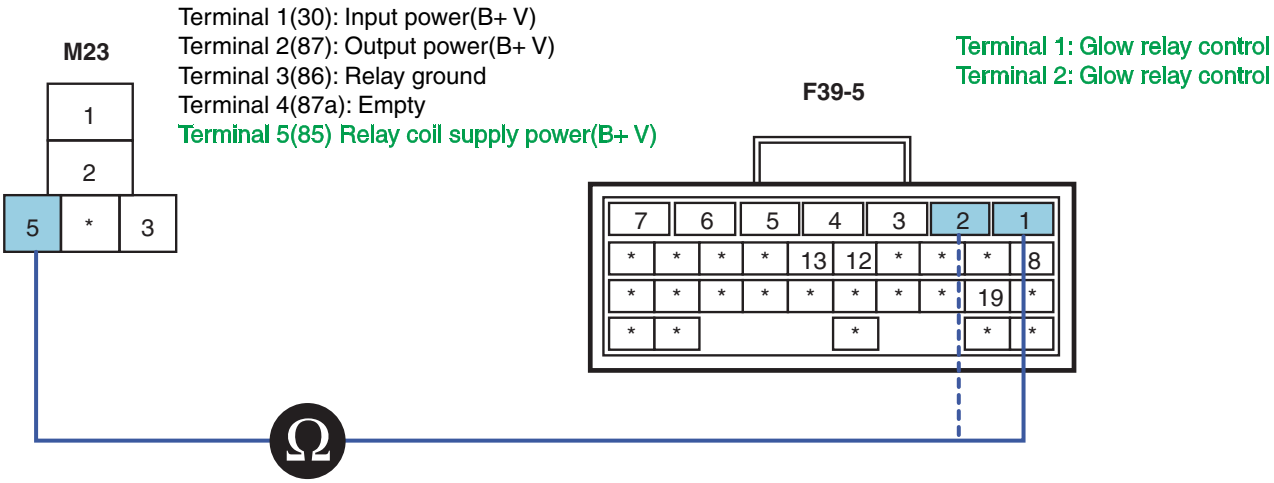
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn the ignition OFF.

2) Disconnect glow relay(M23) and ECM connector(F39-5).

3) Measure resistance between terminal 5 of glow relay harness connector and terminal 1,2 of ECM connector(F39-5).



SNBFL8138L

■ Specification: Continuity

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

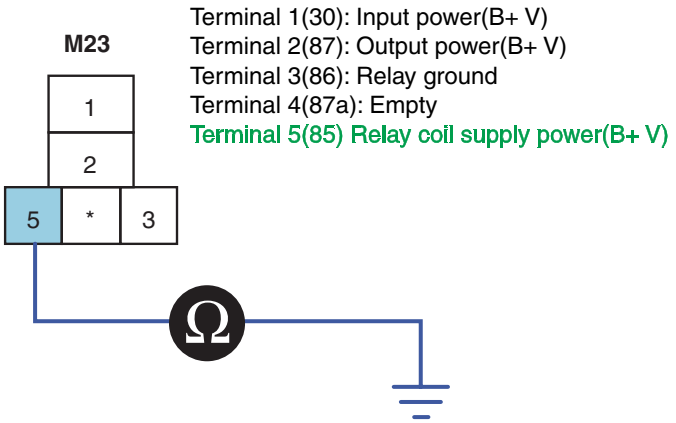
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

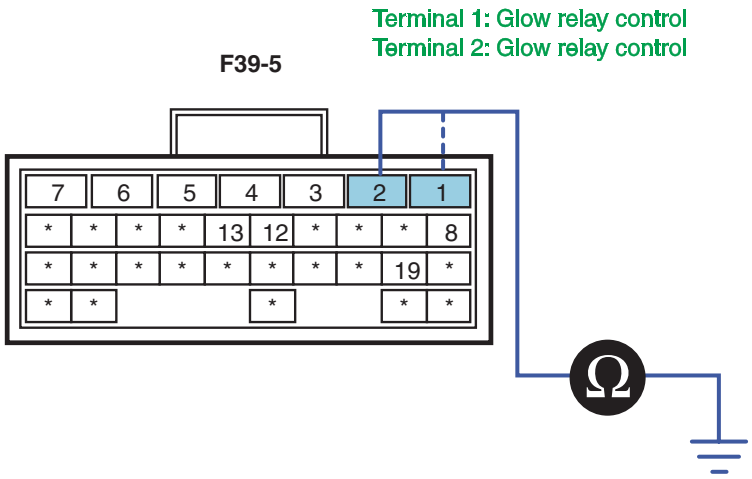
2) Disconnect the glow relay(M23) and the ECM connector(F39-5).

3) Measure resistance between terminal 5(85) of glow relay harness connector and chassis ground.



SNBFL8139L

4) Measure resistance between terminal 1,2 of ECM connector(F39-5) and chassis ground.



SNBFL8140L

■ Specification: Infinite

5) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E5B6AD09

1. Glow Relay Component Resistance Inspection

1) Turn ignition OFF.

2) Disconnect glow relay(M23).

3) Measure coil resistance between terminals 85 and 86 of glow relay.

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the glow relay and then go to "Verification of Vehicle Repair" procedure.

Repeat above operation checks 2 or 3 times.

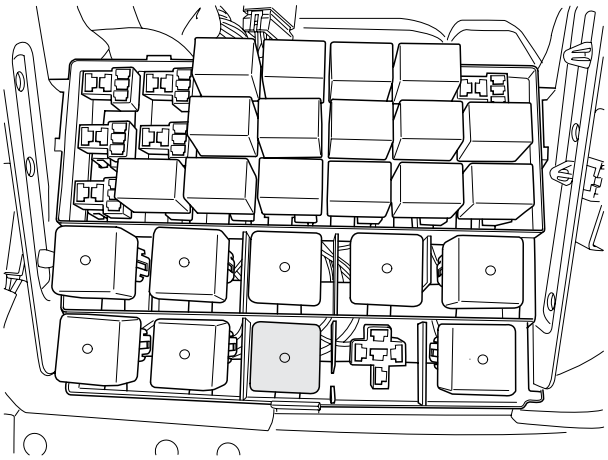
VERIFICATION OF VEHICLE REPAIR E07E6C9F

Refer to DTC P0112.

DTC P1616 MAIN RELAY MALFUNTION

COMPONENT LOCATION EBA61B16

Start relay



SUDFL8341L

DESCRIPTION E625BE90

1. The main relay works when the ignition turns on and supplies battery power to the ECM. It has function to supply battery power to various switches and actuators and to cut off battery power through junction box.
   When the ignition key is on, the main relay is operated and controls various solenoid, relay, switch as well as the ECM. Therefore, the main relay should be checked in detail.
   And it prevents danger due to wrong control and has function to cut off power to protect system.

2. DTC DESCRIPTION
   Even when ignition key turns off, if the main relay is operated and voltage of 16V or more is detected to terminal 5,6,7 of ECM(F39-4) for 2,097.1ms or more, the ECM judges this as a fault and DTC is set. The probable causes may be short to battery of terminal 5,6,7 of ECM connector(F39-4) and melted in main relay.

DTC DETECTING CONDITION E5011313

<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="5">• Check main relay.
• Short to power of terminal 5,6,7 of ECM connector(F39-4)</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• At IG ON/Running</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• When main relay is operated even when the ignition key turns off</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 2,097.1ms or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• Power is input due to short to power of terminal 5,6,7 of ECM(F39-4) even when the ignition turns off.
• Dark current occurs but there is no problem in driving(Discharge cause)</td></tr>
<tr><td>Fuel Limit</td><td>No</td></tr>
<tr><td>MIL</td><td>OFF</td></tr>
</table>

SPECIFICATION E0410936

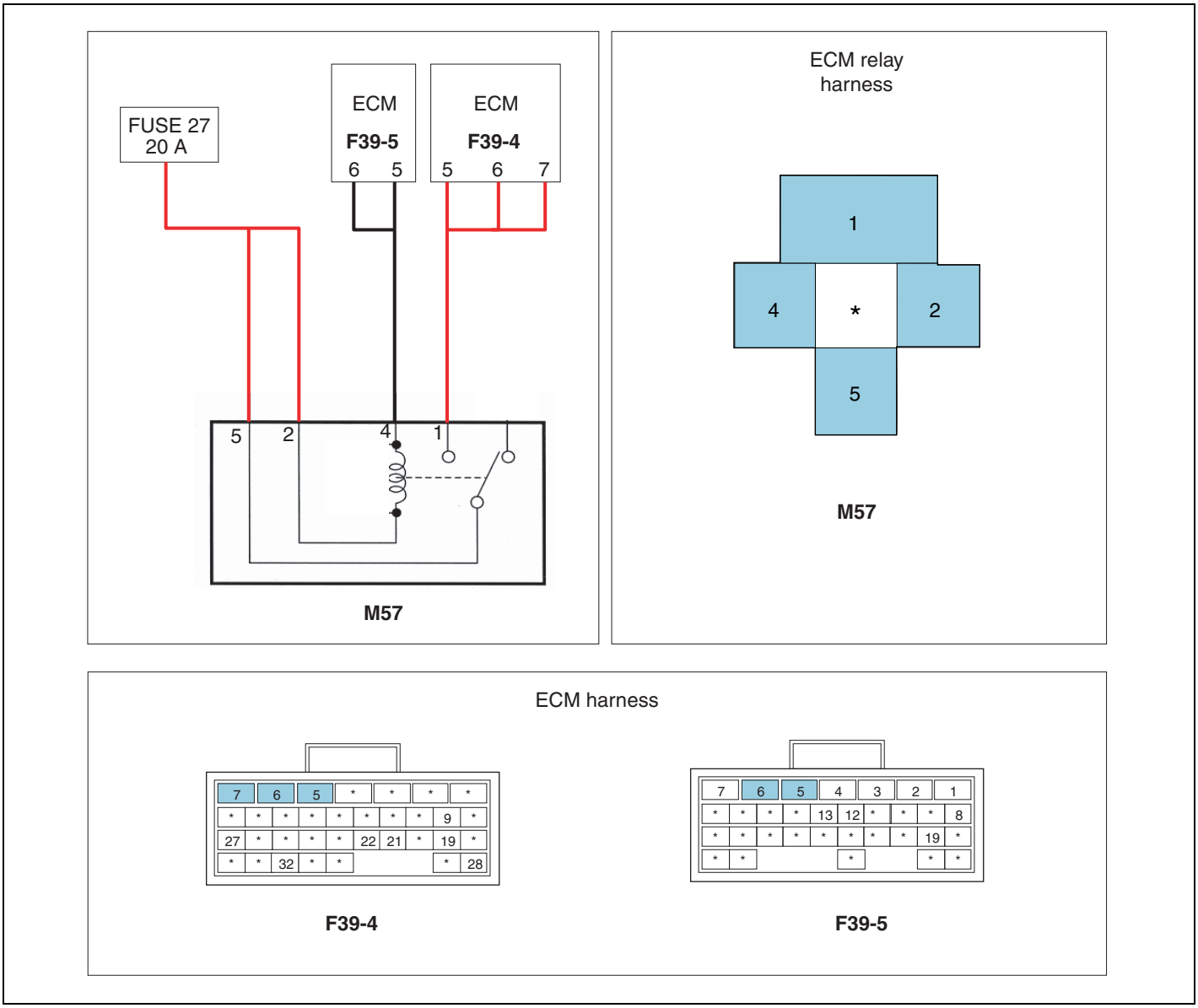
1. Specified resistance between relay terminals

Terminal 85-86 resistance(20℃)	Terminal 30-87a resistance	Terminal 85-86 when applying power
340Ω ±10%	0Ω (Continuity)	Terminal 30-87 0Ω (Continuity)

2. Specified voltage between relay connector terminals(At IG ON)

Terminal 86 voltage	Terminal 87a voltage	Terminal 30 voltage
B+ V	B+ V	B+ V

SCHEMATIC DIAGRAM E7CB4F4B



SNBFL8141L

MONITOR SCAN TOOL DATA E58E0C3D

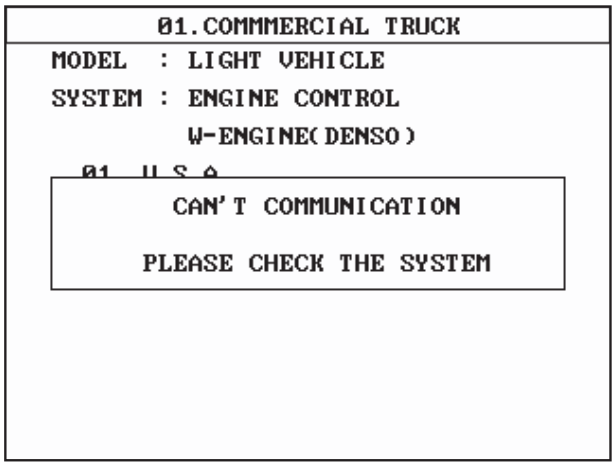
1. Self Diagnosis Inspection

   1) Turn the ignition OFF and the engine stops.

   2) Connect scan tool to the self-diagnosis connector(M72).

   3) Turn the ignition ON.

   4) Select vehicle model and system to diagnose and press " ENTER" .



SUDFL8291L

5) Is there any communication between system and scan tool?

YES

▶ Go to "System" procedure.

NO

▶ Turn the ignition off and disconnect the scan tool. After repeating above 2 or 3 times, if the same symptom occurs, go to "Inspection and Repair" procedure.

TERMINAL & CONNECTOR INSPECTION E4D5B547

Refer to DTC P0112.

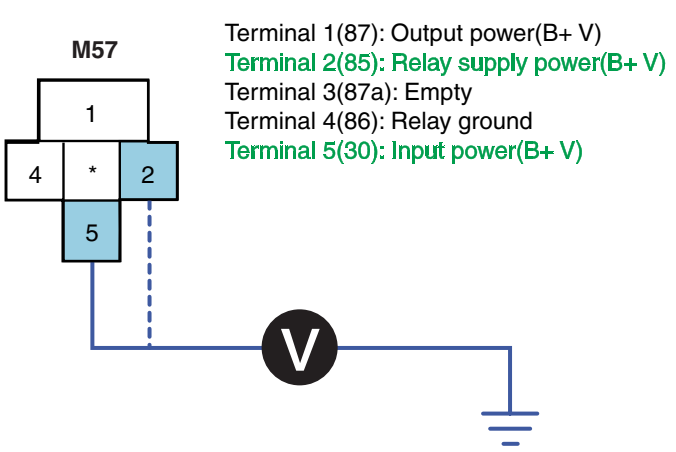
POWER SUPPLY VOLTAGE INSPECTION ED47FC13

1. ECM Relay Power Supply Voltage Inspection

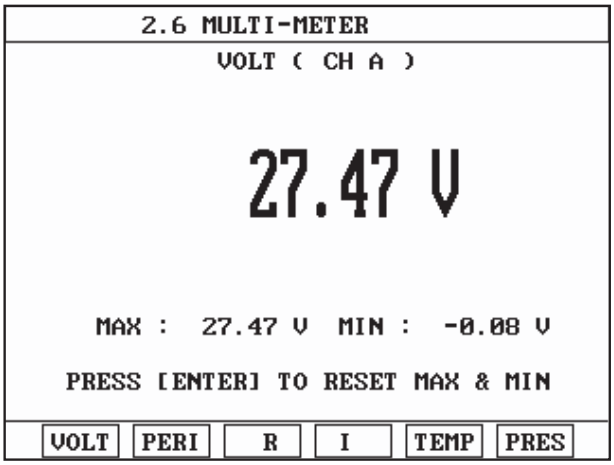
   1) Disconnect the ECM relay(M57).

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 2(85), 5(30) of ECM connector.



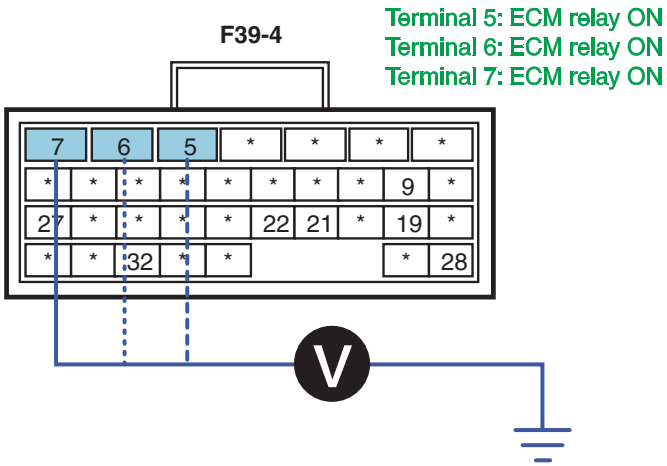
Terminal 1(87): Output power(B+ V)
Terminal 2(85): Relay supply power(B+ V)
Terminal 3(87a): Empty
Terminal 4(86): Relay ground
Terminal 5(30): Input power(B+ V)



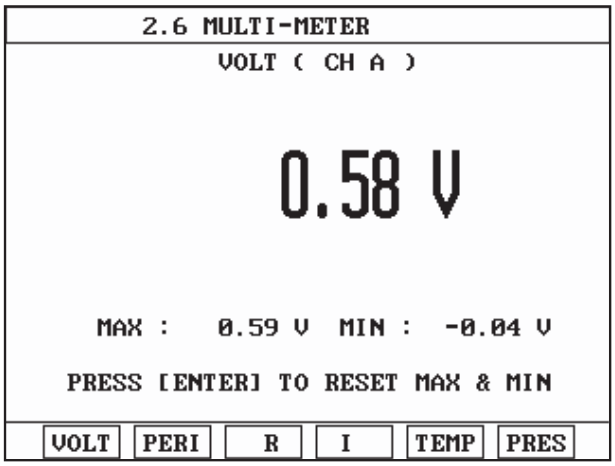
SNBFL8142L

■ Specification:
Battery power of ECM relay side: B+ V

4) Measure voltage between terminal 5,6,7 of ECM connector(F39-4).



Terminal 5: ECM relay ON
Terminal 6: ECM relay ON
Terminal 7: ECM relay ON



SNBFL8143L

■ Specification:
Battery power of ECM side: Approx. 0.8V

5) Is the voltage measured within specification?

YES

▶ Go to "ECM Power Supply Voltage Inspection" procedure if there is battery power(B+V) or more.

NO

▶ Go to "ECM Relay Power Supply Open Inspection" procedure if there is below 1 V, go to "ECM relay Power Supply Short to Power Inspection" procedure if there is below battery voltage(B+ V).

2. ECM Power Supply Voltage Inspection

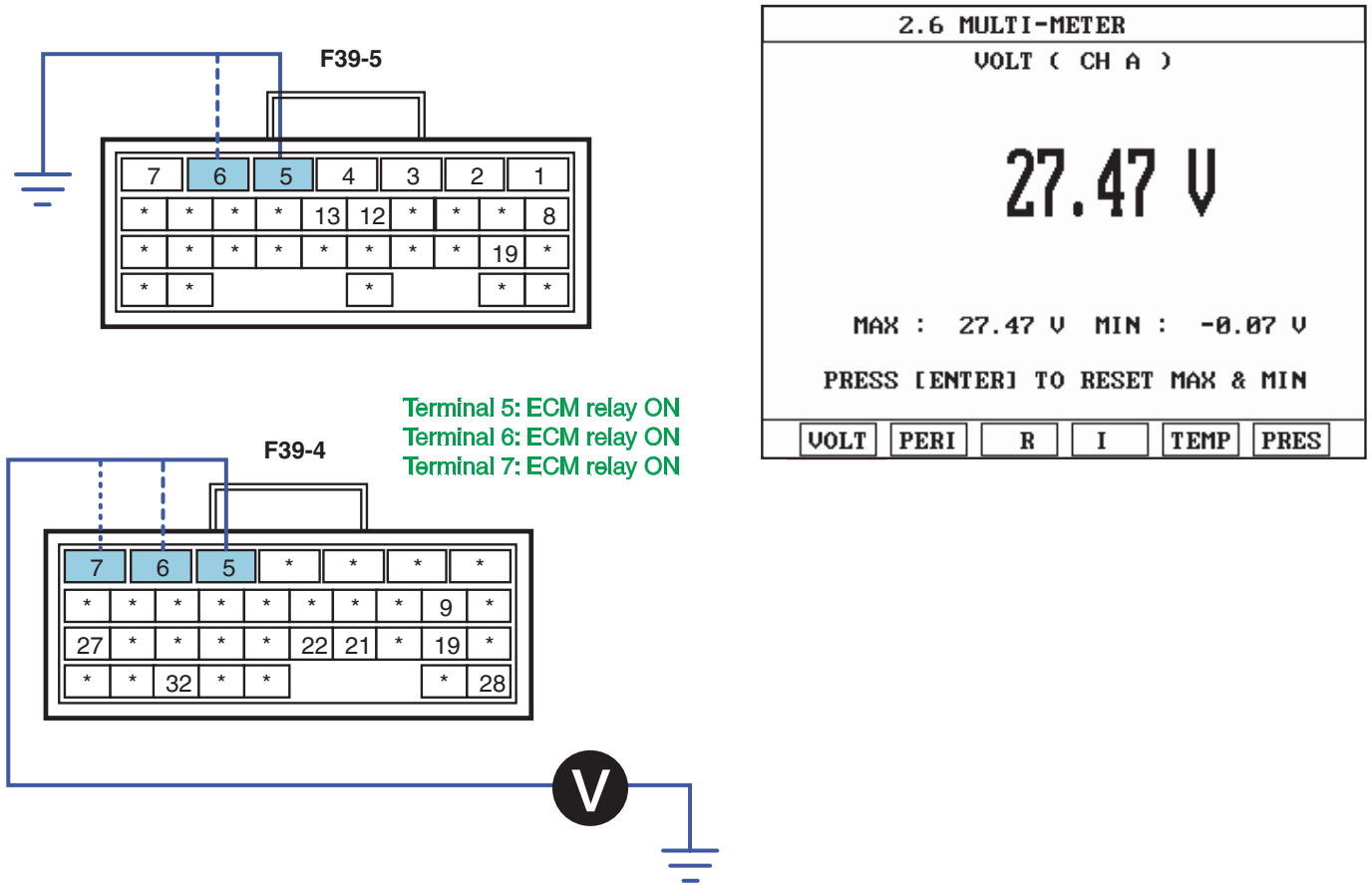
1) Leave the ECM relay(M57) connected.

2) Disconnect the ECM connector(F39-4, F39-5).

3) Using jump cable, connect terminal 5, 6 of ECM(F39-5) to the ground.

4) Turn the ignition ON. The engine stops.

5) Measure voltage between terminal 5,6,7 of ECM connector(F39-4) and chassis ground.



SNBFL8144L

■ Specification: Battery power(B+ V)

6) Is the voltage measured within specification?

YES

▶ Go to "Ground Inspection" procedure if there is above battery power(B+ V).

NO

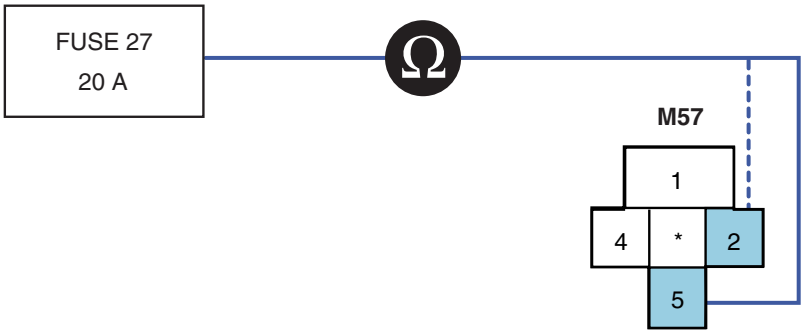
▶ Go to "ECM Relay Power Supply Open Inspection" procedure if there is below 0 V.
▶ Go to "ECM Relay Power Supply Short to Power Inspection" procedure if there is "0~below battery power(B+ V)".

3. ECM Relay Power Supply Open Inspection

1) Turn the ignition OFF.

2) Disconnect the ECM relay(M57) and ECM connector(F39-4, F39-5).

3) Disconnect fuse 20(20A) and measure resistance between terminal of fuse 20 and terminal 2(85), 5(30) of ECM harness connector.

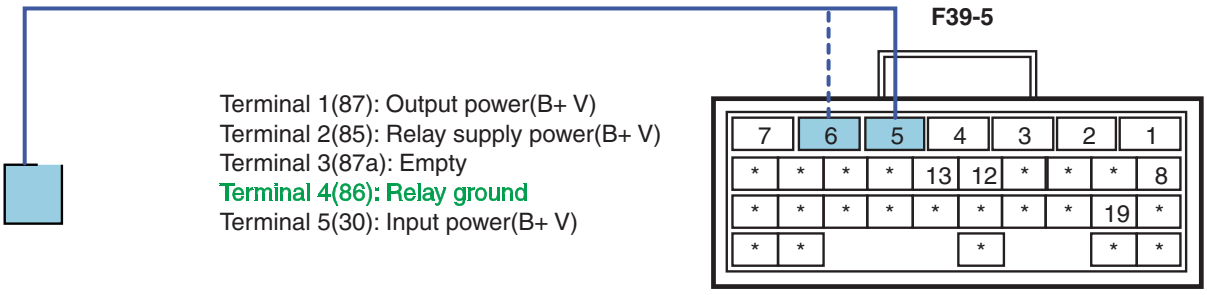


Terminal 1(87): Output power(B+ V)
Terminal 2(85): Relay supply power(B+ V)
Terminal 3(87a): Empty
Terminal 4(86): Relay ground
Terminal 5(30): Input power(B+ V)

SNBFL8145L

4) Measure resistance between terminal 4(86) of ECM relay harness connector and terminal 5,6 of ECM connector(F39-5).

Terminal 5 : ECM control(ground)
Terminal 6 : ECM control(ground)



Terminal 1(87): Output power(B+ V)
Terminal 2(85): Relay supply power(B+ V)
Terminal 3(87a): Empty
Terminal 4(86): Relay ground
Terminal 5(30): Input power(B+ V)

6) Is the resistance measured within specification?

YES

▶ Go to "ECM Relay Power Supply Short to Power Inspection" procedure.

NO

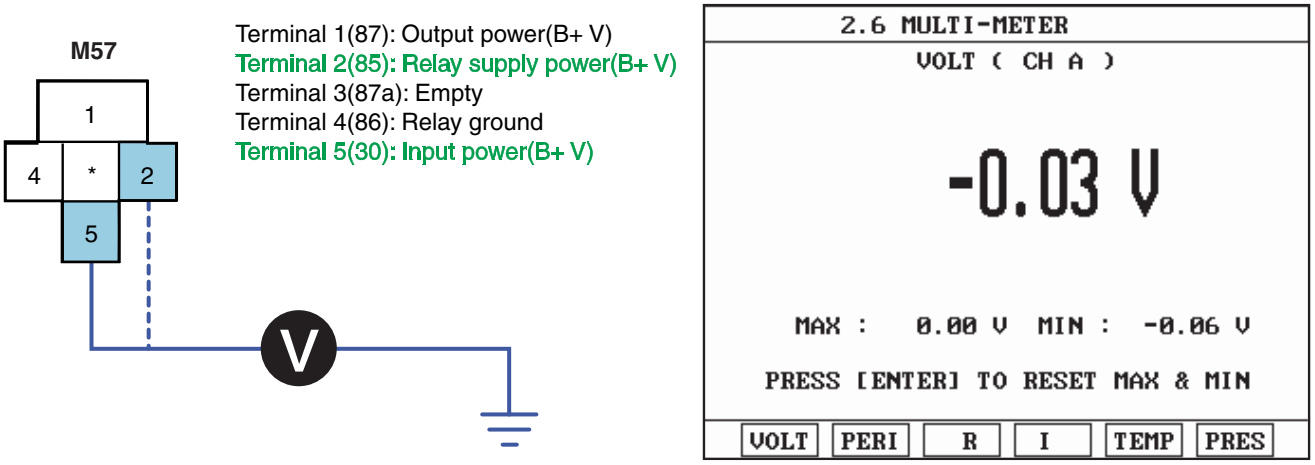
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

4. ECM Relay Power Supply Short to Power Inspection

1) Disconnect fuse 20(20A), ECM relay(M57) and the ECM connector(F39-4, F39-5).

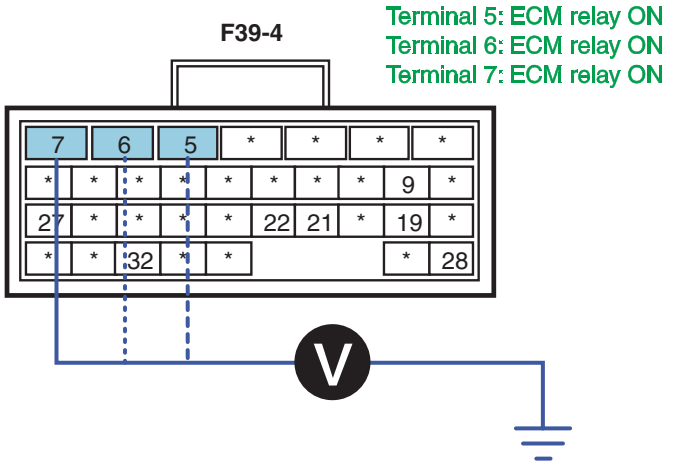
2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 2(85), 5(30) of ECM relay harness connector and chassis ground.



SNBFL8148L

4) Measure voltage between terminal 5,6,7 of ECM connector(F39-4) and chassis ground.



SNBFL8149L

■ Specification: Below 0~0.1V

5) Is the voltage measured within specification?

YES

▶ Go to "Ground Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of Vehicle Repair" procedure.

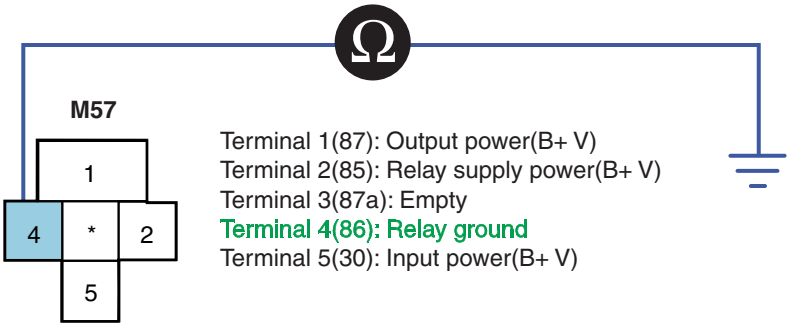
GROUND CIRCUIT INSPECTION E93F1A80

1. Ground Inspection

   1) Turn the ignition OFF.

   2) Disconnect ECM relay connector(M57) and ECM connector(F39-4, F39-5).

   3) Measure resistance between terminal 4(86) of ECM relay harness connector and chassis ground.



SNBFL8150L

■ Specification: Infinite

   4) Is the resistance measured within specification?

YES

▶ Go to "ECM Ground Inspection" procedure.

NO

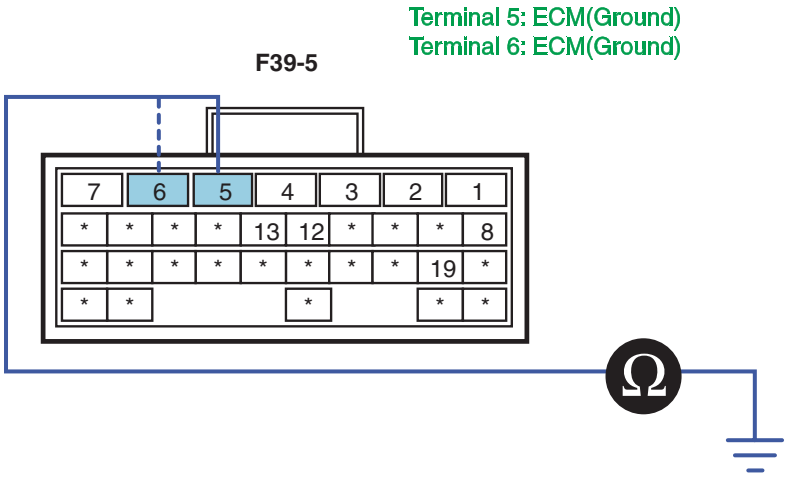
▶ Repair short to ground or poor connection and then go to "Verification of Vehicle Repair" procedure.

2. ECM Ground Inspection

   1) Turn the ignition OFF.

   2) Disconnect ECM relay(M57) and ECM connector(F39-4, F39-5).

   3) Measure resistance between terminal 5,6 of ECM connector(F39-5) and chassis ground.



SNBFL8151L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair short to ground or poor connection and then go to "Verification of Vehicle Repair" procedure.

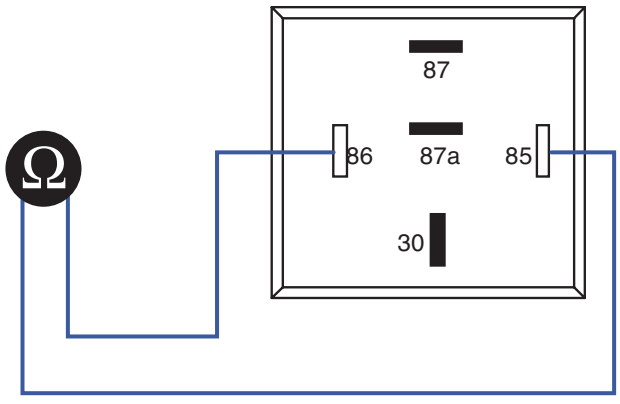
COMPONENT INSPECTION E0340095

1. ECM Relay Component Resistance Inspection

1) Turn ignition OFF.

2) Disconnect ECM relay(M57).

3) Measure coil resistance between terminals 85 and 86 of ECM relay.



Terminal 1(87): Output power(B+ V)
Terminal 2(85): Relay supply power(B+ V)
Terminal 3(87a): Empty
Terminal 4(86): Relay ground
Terminal 5(30): Input power(B+ V)

SUDFL8302L

■ Specification: 340Ω ±10% (At 20℃)

4) Is the coil resistance measured within specification?

YES

▶ Go to "Glow Relay Component Operation Inspection" procedure.

NO

▶ Replace the ECM relay and then go to "Verification of Vehicle Repair" procedure.

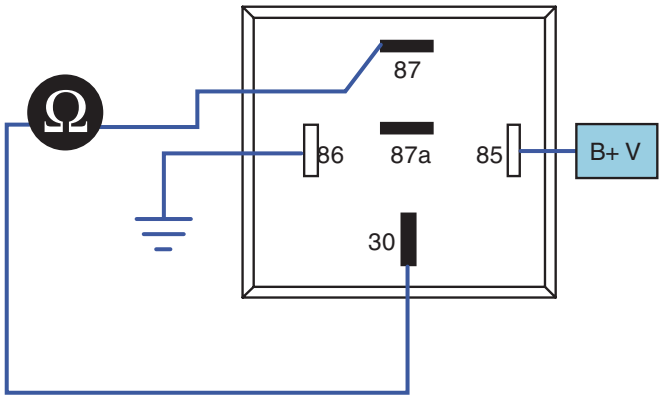
2. ECM Relay Component Operation Inspection

1) Turn ignition OFF.

2) Remove ECM relay(M57).

3) Connect B+ power to terminal 85 and - power to terminal 86 of ECM relay coil.

4) Measure resistance between terminal 30 and 87 of ECM relay.



Terminal 1(87): Output power(B+ V)
Terminal 2(85): Relay supply power(B+ V)
Terminal 3(87a): Empty
Terminal 4(86): Relay ground
Terminal 5(30): Input power(B+ V)

SUDFL8303L

■ Specification: Infinite(When applying power)
Continuity(When cutting off power)

5) Is the resistance measured normal according to condition?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the ECM relay and then go to "Verification of Vehicle Repair" procedure.

Repeat above operation checks 2 or 3 times.

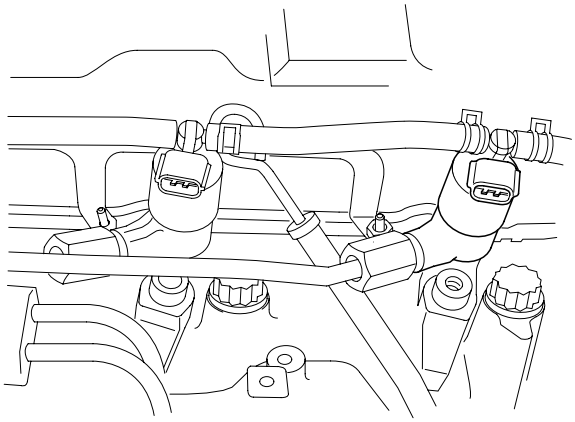
VERIFICATION OF VEHICLE REPAIR E589D3E3

Refer to DTC P0112.

DTC P2146 INJECTION COMMON #1 OPEN CIRCUIT

COMPONENT LOCATION EFBA38FB

Injector



SUDFL8098L

DESCRIPTION E76EE03C

1. GENERAL DESCRIPTION
   Injector carries out function to inject fuel amount calculated by ECM by making diesel spread with small particles to combustion chamber compressed with high pressure. Fuel injected generates power through combustion process.
   Purpose to increase fuel pressure of common rail diesel engine up to Max. 1,600 bar is to make fuel into small particles, small particles of fuel are related to smoke reduction, high power of engine, fuel consumption improvement etc.
   Also, hydraulic servo type is used to control fuel pressure of 1,600 bar with solenoid, injector solenoid is driven by current after increasing solenoid driving voltage up to 135V.
   Multi injection is possible by applying fuel injection which is not mechanic injector but electric control injector.
   ECM injects fuel after dividing into two stages of pilot injection and main injection and it is possible to control Injection time and injection amount independently to each cylinder. Power, torque, exhaust gas, fuel consumption improvement etc. can be optimized by controlling engine to optimum fuel injection amount.

2. DTC DESCRIPTION
   If crank rotating angle is 4499.0 degree or more due to the open in harness of injectors #1 and #4, ECM judges this as a fault and DTC is set. The possible causes are open in terminal 2, 3, 5, 6 of ECM connector(F39-2) and wiring problem etc.
   Lack of engine power will occur since fuel amount is limited to below 40mm³/st in case of fail safe. There may cause damage to engine if the vehicle is driven for a long time with faulty injector.

DTC DETECTING CONDITION E3647426

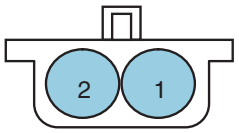
Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Open in harness of terminal 2,3,5,6 of ECM connector(F39-2) • Wiring problem
Enable Conditions	• Ignition ON			
Threshold Value	• Open in harness of injectors #1, #4 simultaneously			
Diagnosis Time	• 4,499.0 CA(Crank angle) or more			
Fail Safe	Fuel Cut	No	• Fuel amount is limited to below 40mm³/st . • Lack of engine power	
	Fuel Limit	Yes		
	MIL	ON		

SPECIFICATION E7C52568

Injector resistance(terminal-to-terminal)

Item	Specification
Resistance	0.45Ω (At 20˚C)
Injector driving voltage	135V
Injector driving current	20A
Injector control type	Current control

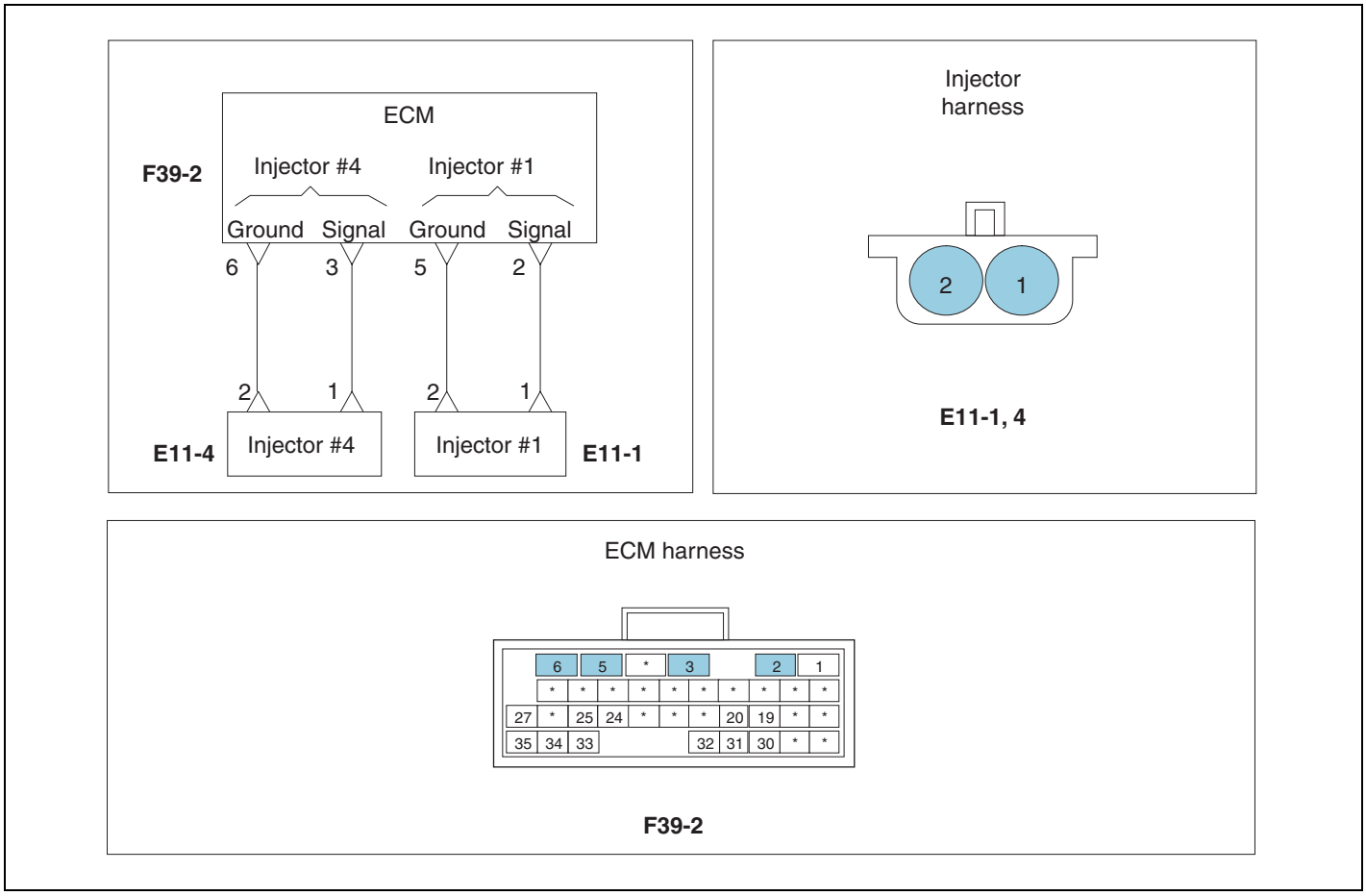
Terminal 1: Signal
Terminal 2: Ground



Sensor connector

SUDFL8099L

SCHEMATIC DIAGRAM EDD8541F



SNBFL8152L

SIGNAL WAVEFORM E9643D10

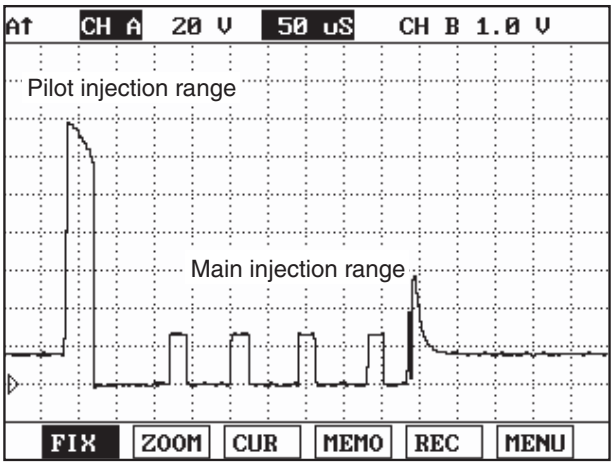


Fig. 1 Low side waveform when activating injector(Ground side)

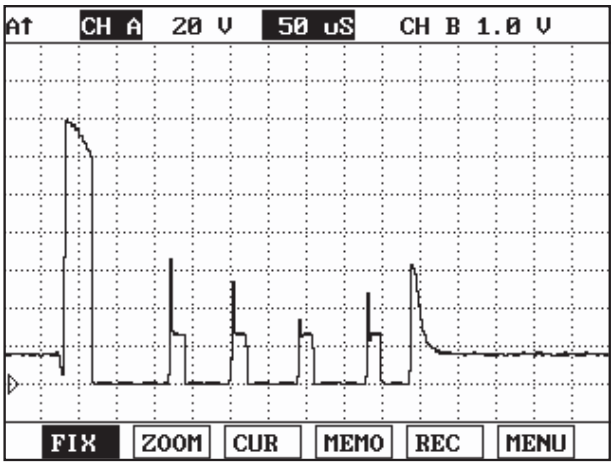


Fig. 2 High side injector power waveform(Signal side)

Fig.1) is divided into pilot injection range and main injection range as low side waveform when activating injector.
Fig.2) is high side injector power waveform.

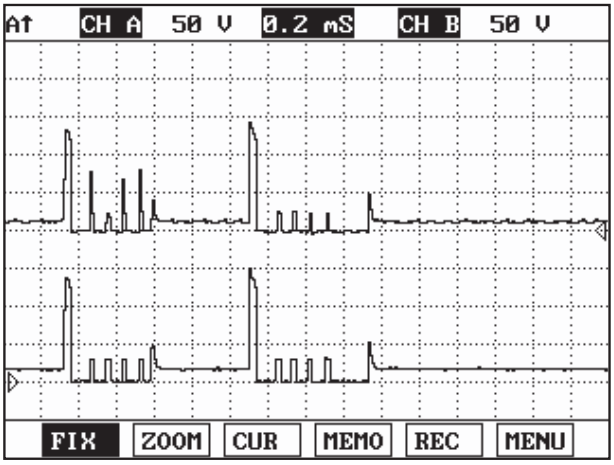


Fig. 3 Injector power waveform combined with High/Low side

SUDFL8101L

NOTE

Waveforms of Fig.1) and Fig.2) are displayed by turns in the course of checking injector waveform in LOW side. The reason that the waveform like a Fig.2) is displayed is used in LOW side in common the power of HIGH side of injector #1, #4 or injector #2, #3 which is not activated.

MONITOR SCAN TOOL DATA E34689E8

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Fuel injection amount" parameter on the scan tool.

NOTE

The scan tool data indicate engine rpm information related to "Fuel injection amount" parameter depending on DTC detecting conditions. Be sure to check that "Fuel amount" is limited to below 40㎣/st in case of fail safe.

■ Specification: Fuel amount - Approx. 9.0~10.5 ㎣/st at idle

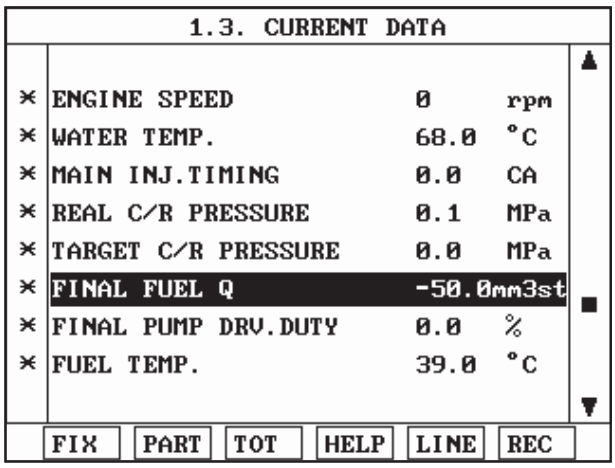


Fig. 1 Fuel injection amount data at ignition ON

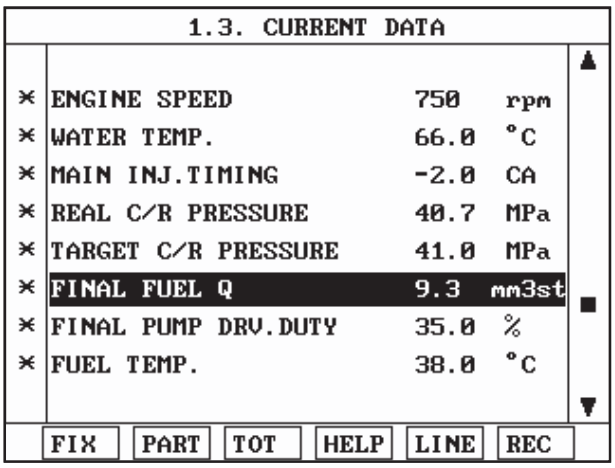


Fig. 2 Fuel injection amount data at idle

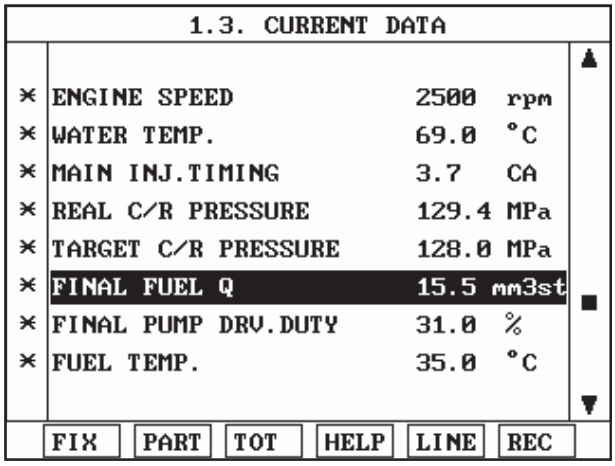


Fig. 3 Fuel injection amount data at 2,500rpm

SUDFL8102L

TERMINAL & CONNECTOR INSPECTION E27FE6B5

Refer to DTC P0112.

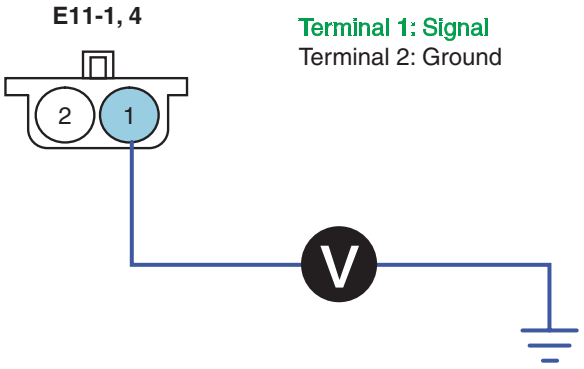
POWER SUPPLY INSPECTION EB12F148

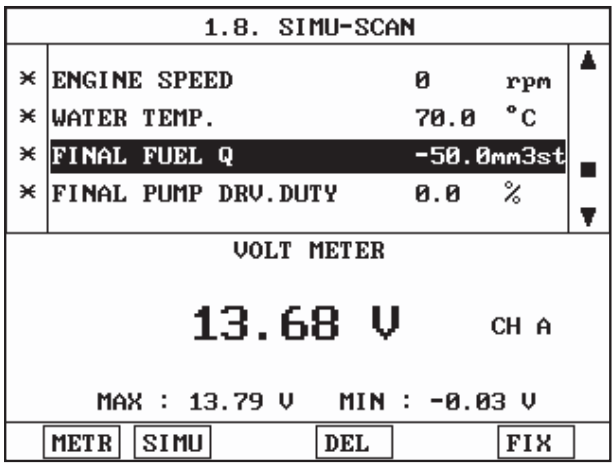
1. Power Supply Voltage Inspection

   1) Leave injector #1, #4 connector(E11-2, 3) installed.

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 1 of the injector #1,#4 and chassis ground.





▶ With injector #1, #4 connector disconnected/connected (At IG ON)

SUDFL8305L

■ Specification: Injector #1, #4 signal power approx. 13.57 V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

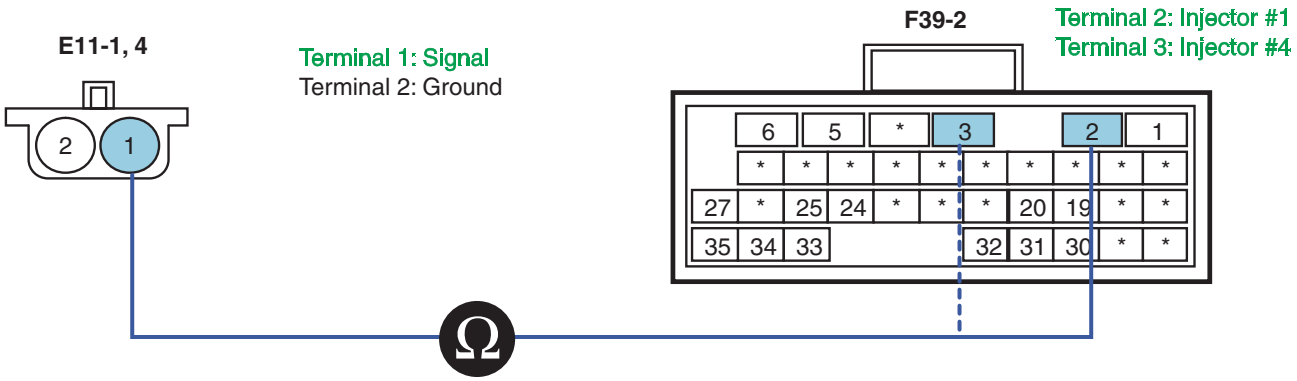
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn ignition OFF.

2) Disconnect injector #1,#4 connector(E11-1,4) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of injector #1, #4 harness connector and terminal 2,3 of ECM connector(F39-2).



SNBFL8153L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

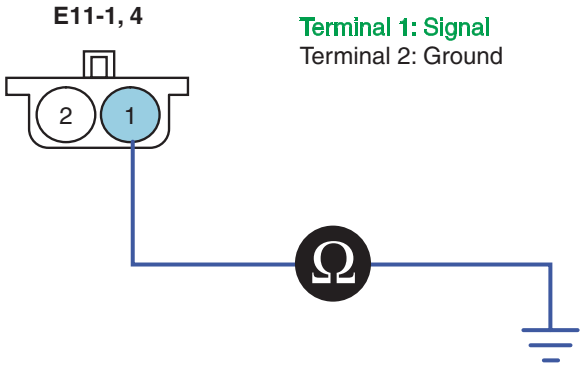
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect injector #1,#4 connector(E11-1,4) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of injector #1,#4 harness connector and chassis ground.



SUDFL8307L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

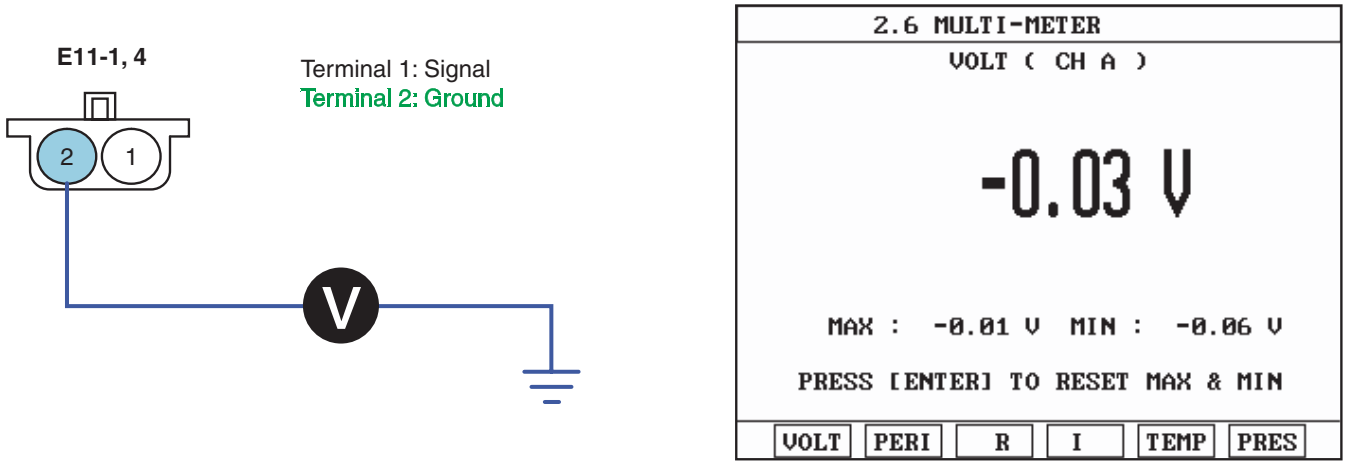
GROUND CIRCUIT INSPECTION EC34E27F

1. Ground Voltage Drop Inspection

1) Disconnect injector #1,#4 connector(E11-1,4).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 2 of injector #1, #4 harness connector and chassis ground.



SUDFL8308L

■ Specification: Ground voltage drop-Within 200mV

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

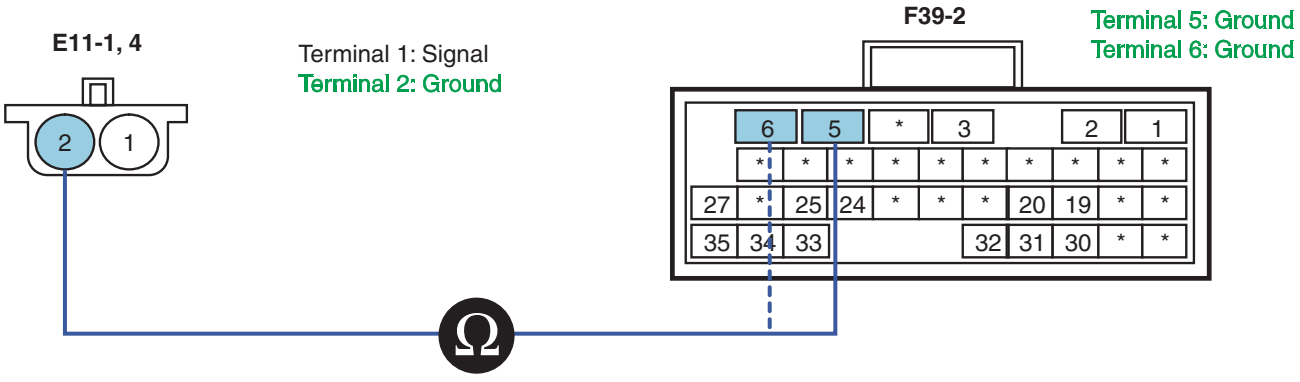
▶ Repair the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect injector #1, #4 connector(E11-1,4) and ECM connector(F39-2).

3) Measure resistance between terminal 2 of injector #1, #4 harness connector(E11-1,4) and terminal 5, 6 of ECM connector(F39-2).



SNBFL8154L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

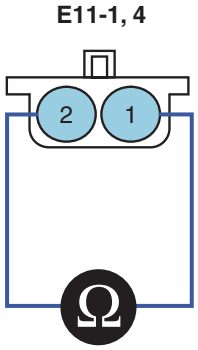
COMPONENT INSPECTION E52C3E25

1. Injector Component Inspection

   1) Turn ignition OFF.

   2) Disconnect injector #1, #4 connector(E11-1,4).

   3) Measure resistance between terminal 1 and 2 of injector#1, #4 connector.



Terminal 1: Signal
Terminal 2: Ground

■ Specification

Item	Specification
Resistance	0.45Ω(20˚C)

SUDFL8310L

   4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the injector and then go to "Verification of Vehicle Repair" procedure.

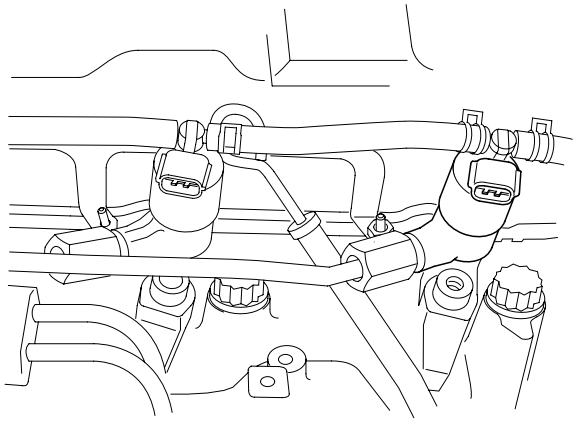
VERIFICATION OF VEHICLE REPAIR E5F4C193

Refer to DTC P0112.

DTC P2147 INJECTION COMMON #1 VOLTAGE - LOW

COMPONENT LOCATION E1973D1A

Injector



SUDFL8098L

DESCRIPTION EC3F5FCE

1. GENERAL DESCRIPTION
   Injector carries out function to inject fuel amount calculated by ECM by making diesel spread with small particles to combustion chamber compressed with high pressure. Fuel injected generates power through combustion process.
   Purpose to increase fuel pressure of common rail diesel engine up to Max. 1,600 bar is to make fuel into small particles, small particles of fuel are related to smoke reduction, high power of engine, fuel consumption improvement etc.
   Also, hydraulic servo type is used to control fuel pressure of 1,600 bar with solenoid, injector solenoid is driven by current after increasing solenoid driving voltage up to 135V.
   Multi injection is possible by applying fuel injection which is not mechanic injector but electric control injector.
   ECM injects fuel after dividing into two stages of pilot injection and main injection and it is possible to control Injection time and injection amount independently to each cylinder. Power, torque, exhaust gas, fuel consumption improvement etc. can be optimized by controlling engine to optimum fuel injection amount.

2. DTC DESCRIPTION
   If crank rotating angle is 2,159.7 degree or more due to the open in harness of injectors #1 and #4, ECM judges this as a fault and DTC is set. The possible causes are open in terminal 2, 3, 5, 6 of ECM connector(F39-2) and wiring problem etc.
   Lack of engine power will occur since fuel amount is limited to below 40mm³/st in case of fail safe. There may cause damage to engine if the vehicle is driven for a long time with faulty injector.

DTC DETECTING CONDITION EC0A00DB

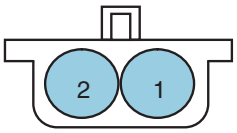
Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Short to ground of terminal 2,3 of ECM connector(F39-2) • Wiring problem
Enable Conditions	• Ignition ON			
Threshold Value	• Short to ground of injectors #1, #4 simultaneously			
Diagnosis Time	• 2,159.7 CA(Crank angle) or more			
Fail Safe	Fuel Cut	No	• Fuel amount is limited to below 40mm³/st . • Lack of engine power	
	Fuel Limit	Yes		
	MIL	ON		

SPECIFICATION ED77B951

Injector resistance(terminal-to-terminal)

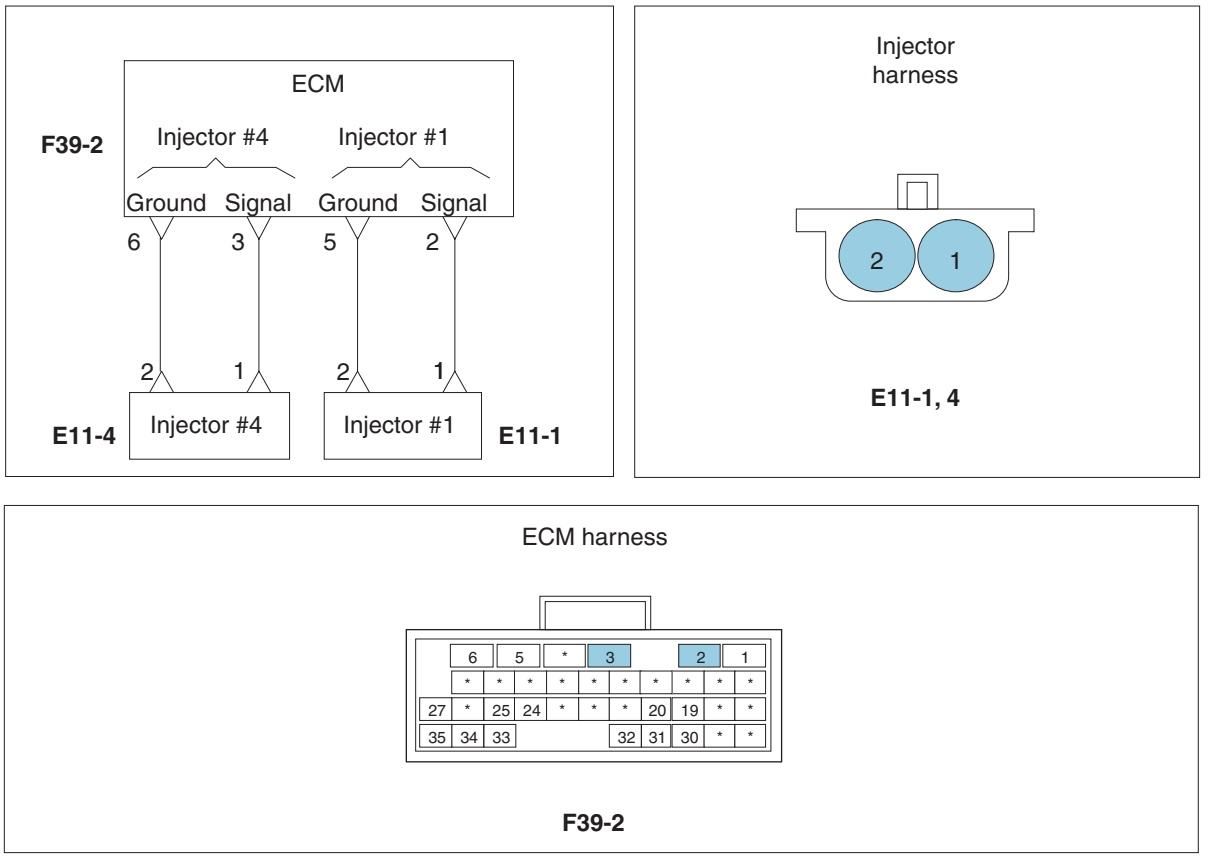
Item	Specification
Resistance	0.45Ω (At 20˚C)
Injector driving voltage	135V
Injector driving current	20A
Injector control type	Current control

Terminal 1: Signal
Ter



Sensor connector

SCHEMATIC DIAGRAM E80EC7F4



SNBFL8155L

SIGNAL WAVEFORM EC83B4E9

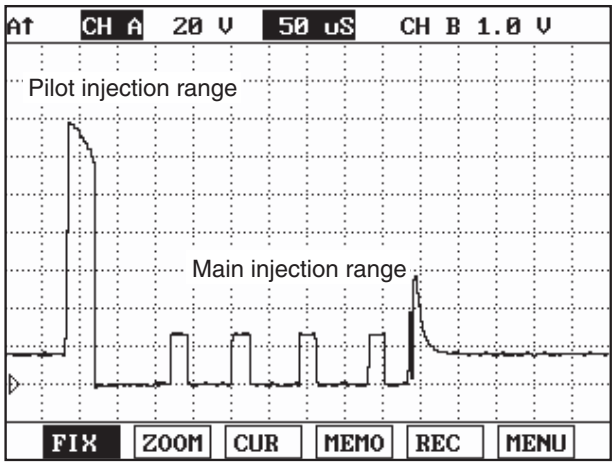


Fig. 1 Low side waveform when activating injector(Ground side)

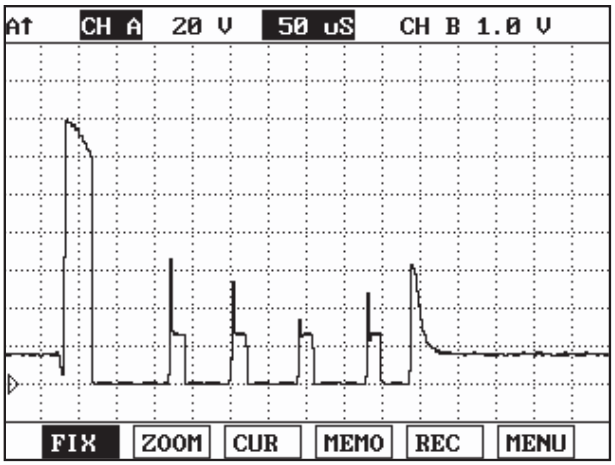


Fig. 2 High side injector power waveform(Signal side)

Fig.1) is divided into pilot injection range and main injection range as low side waveform when activating injector.
Fig.2) is high side injector power waveform.

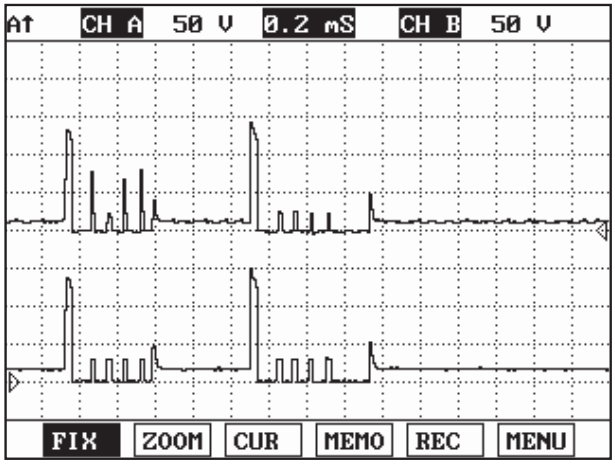


Fig. 3 Injector power waveform combined with High/Low side

SUDFL8101L

NOTE

Waveforms of Fig.1) and Fig.2) are displayed by turns in the course of checking injector waveform in LOW side. The reason that the waveform like a Fig.2) is displayed is used in LOW side in common the power of HIGH side of injector #1, #4 or injector #2, #3 which is not activated.

MONITOR SCAN TOOL DATA E915AA92

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Fuel injection amount" parameter on the scan tool.

NOTE

The scan tool data indicate engine rpm information related to "Fuel injection amount" parameter depending on DTC detecting conditions. Be sure to check that "Fuel amount" is limited to below 40㎣/st in case of fail safe.

■ Specification: Fuel amount - Approx. 9.0~10.5 ㎣/st at idle

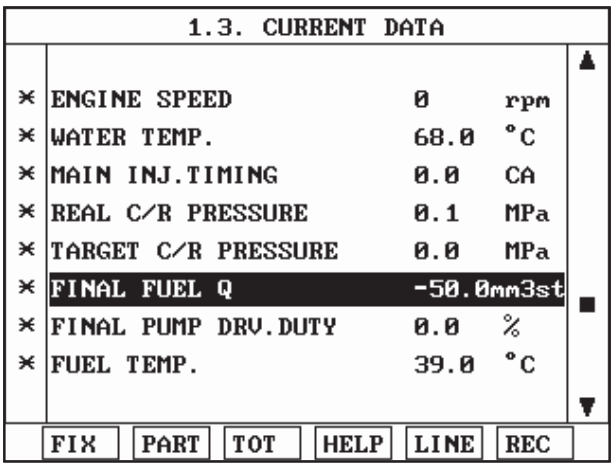


Fig. 1 Fuel injection amount data at ignition ON

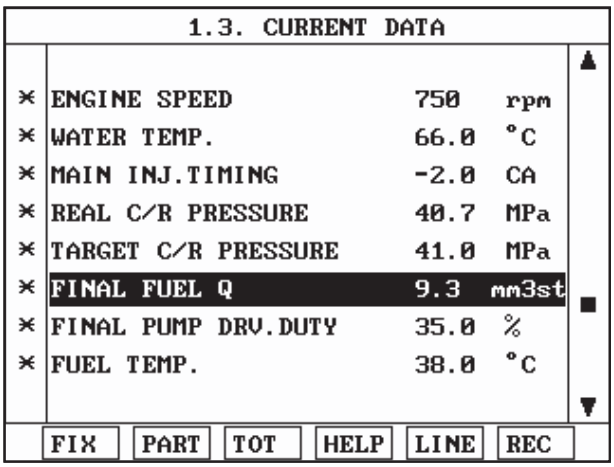


Fig. 2 Fuel injection amount data at idle

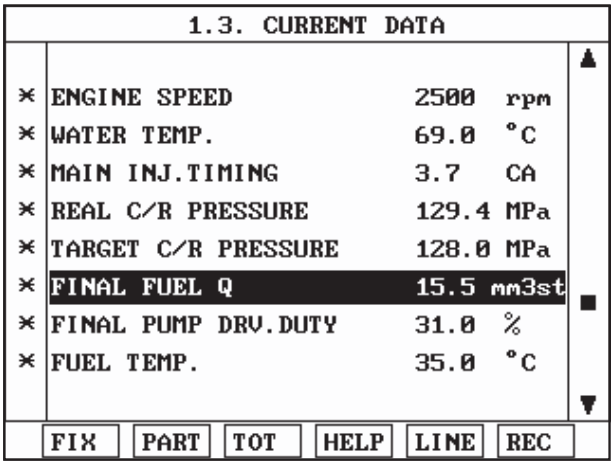


Fig. 3 Fuel injection amount data at 2,500rpm

SUDFL8102L

TERMINAL & CONNECTOR INSPECTION E5D7B2DF

Refer to DTC P0112.

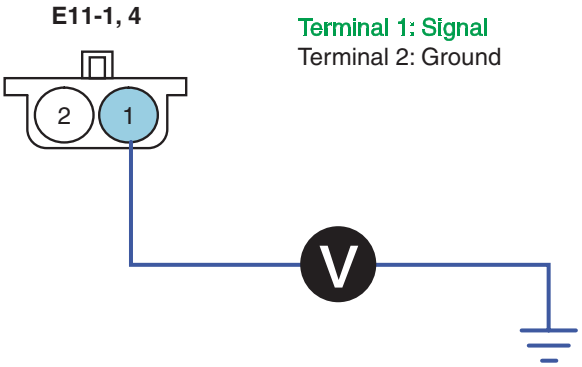
POWER SUPPLY INSPECTION E64FB502

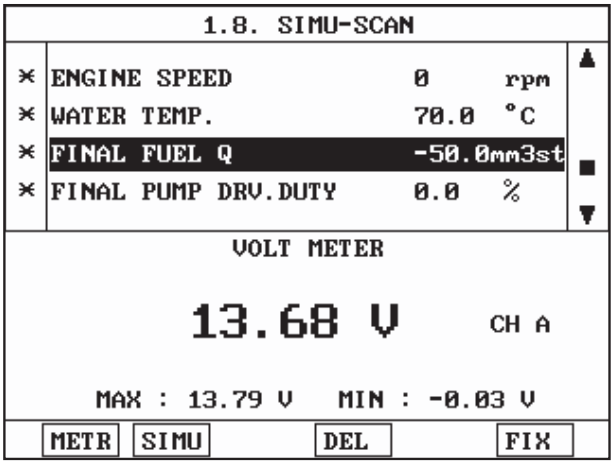
1. Power Supply Voltage Inspection

   1) Leave injector #1, #4 connector(E11-1,4) installed.

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 1 of the injector #1,#4 and chassis ground.





▶ With injector #1, #4 connector disconnected/connected (At IG ON)

SUDFL8305L

■ Specification: Injector #1, #4 signal power approx. 13.57 V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

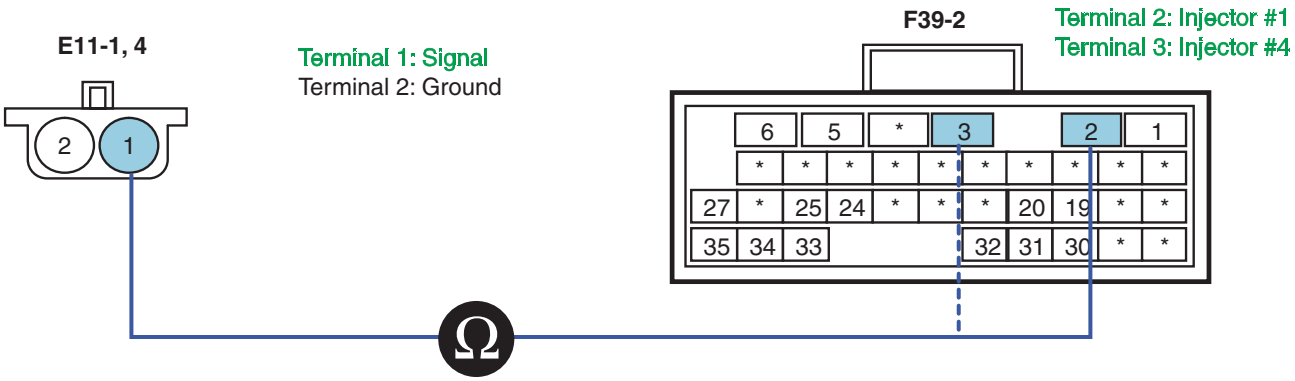
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn ignition OFF.

2) Disconnect injector #1,#4 connector(E11-1,4) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of injector #1, #4 harness connector and terminal 2 ,3 of ECM connector(F39-2).



SNBFL8153L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

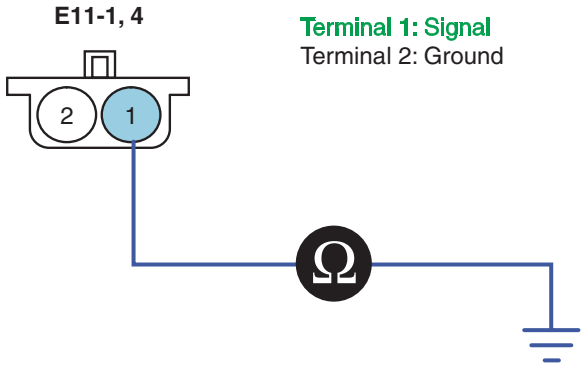
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect injector #1,#4 connector(E11-1,4) and ECM connector(F39-2).

3) Measure resistance between terminal 1 of injector #1,#4 harness connector and chassis ground.



SUDFL8307L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

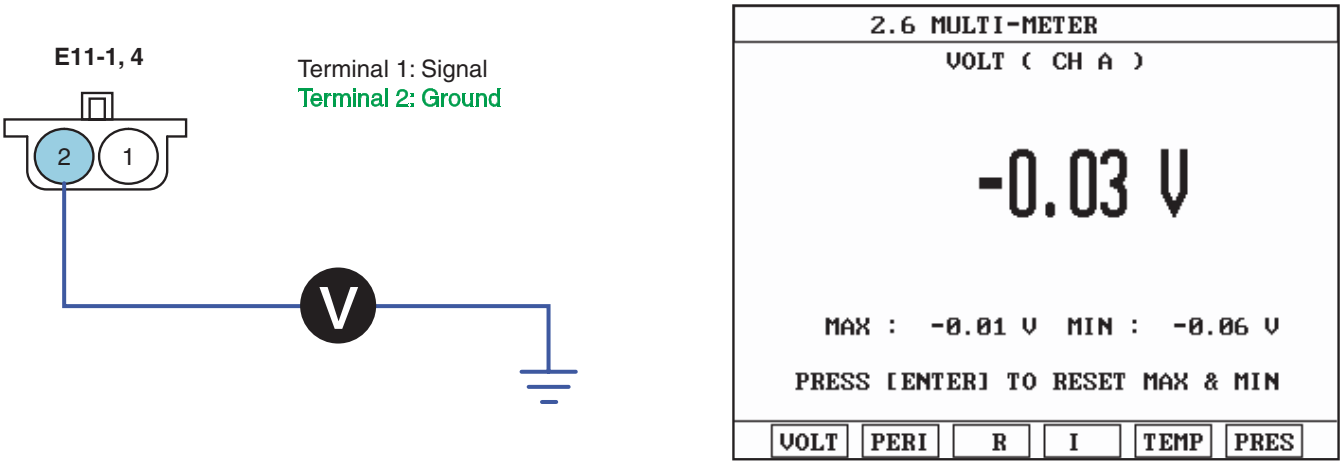
GROUND CIRCUIT INSPECTION EB8D01BF

1. Ground Voltage Drop Inspection

1) Disconnect injector #1,#4 connector(E11-1,4).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 2 of injector #1, #4 harness connector and chassis ground.



SUDFL8308L

■ Specification: Ground voltage drop-Within 200mV

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

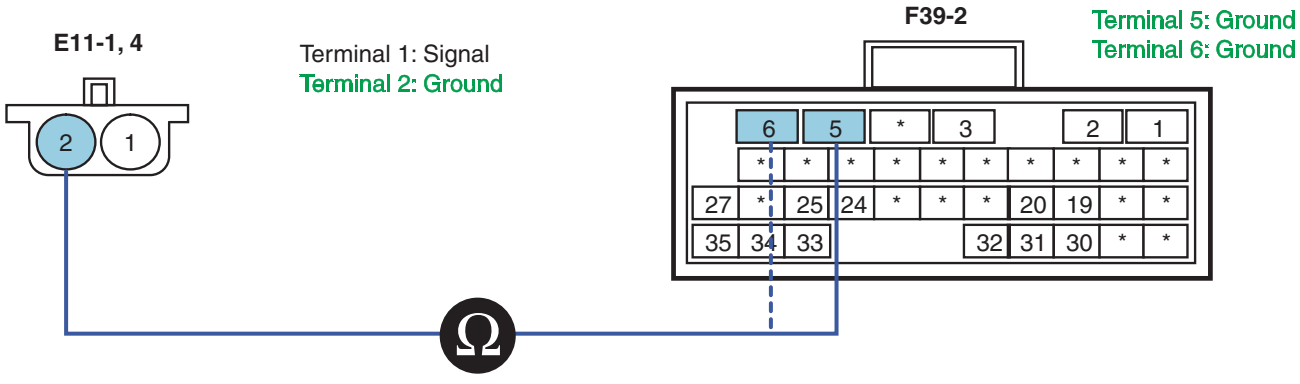
▶ Repair the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect injector #1, #4 connector(E11-1,4) and ECM connector(F39-2).

3) Measure resistance between terminal 2 of injector #1, #4 harness connector(E11-1,4) and terminal 5, 6 of ECM connector(F39-2).



SNBFL8154L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

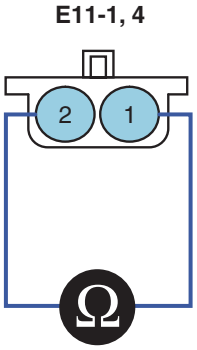
COMPONENT INSPECTION E9B29F20

1. Injector Component Inspection

   1) Turn ignition OFF.

   2) Disconnect injector #1, #4 connector(E11-1,4).

   3) Measure resistance between terminal 1 and 2 of injector#1, #4 connector.



Terminal 1: Signal
Terminal 2: Ground

■ Specification

Item	Specification
Resistance	0.45Ω(20˚C)

SUDFL8310L

   4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the injector and then go to "Verification of Vehicle Repair" procedure.

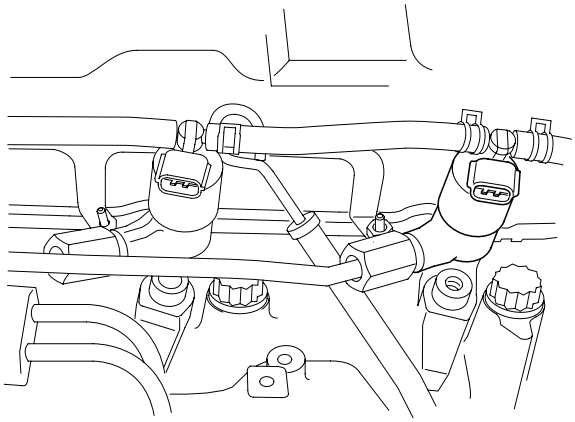
VERIFICATION OF VEHICLE REPAIR ED24C61D

Refer to DTC P0112.

DTC P2148 INJECTION COMMON #1 VOLTAGE - HIGH

COMPONENT LOCATION E0402CF1

Injector



SUDFL8098L

DESCRIPTION E508A9D7

1. GENERAL DESCRIPTION
   Injector carries out function to inject fuel amount calculated by ECM by making diesel spread with small particles to combustion chamber compressed with high pressure. Fuel injected generates power through combustion process.
   Purpose to increase fuel pressure of common rail diesel engine up to Max. 1,600 bar is to make fuel into small particles, small particles of fuel are related to smoke reduction, high power of engine, fuel consumption improvement etc.
   Also, hydraulic servo type is used to control fuel pressure of 1,600 bar with solenoid, injector solenoid is driven by current after increasing solenoid driving voltage up to 135V.
   Multi injection is possible by applying fuel injection which is not mechanic injector but electric control injector.
   ECM injects fuel after dividing into two stages of pilot injection and main injection and it is possible to control Injection time and injection amount independently to each cylinder. Power, torque, exhaust gas, fuel consumption improvement etc. can be optimized by controlling engine to optimum fuel injection amount.

2. DTC DESCRIPTION
   If crank rotating angle is 2,159.7 degree or more due short to B+ of injectors #1 and #4, ECM judges this as a fault and DTC is set. The possible causes are short to terminal 5,6(power) of ECM connector(F39-2) and wiring problem etc.
   Lack of engine power will occur since fuel amount is limited to below 40mm³/st in case of fail safe. There may cause damage to engine if the vehicle is driven for a long time with faulty injector.

DTC DETECTING CONDITION EE1C498C

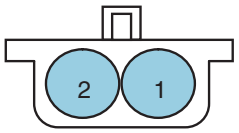
Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Short to ground of terminal 5,6 of ECM connector(F39-2) • Wiring problem
Enable Conditions	• Ignition ON			
Threshold Value	• Short to B+ of injectors #1, #4 simultaneously			
Diagnosis Time	• 2,159.7 CA(Crank angle) or more			
Fail Safe	Fuel Cut	No	• Fuel amount is limited to below 40mm³/st . • Lack of engine power	
	Fuel Limit	Yes		
	MIL	ON		

SPECIFICATION EA9B946E

Injector resistance(terminal-to-terminal)

Item	Specification
Resistance	0.45Ω (At 20˚C)
Injector driving voltage	135V
Injector driving current	20A
Injector control type	Current control

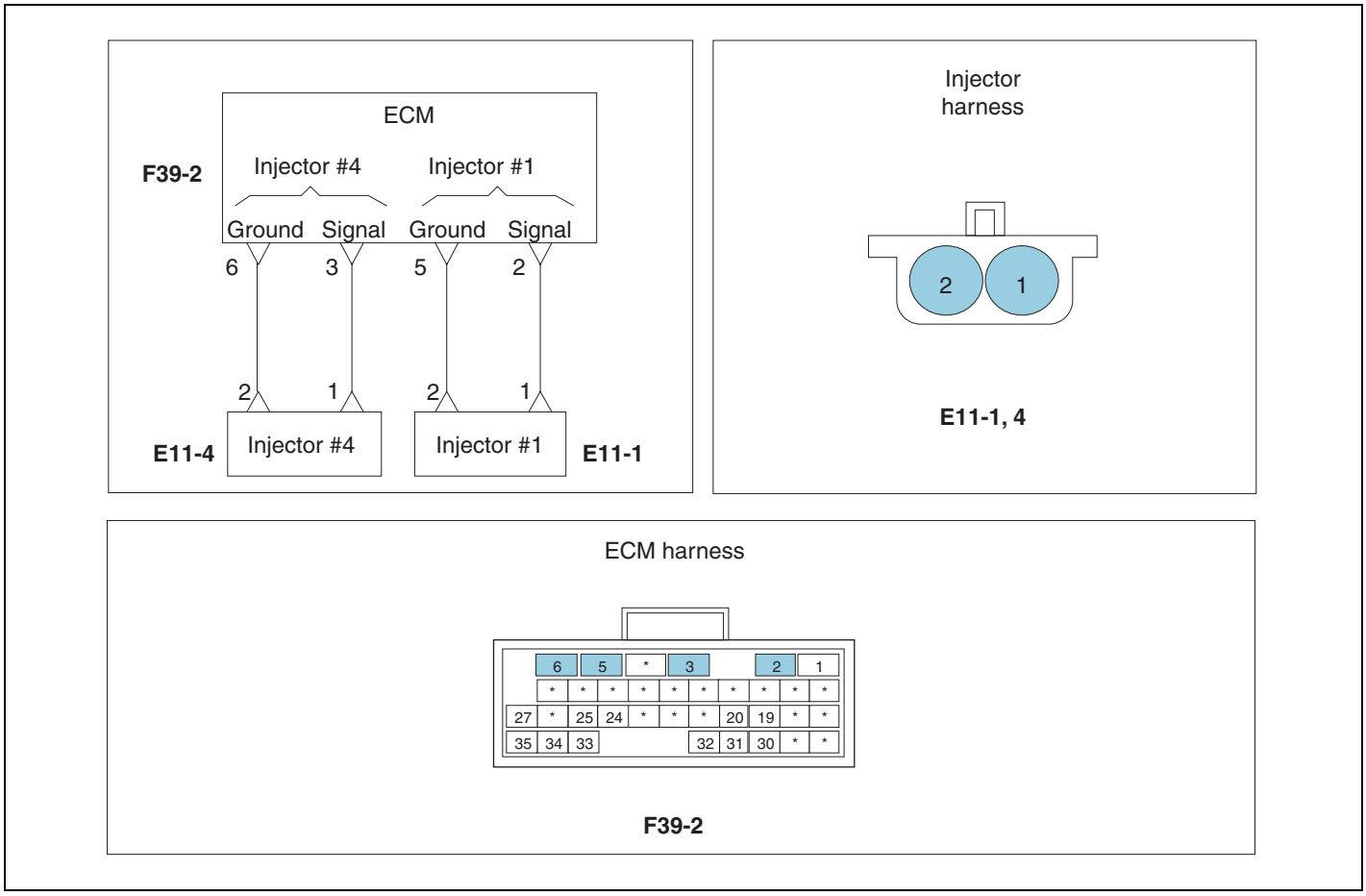
Terminal 1: Signal
Terminal 2: Ground



Sensor connector

SUDFL8099L

SCHEMATIC DIAGRAM E258381F



SNBFL8152L

SIGNAL WAVEFORM E4340271

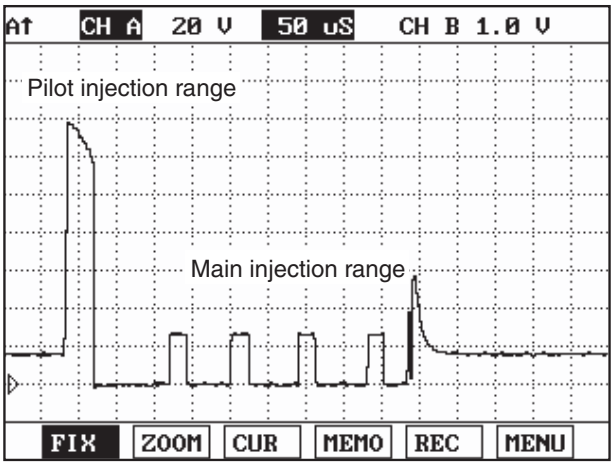


Fig. 1 Low side waveform when activating injector(Ground side)

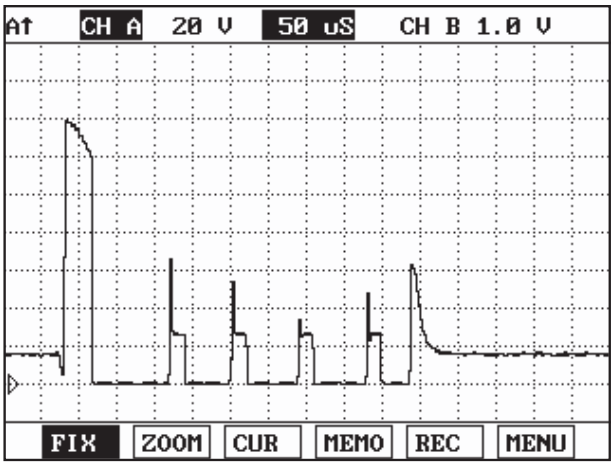


Fig. 2 High side injector power waveform(Signal side)

Fig.1) is divided into pilot injection range and main injection range as low side waveform when activating injector.
Fig.2) is high side injector power waveform.

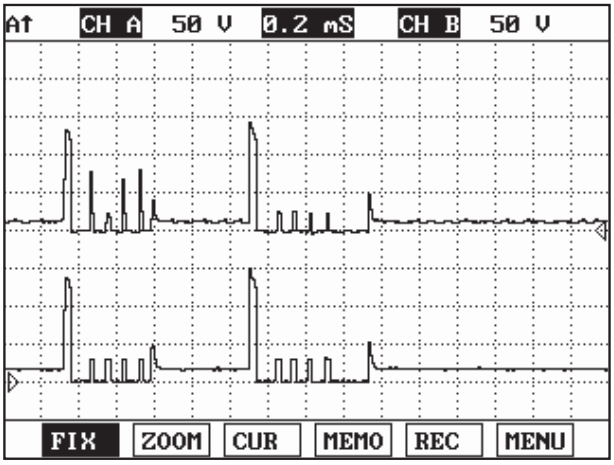


Fig. 3 Injector power waveform combined with High/Low side

SUDFL8101L

NOTE

Waveforms of Fig.1) and Fig.2) are displayed by turns in the course of checking injector waveform in LOW side. The reason that the waveform like a Fig.2) is displayed is used in LOW side in common the power of HIGH side of injector #1, #4 or injector #2, #3 which is not activated.

MONITOR SCAN TOOL DATA EE95CCA6

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Fuel injection amount" parameter on the scan tool.

NOTE

The scan tool data indicate engine rpm information related to "Fuel injection amount" parameter depending on DTC detecting conditions. Be sure to check that "Fuel amount" is limited to below 40㎣/st in case of fail safe.

■ Specification: Fuel amount - Approx. 9.0~10.5 ㎣/st at idle

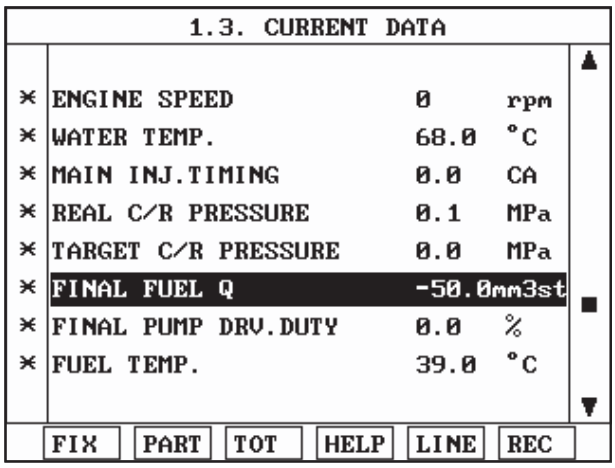


Fig. 1 Fuel injection amount data at ignition ON

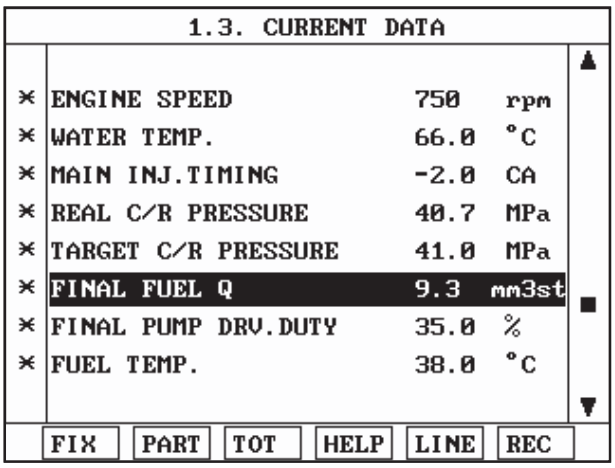


Fig. 2 Fuel injection amount data at idle

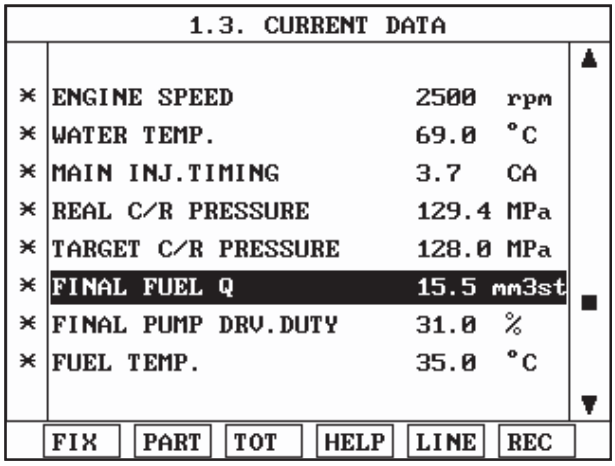


Fig. 3 Fuel injection amount data at 2,500rpm

SUDFL8102L

TERMINAL & CONNECTOR INSPECTION E8D02A15

Refer to DTC P0112.

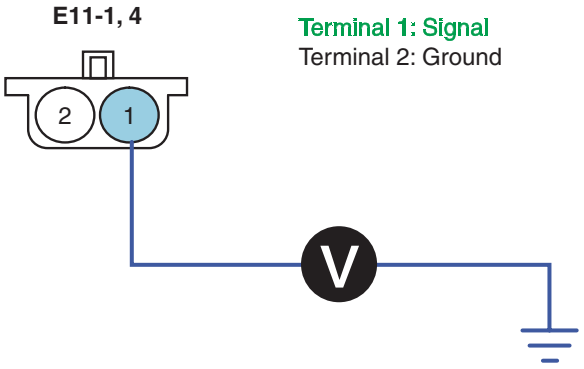
POWER SUPPLY INSPECTION E365407B

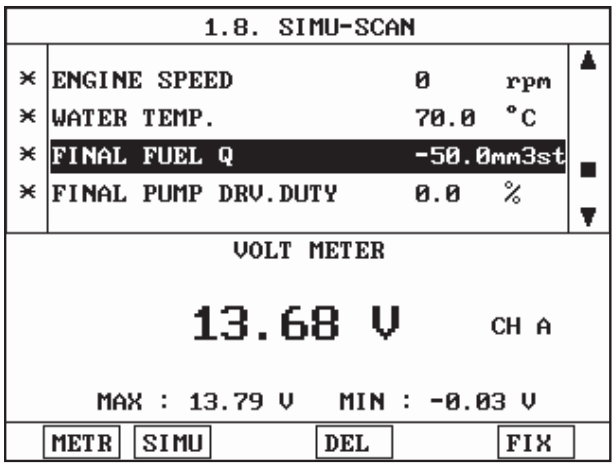
1. Power Supply Voltage Inspection

   1) Leave injector #1, #4 connector(E11-1,4) installed.

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 1 of the injector #1,#4 and chassis ground.





▶ With injector #1, #4 connector disconnected/connected (At IG ON)

SUDFL8305L

■ Specification: Injector #1, #4 signal power approx. 13.57 V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

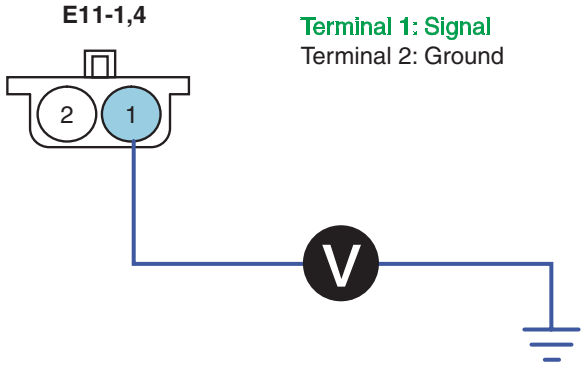
▶ Go to "Power Supply Short to Power Inspection" procedure.

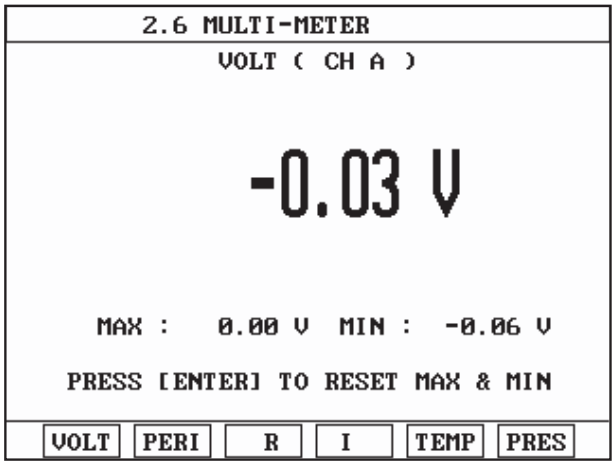
2. Power Supply Short to Power Inspection

1) Disconnect injector #1,#4 connector(E11-1,4) and ECM connector(F39-2).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of injector #1, #4 harness connector and chassis ground.





SUDFL8312L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

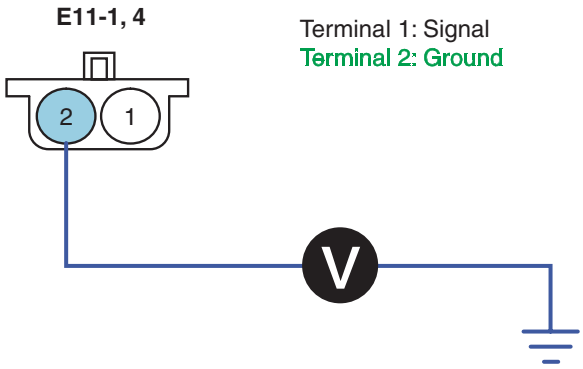
GROUND CIRCUIT INSPECTION E610531F

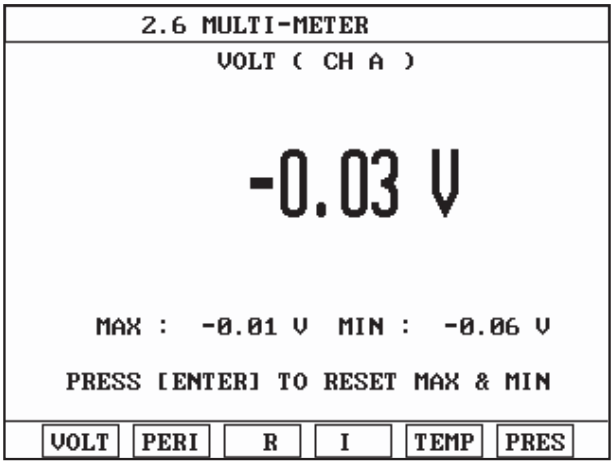
1. Ground Voltage Drop Inspection

   1) Disconnect injector #1,#4 connector(E11-1,4).

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage drop between terminal 2 of injector #1, #4 harness connector and chassis ground.





SUDFL8308L

■ Specification: Ground voltage drop-Within 200mV

   4) Is the voltage measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

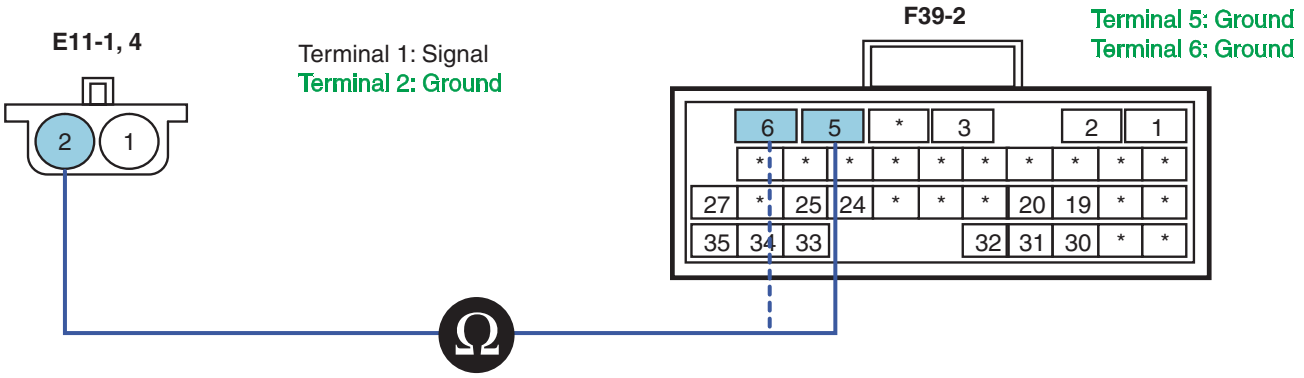
▶ Repair the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

   1) Turn the ignition OFF.

   2) Disconnect injector #1, #4 connector(E11-1,4) and ECM connector(F39-2).

   3) Measure resistance between terminal 2 of injector #1, #4 harness connector(E11-1,4) and terminal 5, 6 of ECM connector(F39-2).



SNBFL8154L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

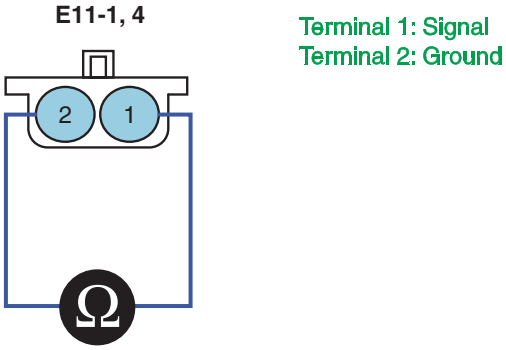
COMPONENT INSPECTION E3FD1CDC

1. Injector Component Inspection

1) Turn ignition OFF.

2) Disconnect injector #1, #4 connector(E11-1,4).

3) Measure resistance between terminal 1 and 2 of injector#1, #4 connector.



■ Specification

Item	Specification
Resistance	0.45Ω(20˚C)

SUDFL8310L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the injector and then go to "Verification of Vehicle Repair" procedure.

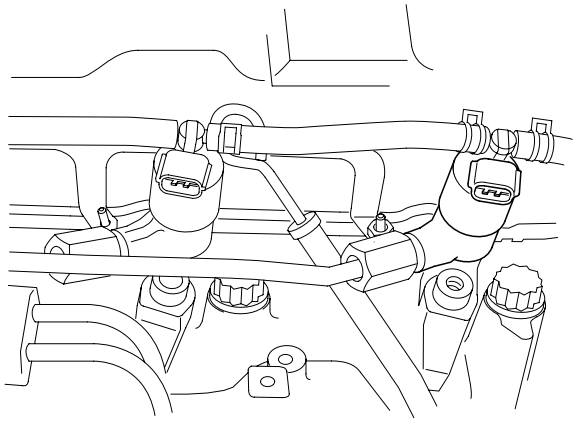
VERIFICATION OF VEHICLE REPAIR E3484596

Refer to DTC P0112.

DTC P2149 INJECTION COMMON #2 OPEN CIRCUIT

COMPONENT LOCATION EA080C20

Injector



SUDFL8098L

DESCRIPTION E07472FC

1. GENERAL DESCRIPTION
   Injector carries out function to inject fuel amount calculated by ECM by making diesel spread with small particles to combustion chamber compressed with high pressure. Fuel injected generates power through combustion process.
   Purpose to increase fuel pressure of common rail diesel engine up to Max. 1,600 bar is to make fuel into small particles, small particles of fuel are related to smoke reduction, high power of engine, fuel consumption improvement etc.
   Also, hydraulic servo type is used to control fuel pressure of 1,600 bar with solenoid, injector solenoid is driven by current after increasing solenoid driving voltage up to 135V.
   Multi injection is possible by applying fuel injection which is not mechanic injector but electric control injector.
   ECM injects fuel after dividing into two stages of pilot injection and main injection and it is possible to control Injection time and injection amount independently to each cylinder. Power, torque, exhaust gas, fuel consumption improvement etc. can be optimized by controlling engine to optimum fuel injection amount.

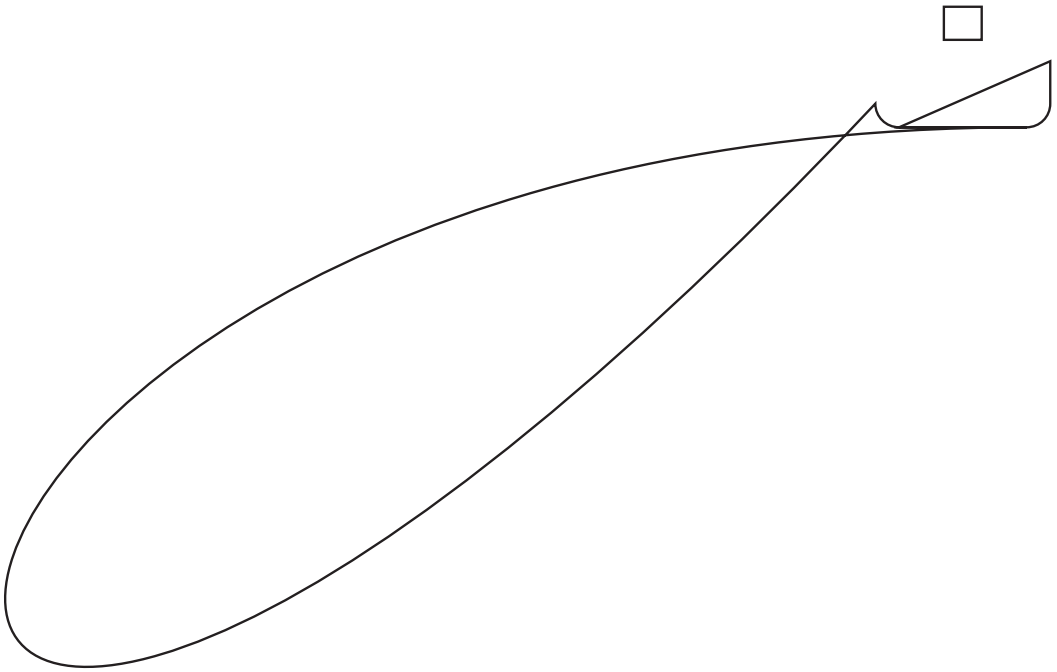
2. DTC DESCRIPTION
   If crank rotating angle is 4499.0 degree or more due to the open in harness of injectors #2 and #3, ECM judges this as a fault and DTC is set. The possible causes are open in terminal 1, 2, 6, 7 of ECM connector(F39-2) and wiring problem etc.
   Lack of engine power will occur since fuel amount is limited to below 40mm³/st in case of fail safe. There may cause damage to engine if the vehicle is driven for a long time with faulty injector.

DTC DETECTING CONDITION ED609167

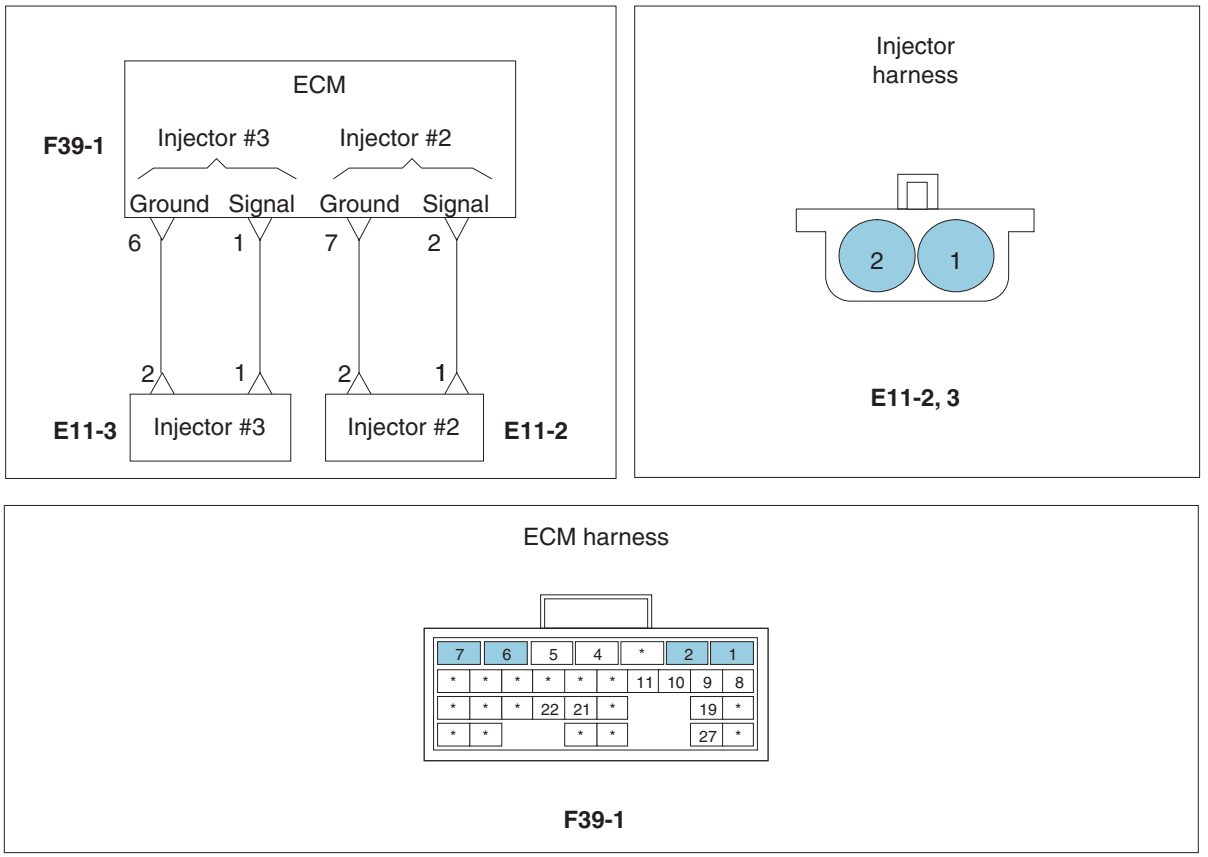
<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="5">• Open in harness of terminal 1,2,6,7 of ECM connector(F39-1)
• Wiring problem</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Ignition ON</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• Open in harness of injectors #2, #3 simultaneously</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 4,499.0 CA(Crank angle) or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• Fuel amount is limited to below 40mm³/st .
• Lack of engine power</td></tr>
<tr><td>Fuel Limit</td><td>Yes</td></tr>
<tr><td>MIL</td><td>ON</td></tr>
</table>

SPECIFICATION E49332F9

Injector resistance(terminal-to-terminal)



SCHEMATIC DIAGRAM EAC4BA95



SNBFL8156L

SIGNAL WAVEFORM EE868AE0

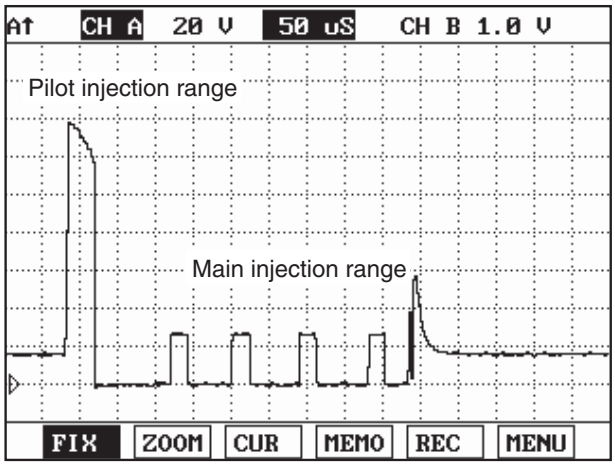


Fig. 1 Low side waveform when activating injector(Ground side)

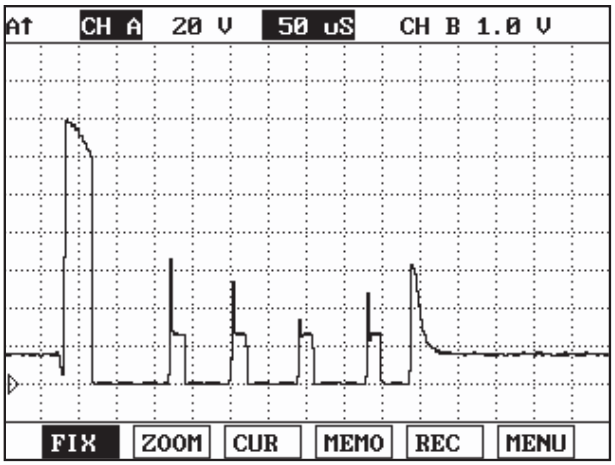


Fig. 2 High side injector power waveform(Signal side)

Fig.1) is divided into pilot injection range and main injection range as low side waveform when activating injector.
Fig.2) is high side injector power waveform.

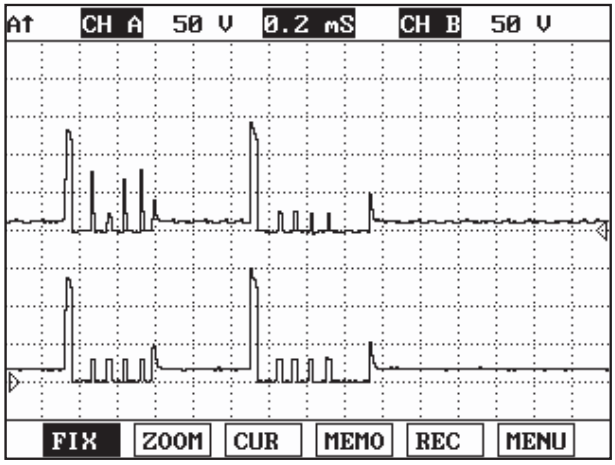


Fig. 3 Injector power waveform combined with High/Low side

SUDFL8101L

NOTE

Waveforms of Fig.1) and Fig.2) are displayed by turns in the course of checking injector waveform in LOW side. The reason that the waveform like a Fig.2) is displayed is used in LOW side in common the power of HIGH side of injector #1, #4 or injector #2, #3 which is not activated.

MONITOR SCAN TOOL DATA E16AC383

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Fuel injection amount" parameter on the scan tool.

NOTE

The scan tool data indicate engine rpm information related to "Fuel injection amount" parameter depending on DTC detecting conditions. Be sure to check that "Fuel amount" is limited to below 40㎣/st in case of fail safe.

■ Specification: Fuel amount - Approx. 9.0~10.5 ㎣/st at idle

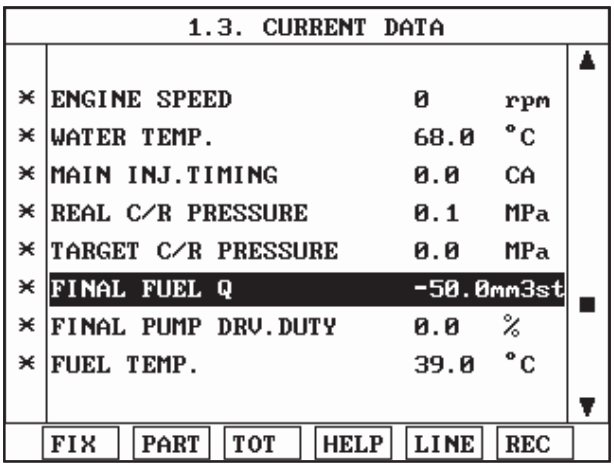


Fig. 1 Fuel injection amount data at ignition ON

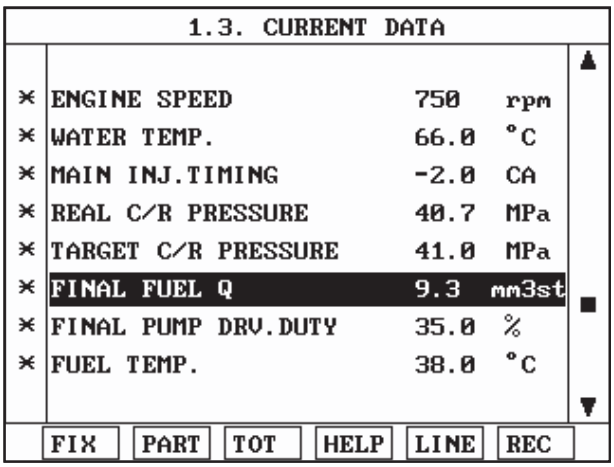


Fig. 2 Fuel injection amount data at idle

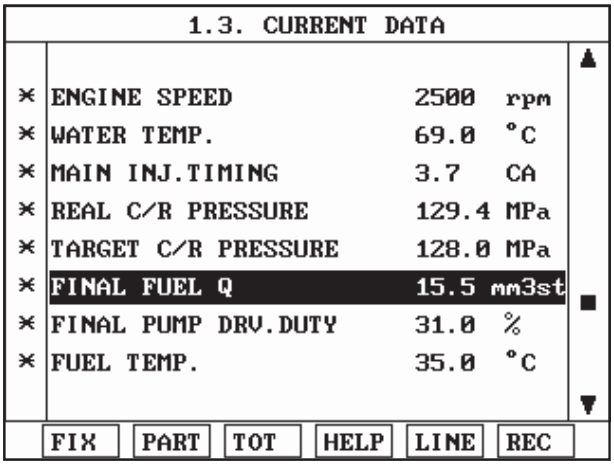


Fig. 3 Fuel injection amount data at 2,500rpm

SUDFL8102L

TERMINAL & CONNECTOR INSPECTION ECF1E303

Refer to DTC P0112.

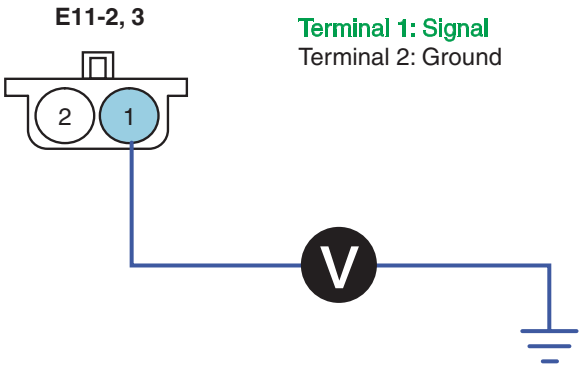
POWER SUPPLY INSPECTION EF073ED1

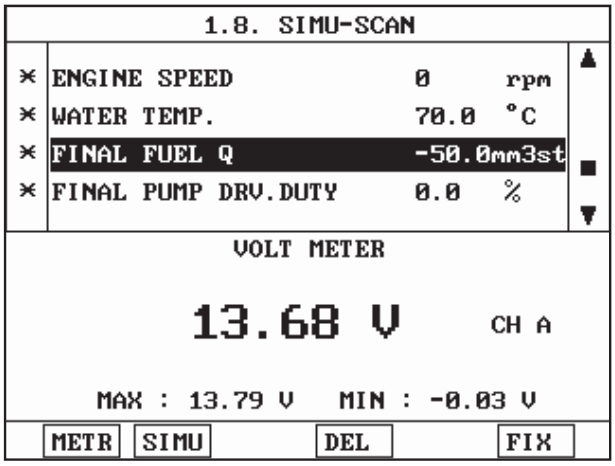
1. Power Supply Voltage Inspection

   1) Leave injector #2, #3 connector(E11-2, 3) installed.

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 1 of the injector #2,#3 and chassis ground.





▶ With injector #2, #3 connector disconnected/connected (At IG ON)

SUDFL8314L

■ Specification: Injector #2, #3 signal power approx. 13.57 V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

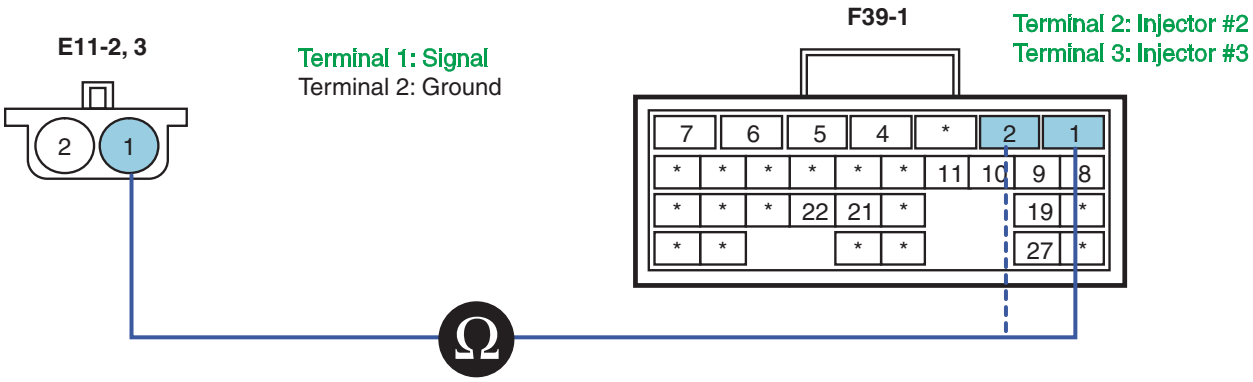
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn ignition OFF.

2) Disconnect injector #2,#3 connector(E11-2,3) and ECM connector(F39-1).

3) Measure resistance between terminal 1 of injector #2, #3 harness connector and terminal 1,2 of ECM connector(F39-1).



SNBFL8157L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

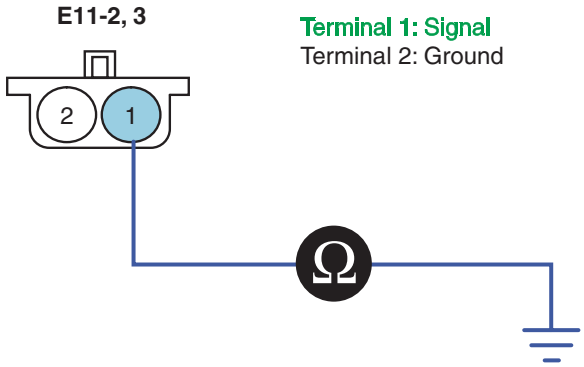
▶ Repair open circuit and then go to " Verification of vehicle repair" procedure.

3. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect injector #2,#3 connector(E11-2,3) and ECM connector(F39-1).

3) Measure resistance between terminal 1 of injector #2,#3 harness connector and chassis ground.



SUDFL8316L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

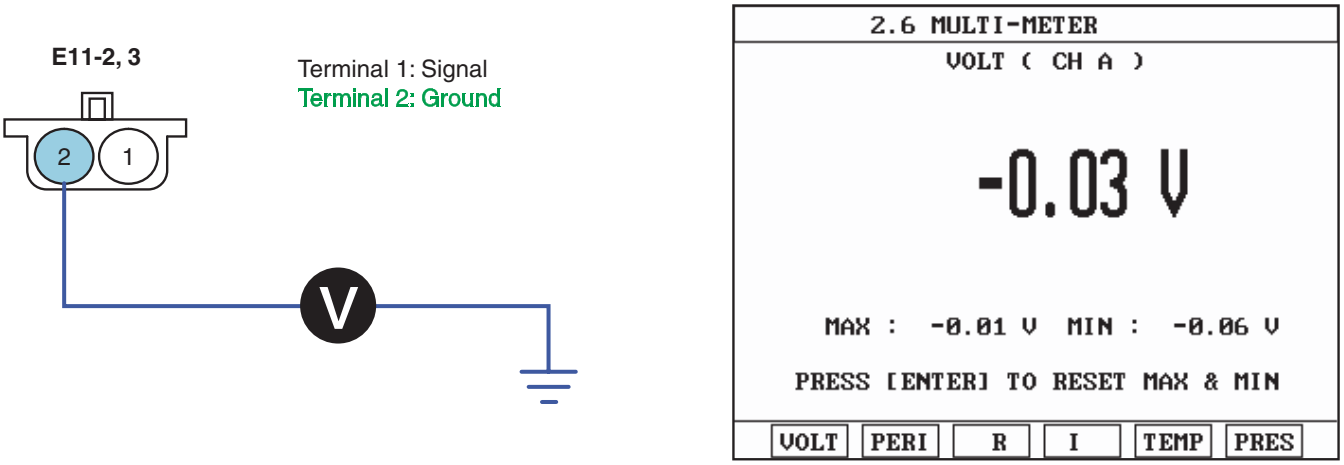
GROUND CIRCUIT INSPECTION E02ACE36

1. Ground Voltage Drop Inspection

1) Disconnect injector #2,#3 connector(E11-2,3).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 2 of injector #2, #3 harness connector and chassis ground.



SUDFL8317L

■ Specification: Ground voltage drop-Within 200mV

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

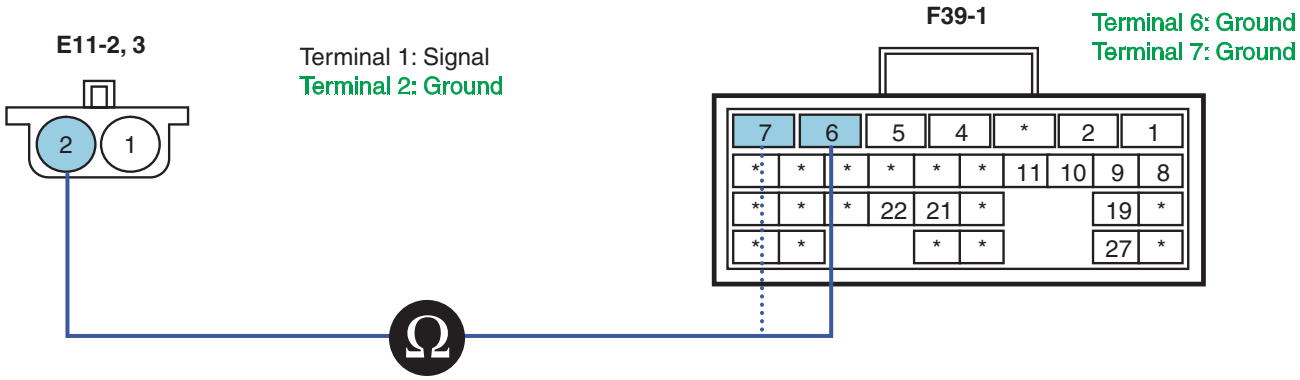
▶ Repair the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

1) Turn the ignition OFF.

2) Disconnect injector #2, #3 connector(E11-2,3) and ECM connector(F39-1).

3) Measure resistance between terminal 2 of injector #2, #3 harness connector and terminal 6,7 of ECM connector.



SNBFL8158L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

COMPONENT INSPECTION E2B859DD

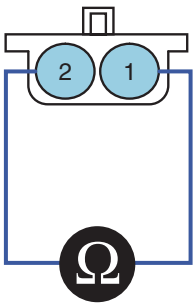
1. Injector Component Inspection

   1) Turn ignition OFF.

   2) Disconnect injector #2, #3 connector(E11-2,3).

   3) Measure resistance between terminal 1 and 2 of injector#2, #3 connector.

E11-2, 3



Terminal 1: Signal
Terminal 2: Ground

■ Specification

Item	Specification
Resistance	0.45Ω(20˚C)

SUDFL8319L

   4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the injector and then go to "Verification of Vehicle Repair" procedure.

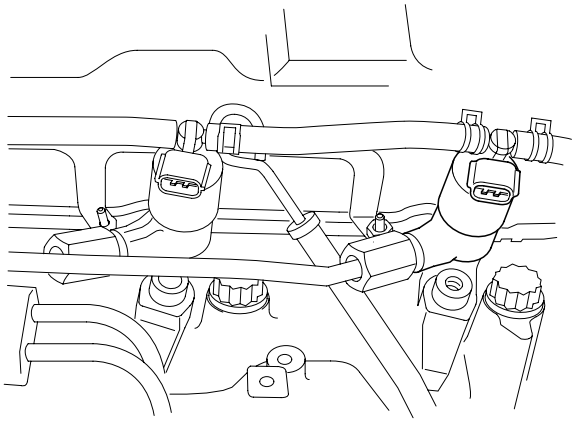
VERIFICATION OF VEHICLE REPAIR EAE29FA0

Refer to DTC P0112.

DTC P2150 INJECTION COMMON #2 VOLTAGE - LOW

COMPONENT LOCATION EA95C042

Injector



SUDFL8098L

DESCRIPTION ED0B0750

1. GENERAL DESCRIPTION
   Injector carries out function to inject fuel amount calculated by ECM by making diesel spread with small particles to combustion chamber compressed with high pressure. Fuel injected generates power through combustion process.
   Purpose to increase fuel pressure of common rail diesel engine up to Max. 1,600 bar is to make fuel into small particles, small particles of fuel are related to smoke reduction, high power of engine, fuel consumption improvement etc.
   Also, hydraulic servo type is used to control fuel pressure of 1,600 bar with solenoid, injector solenoid is driven by current after increasing solenoid driving voltage up to 135V.
   Multi injection is possible by applying fuel injection which is not mechanic injector but electric control injector.
   ECM injects fuel after dividing into two stages of pilot injection and main injection and it is possible to control Injection time and injection amount independently to each cylinder. Power, torque, exhaust gas, fuel consumption improvement etc. can be optimized by controlling engine to optimum fuel injection amount.

2. DTC DESCRIPTION
   If crank rotating angle is 2,159.7 degree or more due to short to ground of injectors #2 and #3, ECM judges this as a fault and DTC is set. The possible causes are short to terminal 1, 2 of ECM connector(F39-1) and wiring problem etc. Lack of engine power will occur since fuel amount is limited to below 40mm³/st in case of fail safe. There may cause damage to engine if the vehicle is driven for a long time with faulty injector.

DTC DETECTING CONDITION E076BB84

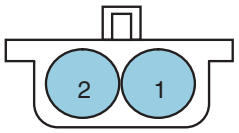
Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Short to ground of terminal 1,2 of ECM connector(F39-1) • Wiring problem
Enable Conditions	• Ignition ON			
Threshold Value	• Short to ground of injectors #2, #3 simultaneously			
Diagnosis Time	• 2,159.7 CA(Crank angle) or more			
Fail Safe	Fuel Cut	No	• Fuel amount is limited to below 40mm³/st . • Lack of engine power	
	Fuel Limit	Yes		
	MIL	ON		

SPECIFICATION EF8ED02D

Injector resistance(terminal-to-terminal)

Item	Specification
Resistance	0.45Ω (At 20˚C)
Injector driving voltage	135V
Injector driving current	20A
Injector control type	Current control

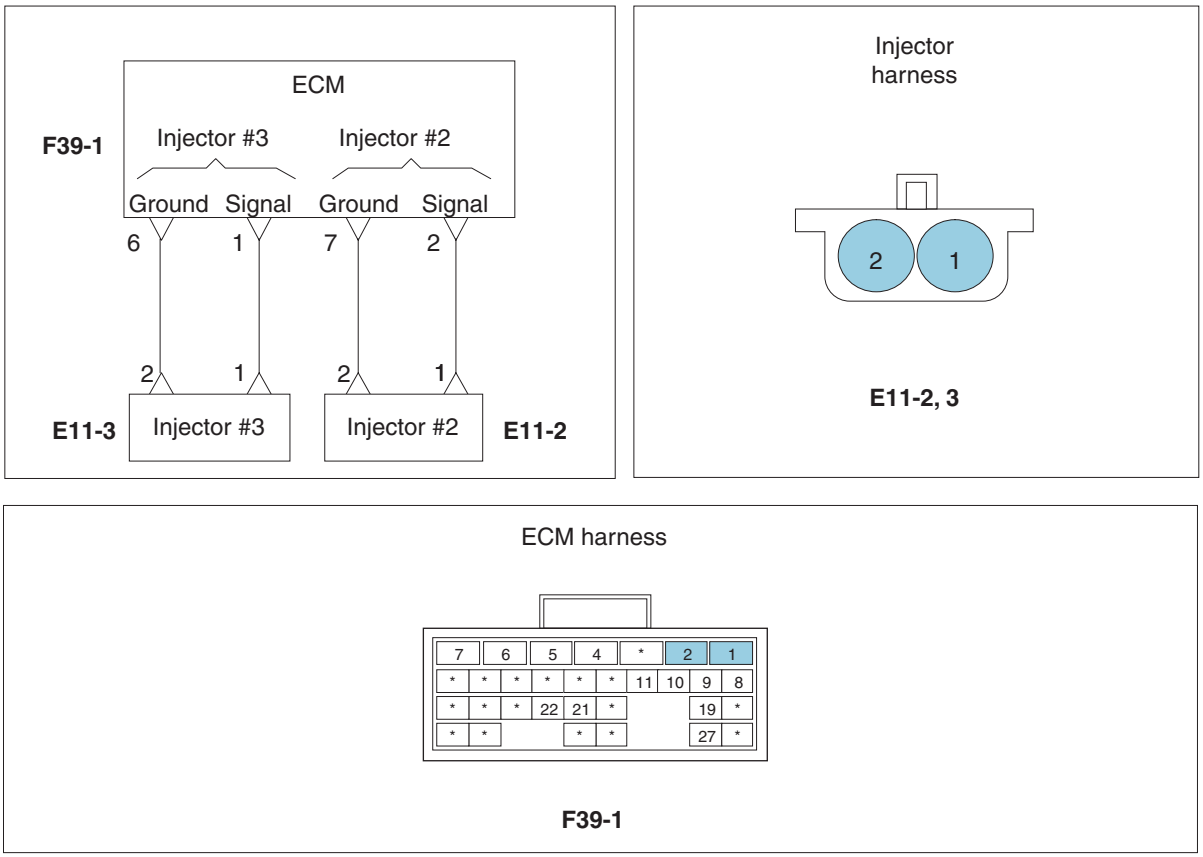
Terminal 1: Signal
Terminal 2: Ground



Sensor connector

SUDFL8099L

SCHEMATIC DIAGRAM E1E3588B



SNBFL8159L

SIGNAL WAVEFORM ED3F2A35

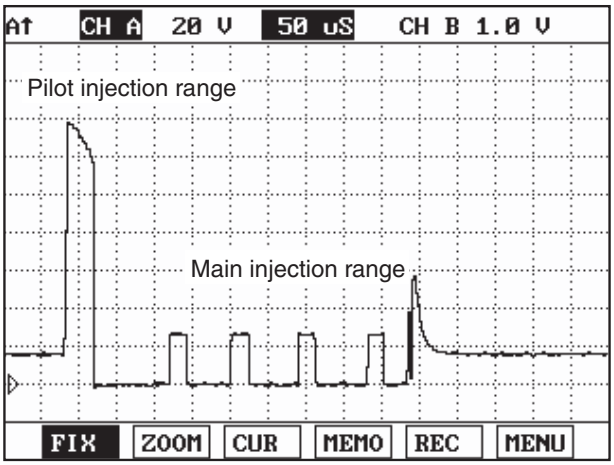


Fig. 1 Low side waveform when activating injector(Ground side)

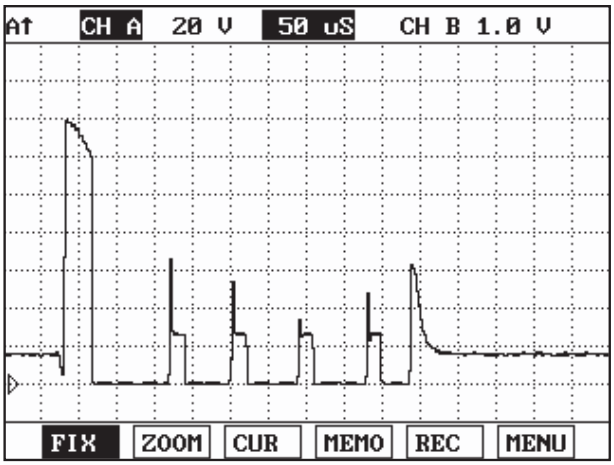


Fig. 2 High side injector power waveform(Signal side)

Fig.1) is divided into pilot injection range and main injection range as low side waveform when activating injector.
Fig.2) is high side injector power waveform.

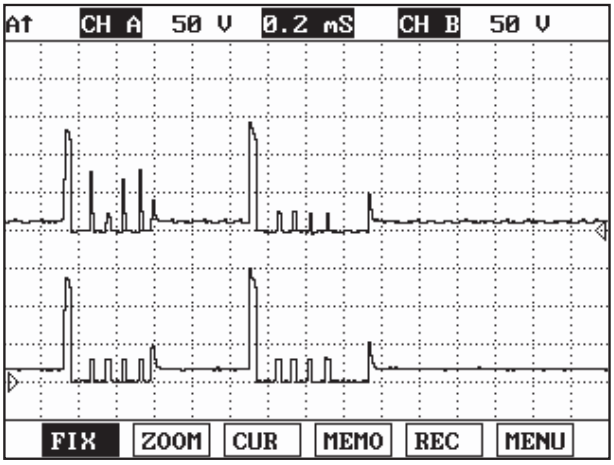


Fig. 3 Injector power waveform combined with High/Low side

SUDFL8101L

NOTE

Waveforms of Fig.1) and Fig.2) are displayed by turns in the course of checking injector waveform in LOW side. The reason that the waveform like a Fig.2) is displayed is used in LOW side in common the power of HIGH side of injector #1, #4 or injector #2, #3 which is not activated.

MONITOR SCAN TOOL DATA E38AC012

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Fuel injection amount" parameter on the scan tool.

NOTE

The scan tool data indicate engine rpm information related to "Fuel injection amount" parameter depending on DTC detecting conditions. Be sure to check that "Fuel amount" is limited to below 40㎣/st in case of fail safe.

■ Specification: Fuel amount - Approx. 9.0~10.5 ㎣/st at idle

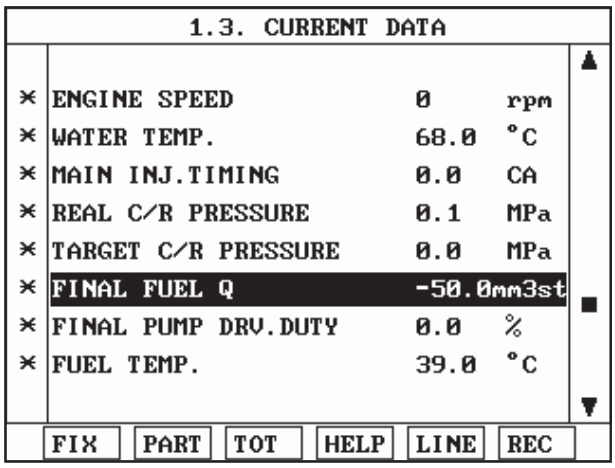


Fig. 1 Fuel injection amount data at ignition ON

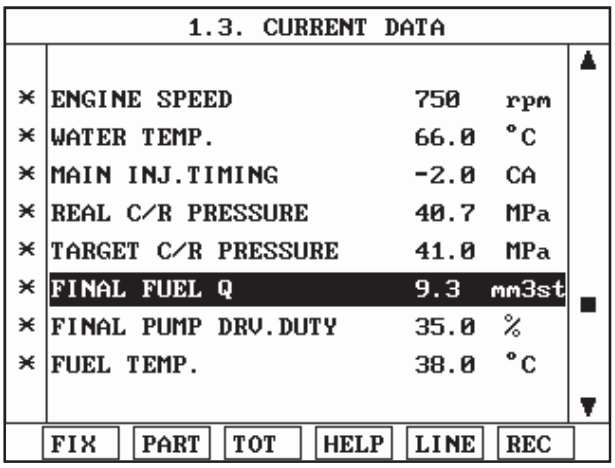


Fig. 2 Fuel injection amount data at idle

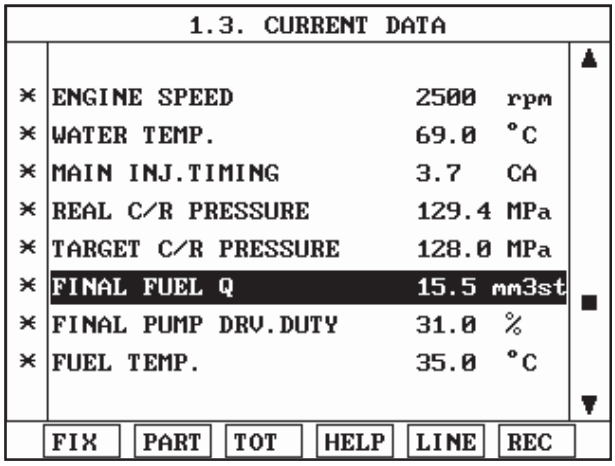


Fig. 3 Fuel injection amount data at 2,500rpm

SUDFL8102L

TERMINAL & CONNECTOR INSPECTION ECC85F49

Refer to DTC P0112.

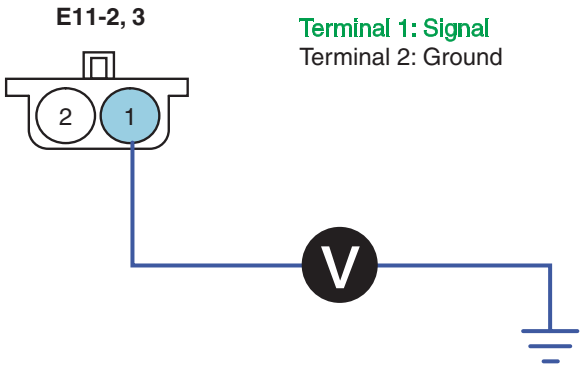
POWER SUPPLY INSPECTION E01A5AD8

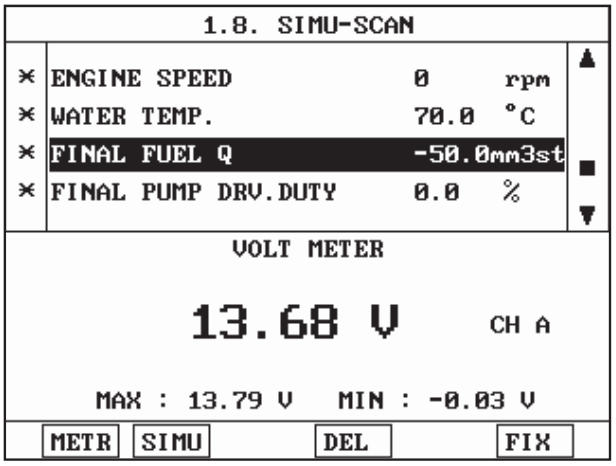
1. Power Supply Voltage Inspection

   1) Leave injector #2, #3 connector(E11-2, 3) installed.

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 1 of the injector #2,#3 and chassis ground.





▶ With injector #2, #3 connector disconnected/connected (At IG ON)

SUDFL8314L

■ Specification: Injector #2, #3 signal power approx. 13.57 V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

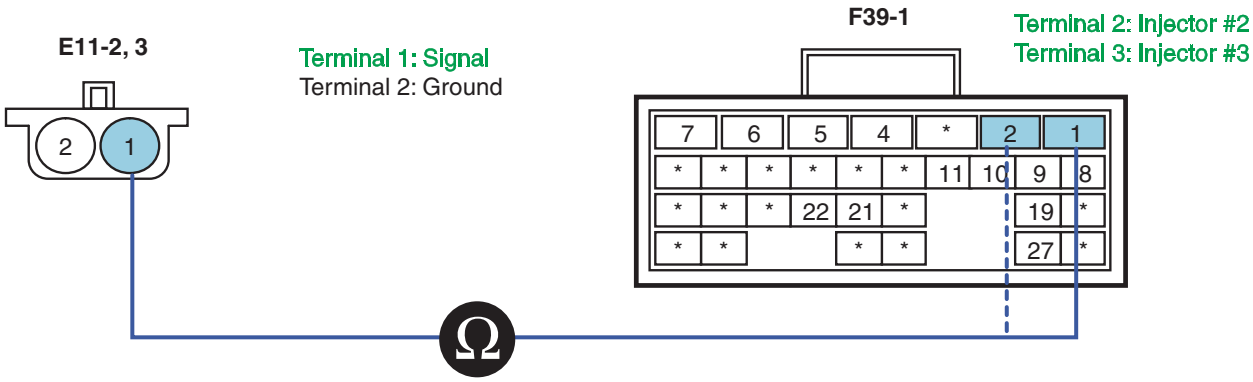
▶ Go to "Power Supply Open Inspection" procedure.

2. Power Supply Open Inspection

1) Turn ignition OFF.

2) Disconnect injector #2,#3 connector(E11-2,3) and ECM connector(F39-1).

3) Measure resistance between terminal 1 of injector #2, #3 harness connector and terminal 1,2 of ECM connector(F39-1).



SNBFL8157L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Power Supply Short to Ground Inspection" procedure.

NO

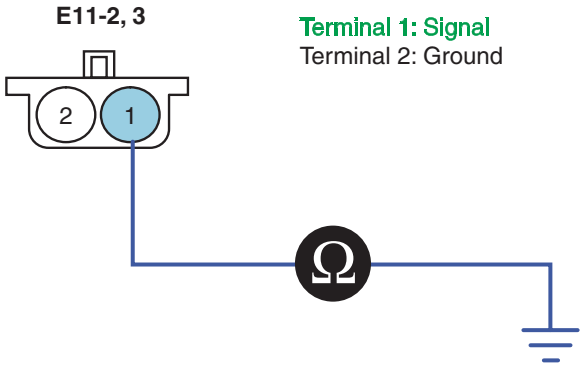
▶ Repair open circuit and then go to "Verification of vehicle repair" procedure.

3. Power Supply Short to Ground Inspection

1) Turn the ignition OFF.

2) Disconnect injector #2,#3 connector(E11-2,3) and ECM connector(F39-1).

3) Measure resistance between terminal 1 of injector #2,#3 harness connector and chassis ground.



SUDFL8316L

■ Specification: Infinite

4) Is the resistance measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to ground and then go to "Verification of vehicle repair" procedure.

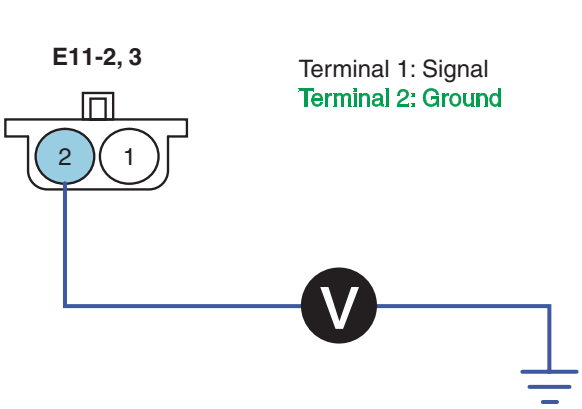
GROUND CIRCUIT INSPECTION E0A9EC54

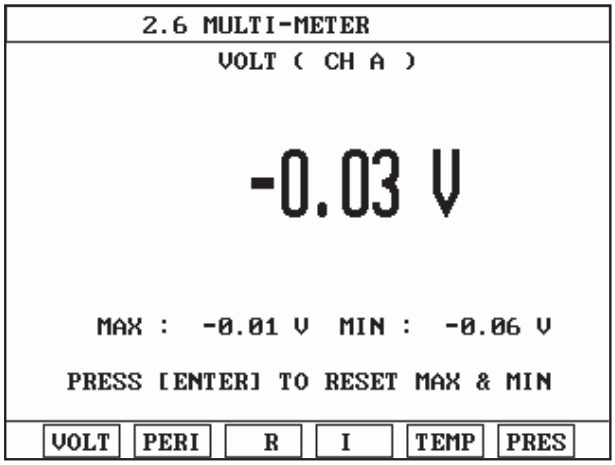
1. Ground Voltage Drop Inspection

1) Disconnect injector #2,#3 connector(E11-2,3).

2) Turn the ignition ON. The engine stops.

3) Measure voltage drop between terminal 2 of injector #2, #3 harness connector and chassis ground.





SUDFL8317L

■ Specification: Ground voltage drop-Within 200mV

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

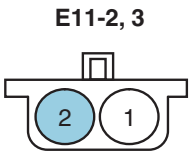
▶ Repair the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

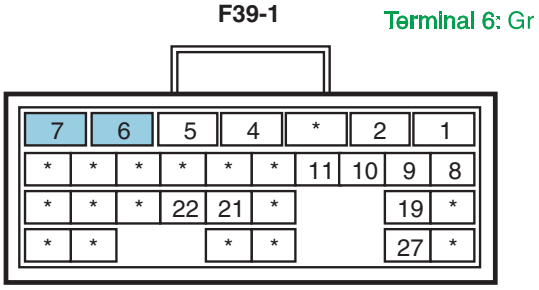
1) Turn the ignition OFF.

2) Disconnect injector #2, #3 connector(E11-2,3) and ECM connector(F39-1).

3) Measure resistance between terminal 2 of injector #2, #3 harness connector(E11-2,3) and terminal 6,7 of ECM connector(F39-1).



Terminal 1: Signal
Terminal 2: Ground



YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

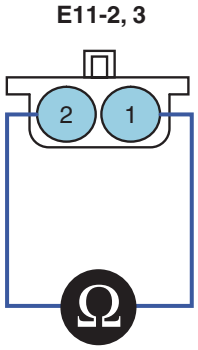
COMPONENT INSPECTION EF62AE7F

1. Injector Component Inspection

   1) Turn ignition OFF.

   2) Disconnect injector #2, #3 connector(E11-2,3).

   3) Measure resistance between terminal 1 and 2 of injector#2, #3 connector.



Terminal 1: Signal
Terminal 2: Ground

■ Specification

Item	Specification
Resistance	0.45Ω(20˚C)

SUDFL8319L

   4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the injector and then go to "Verification of Vehicle Repair" procedure.

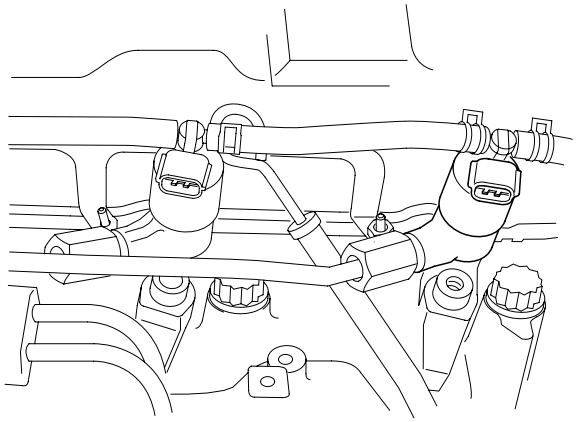
VERIFICATION OF VEHICLE REPAIR E40817AB

Refer to DTC P0112.

DTC P2151 INJECTION COMMON #2 VOLTAGE - HIGH

COMPONENT LOCATION E5EF0649

Injector



SUDFL8098L

DESCRIPTION E94F3F09

1. GENERAL DESCRIPTION
   Injector carries out function to inject fuel amount calculated by ECM by making diesel spread with small particles to combustion chamber compressed with high pressure. Fuel injected generates power through combustion process.
   Purpose to increase fuel pressure of common rail diesel engine up to Max. 1,600 bar is to make fuel into small particles, small particles of fuel are related to smoke reduction, high power of engine, fuel consumption improvement etc.
   Also, hydraulic servo type is used to control fuel pressure of 1,600 bar with solenoid, injector solenoid is driven by current after increasing solenoid driving voltage up to 135V.
   Multi injection is possible by applying fuel injection which is not mechanic injector but electric control injector.
   ECM injects fuel after dividing into two stages of pilot injection and main injection and it is possible to control Injection time and injection amount independently to each cylinder. Power, torque, exhaust gas, fuel consumption improvement etc. can be optimized by controlling engine to optimum fuel injection amount.

2. DTC DESCRIPTION
   If crank rotating angle is 2,159.7 degree or more due to short to B+ of injectors #2 and #3, ECM judges this as a fault and DTC is set. The possible causes are short to terminal 6,7(power) of ECM connector(F39-1) and wiring problem etc.
   Lack of engine power will occur since fuel amount is limited to below 40mm³/st in case of fail safe. There may cause damage to engine if the vehicle is driven for a long time with faulty injector.

DTC DETECTING CONDITION EA96687B

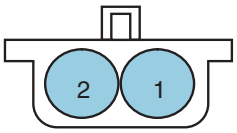
<table>
<tr><th>Item</th><th colspan="3">Detecting Condition</th><th>Possible Cause</th></tr>
<tr><td>DTC Strategy</td><td colspan="3">• Voltage monitoring</td><td rowspan="4">• Short to B+ of terminal 6,7 of ECM connector(F39-1)
• Wiring problem</td></tr>
<tr><td>Enable Conditions</td><td colspan="3">• Ignition ON</td></tr>
<tr><td>Threshold Value</td><td colspan="3">• Short to B+ of injectors #2, #3 simultaneously</td></tr>
<tr><td>Diagnosis Time</td><td colspan="3">• 2,159.7 CA(Crank angle) or more</td></tr>
<tr><td rowspan="3">Fail Safe</td><td>Fuel Cut</td><td>No</td><td rowspan="3">• Fuel amount is limited to below 40mm³/st .
• Lack of engine power</td><td rowspan="3"></td></tr>
<tr><td>Fuel Limit</td><td>Yes</td></tr>
<tr><td>MIL</td><td>ON</td></tr>
</table>

SPECIFICATION E9B90987

Injector resistance(terminal-to-terminal)

Item	Specification
Resistance	0.45Ω (At 20˚C)
Injector driving voltage	135V
Injector driving current	20A
Injector control type	Current control

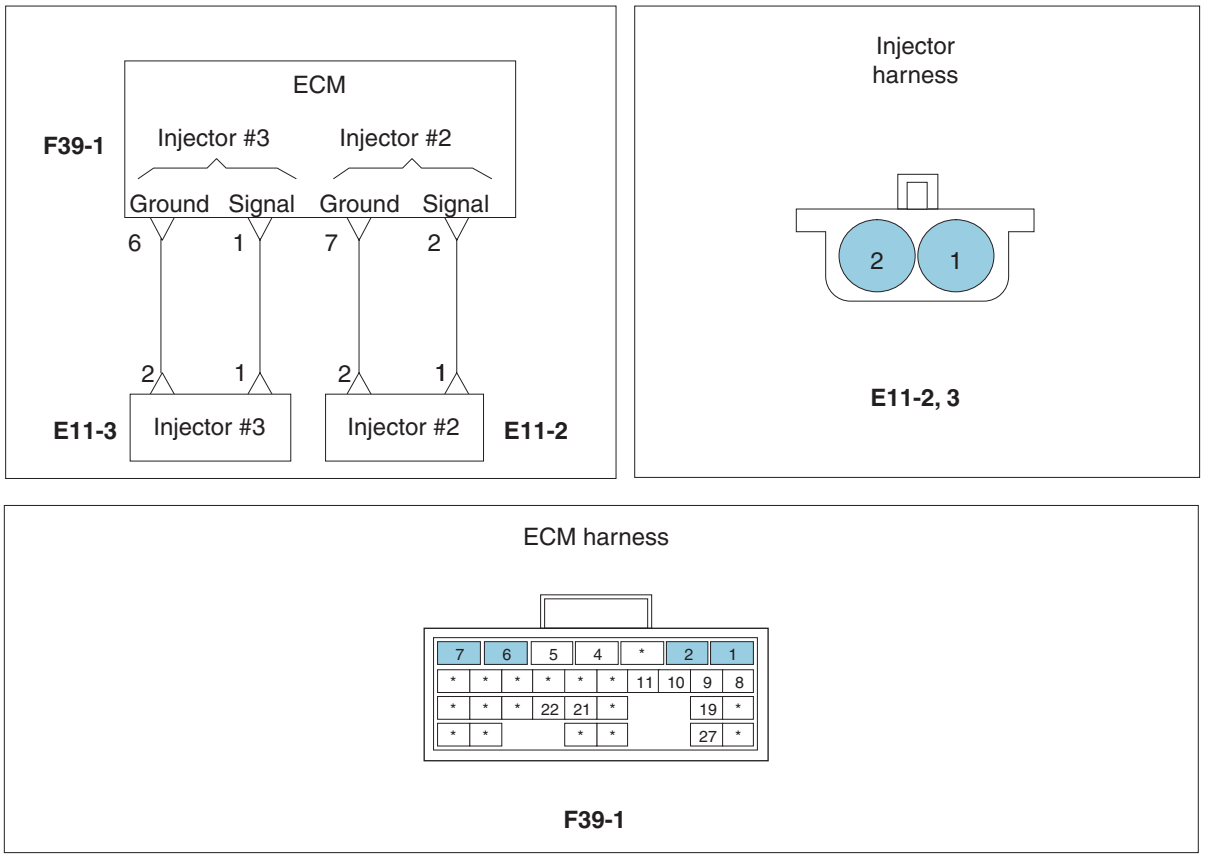
Terminal 1: Signal
Terminal 2: Ground



Sensor connector

SUDFL8099L

SCHEMATIC DIAGRAM E435C87B



SNBFL8156L

SIGNAL WAVEFORM E5B5BD49

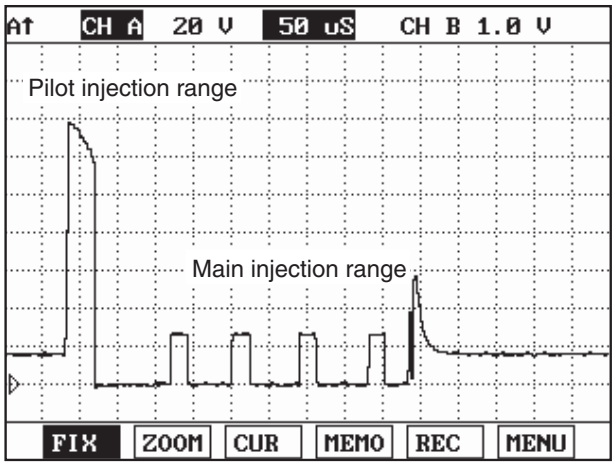


Fig. 1 Low side waveform when activating injector(Ground side)

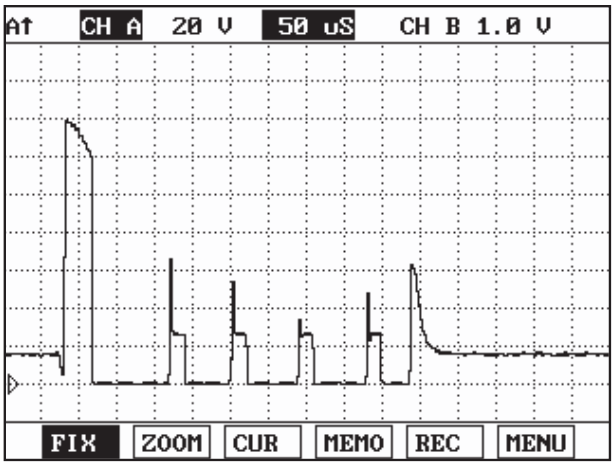


Fig. 2 High side injector power waveform(Signal side)

Fig.1) is divided into pilot injection range and main injection range as low side waveform when activating injector.
Fig.2) is high side injector power waveform.

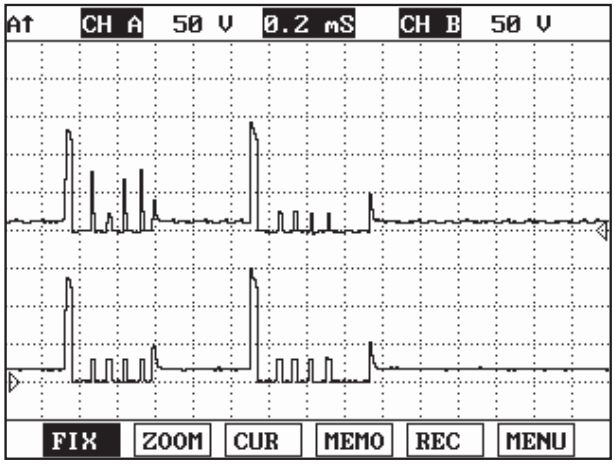


Fig. 3 Injector power waveform combined with High/Low side

SUDFL8101L

NOTE

Waveforms of Fig.1) and Fig.2) are displayed by turns in the course of checking injector waveform in LOW side. The reason that the waveform like a Fig.2) is displayed is used in LOW side in common the power of HIGH side of injector #2, #3 or injector #2, #3 which is not activated.

MONITOR SCAN TOOL DATA E63B1BDD

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Fuel injection amount" parameter on the scan tool.

NOTE

The scan tool data indicate engine rpm information related to "Fuel injection amount" parameter depending on DTC detecting conditions. Be sure to check that "Fuel amount" is limited to below 40㎣/st in case of fail safe.

■ Specification: Fuel amount - Approx. 9.0~10.5 ㎣/st at idle

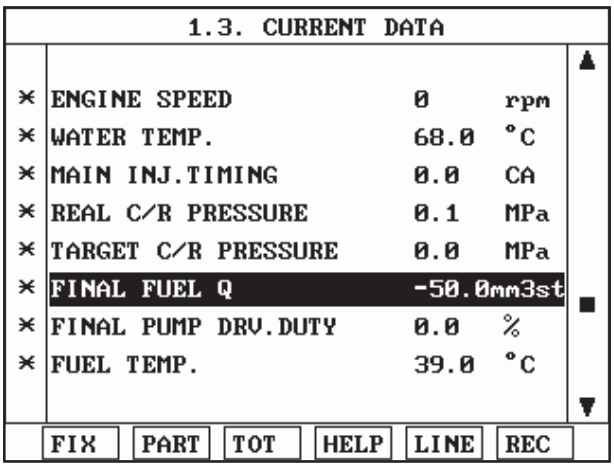


Fig. 1 Fuel injection amount data at ignition ON

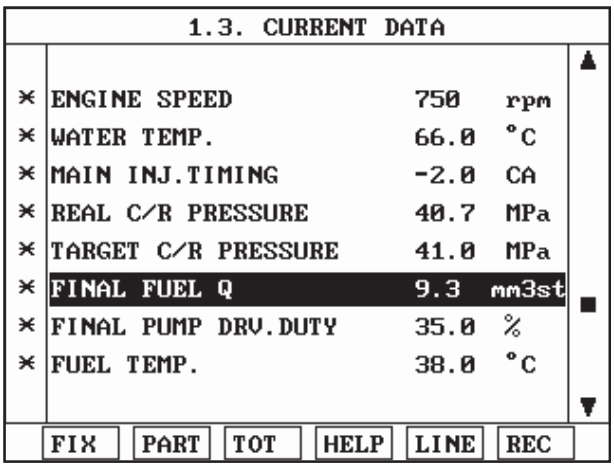


Fig. 2 Fuel injection amount data at idle

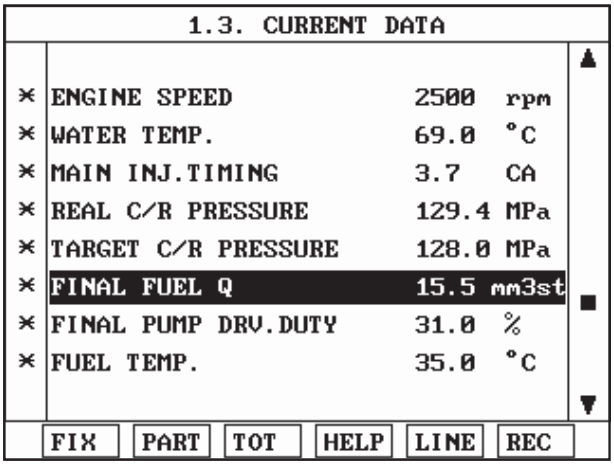


Fig. 3 Fuel injection amount data at 2,500rpm

SUDFL8102L

TERMINAL & CONNECTOR INSPECTION ECBFC0AA

Refer to DTC P0112.

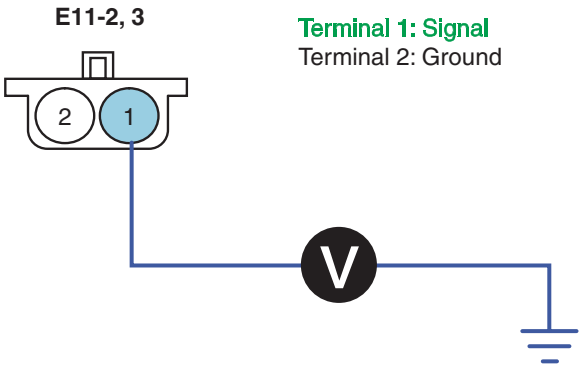
POWER SUPPLY INSPECTION EDAF4E1C

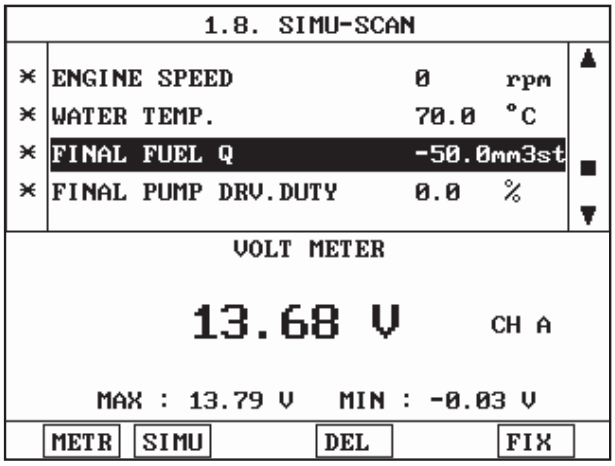
1. Power Supply Voltage Inspection

   1) Leave injector #2, #3 connector(E11-2, 3) installed.

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage between terminal 1 of the injector #2,#3 and chassis ground.





▶ With injector #2, #3 connector disconnected/connected (At IG ON)

SUDFL8314L

■ Specification: Injector #2, #3 signal power approx. 13.57 V

4) Is the voltage measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

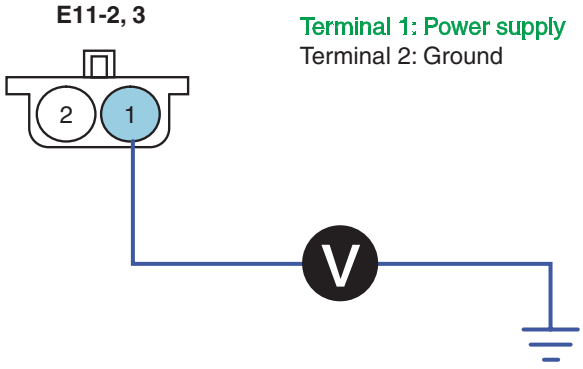
▶ Go to "Power Supply Short to Power Inspection" procedure.

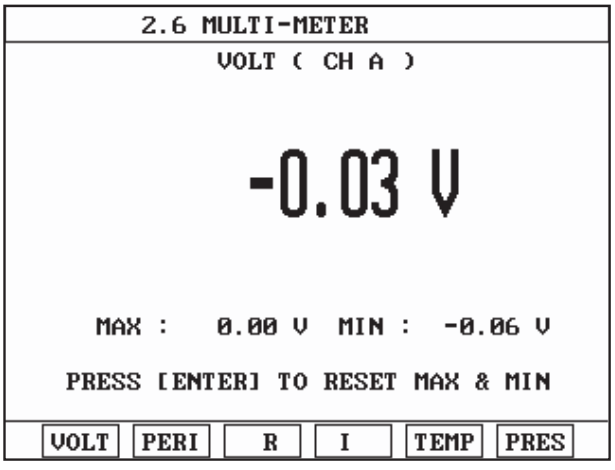
2. Power Supply Short to Power Inspection

1) Disconnect injector #2,#3 connector(E11-2,3) and ECM connector(F39-1).

2) Turn the ignition ON. The engine stops.

3) Measure voltage between terminal 1 of injector #2, #3 harness connector and chassis ground.





SUDFL8321L

■ Specification: Below 0~0.1V

4) Is the voltage measured within specification?

YES

▶ Go to "Ground Circuit Inspection" procedure.

NO

▶ Repair short to power and then go to "Verification of vehicle repair" procedure.

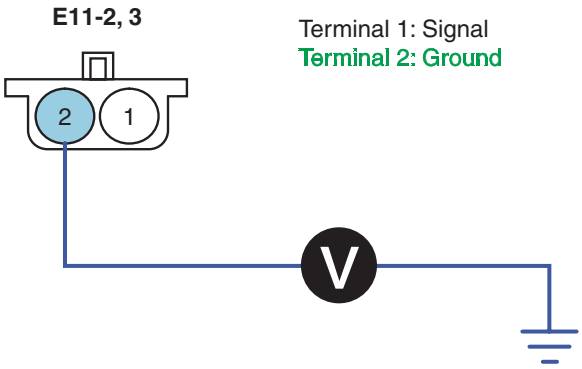
GROUND CIRCUIT INSPECTION EC2277FB

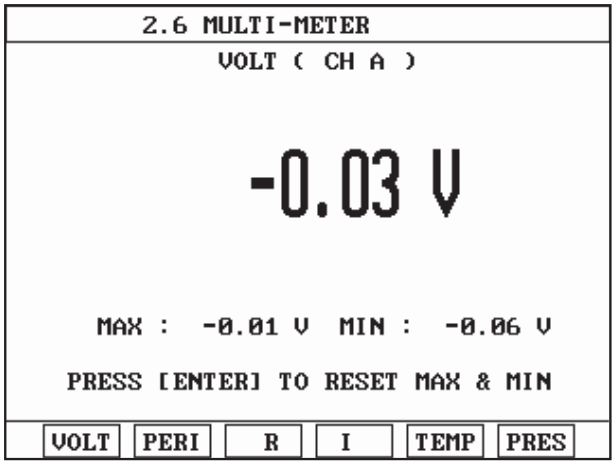
1. Ground Voltage Drop Inspection

   1) Disconnect injector #2,#3 connector(E11-2,3).

   2) Turn the ignition ON. The engine stops.

   3) Measure voltage drop between terminal 2 of injector #2, #3 harness connector and chassis ground.





SUDFL8317L

■ Specification: Ground voltage drop-Within 200mV

   4) Is the voltage measured within specification?

YES

▶ Go to "Ground Open Inspection" procedure.

NO

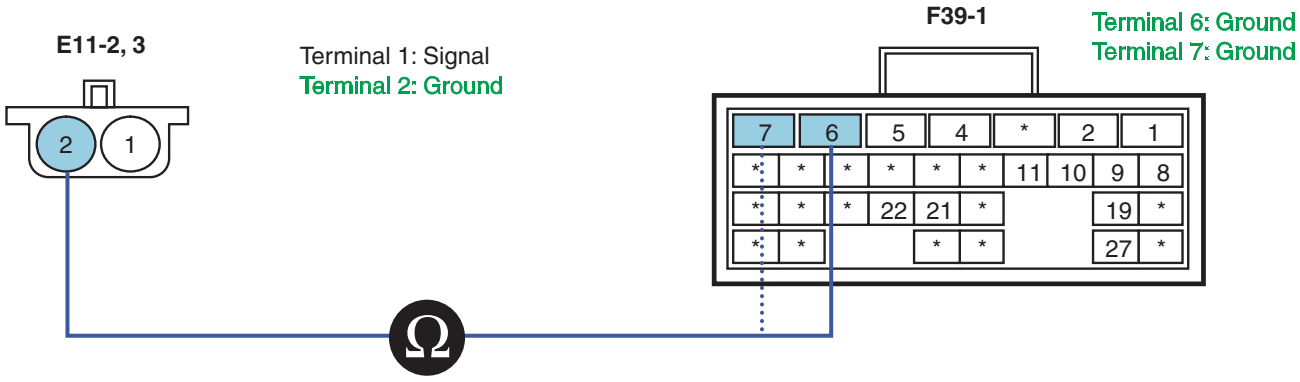
▶ Repair the cause of excessive resistance and then go to "Verification of Vehicle Repair" procedure.

2. Ground Open Inspection

   1) Turn the ignition OFF.

   2) Disconnect injector #2, #3 connector(E11-2,3) and ECM connector(F39-1).

   3) Measure resistance between terminal 2 of injector #2, #3 harness connector(E11-2,3) and terminal 6, 7 of ECM connector(F39-1).



SNBFL8158L

■ Specification: Continuity(Below 1.0 Ω)

4) Is the resistance measured within specification?

YES

▶ Go to "Component Inspection" procedure.

NO

▶ Repair open circuit and then go to "Verification of Vehicle Repair" procedure.

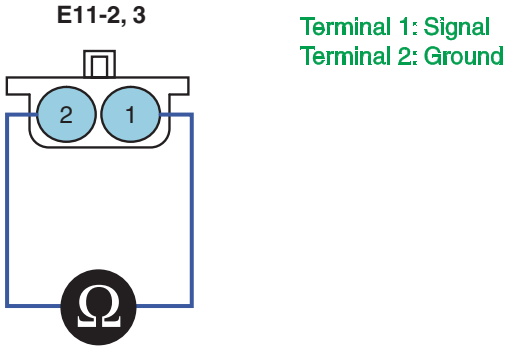
COMPONENT INSPECTION EAAB871B

1. Injector Component Inspection

1) Turn ignition OFF.

2) Disconnect injector #2, #3 connector(E11-2,3).

3) Measure resistance between terminal 1 and 2 of injector#2, #3 connector.



■ Specification

Item	Specification
Resistance	0.45Ω(20˚C)

SUDFL8319L

4) Is the resistance measured within specification?

YES

▶ Go to "Verification of Vehicle Repair" procedure.

NO

▶ Replace the injector and then go to "Verification of Vehicle Repair" procedure.

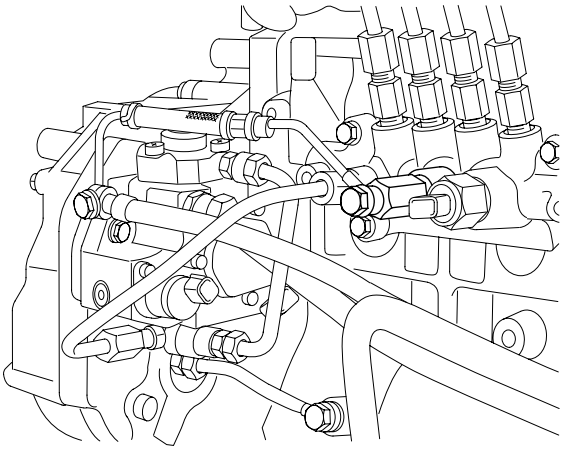
VERIFICATION OF VEHICLE REPAIR E4DE9933

Refer to DTC P0112.

DTC P2293 FUEL PRESSURE REGULATOR 2 PERFORMANCE

COMPONENT LOCATION E740CD96

Fuel pressure limiter valve



SUDFL8400L

DESCRIPTION E44903C0

1. If the pressure limiter detects abnormal high pressure in the common rail system, it works and plays a role to return fuel to the fuel tank to protect system.
   If the engine is started with SCV connector disconnected, the vehicle is driven with fuel line clogged or the engine is started without fuel in the fuel line, there is a possibility to display this code. Therefore, fuel filter should be replaced according to service interval. When the vehicle performs the initial start, be sure to try to start the engine after replacing it with a new one and feeding fuel to fuel pump by priming the pump with a priming pump.

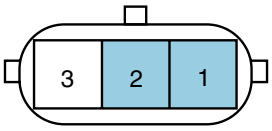
2. DTC DESCRIPTION
   If common rail pressure sensor has malfunction or fuel pressure in the rail is detected above 2,210 bar or more for 16.0ms or more, the ECM judges this as a fault and DTC is set.

DTC DETECTING CONDITION EB8CBBDD

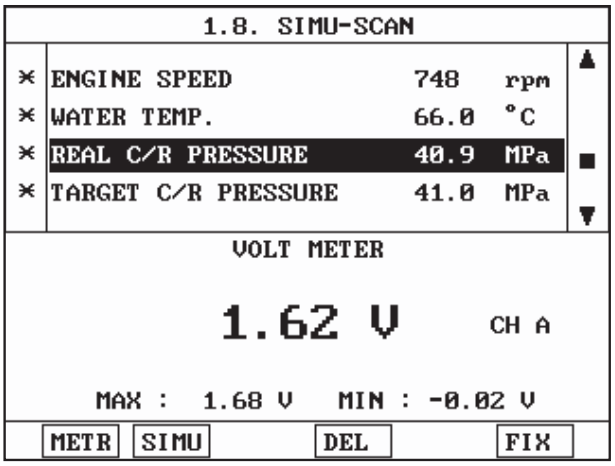
Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Check low pressure fuel line for clogging. • Check fuel filter for clogging. • Check SCV connector for connection. • Check common rail assembly.
Enable Conditions	• Running			
Threshold Value	• When common rail pressure sensor has malfunction or fuel pressure in the rail rises 2,210 bar or more			
Diagnosis Time	• 16.0 ms or more			
Fail Safe	Fuel Cut	No	• Engine power is limited	
	Fuel Limit	Yes		
	MIL	ON		

SPECIFICATION E2104A83

Rail pressure sensor	Specification
Output voltage	Below 1.7V (At idle after engine warming-up)
Rail pressure	350~500 bar(Engine idling)



Sensor connector

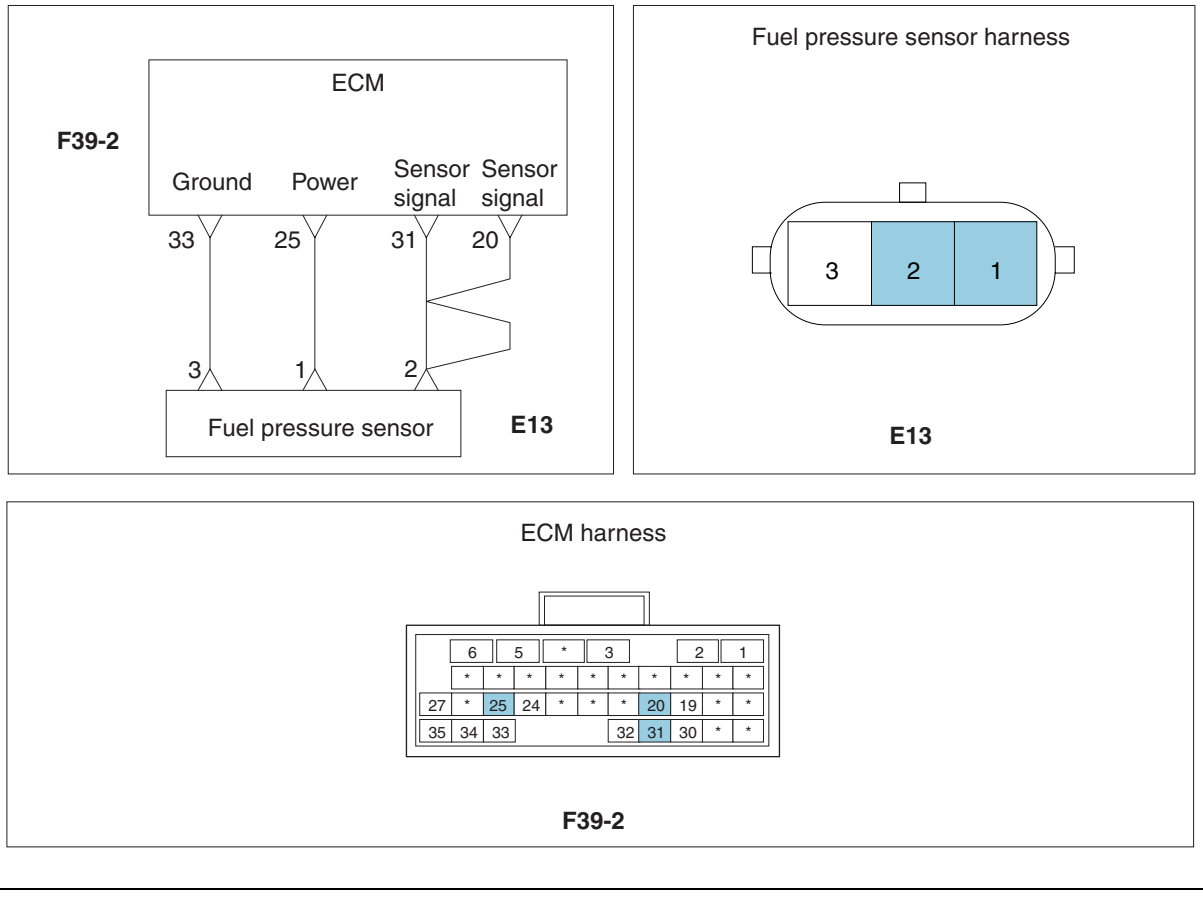


Terminal 1: Power
Terminal 2: Sensor signal
Terminal 3: Ground

Resistance	Specification
1, 2번	3 KΩ
1, 3번	13 KΩ
2, 3번	16.4 KΩ

SNBFL8160L

SCHEMATIC DIAGRAM E375222C



SNBFL8161L

SIGNAL WAVEFORM EBC47636

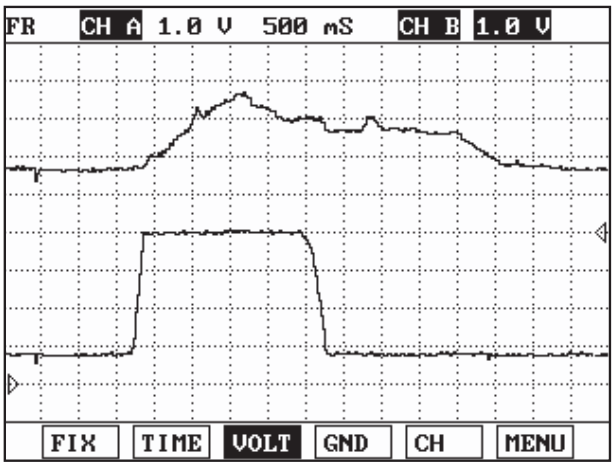
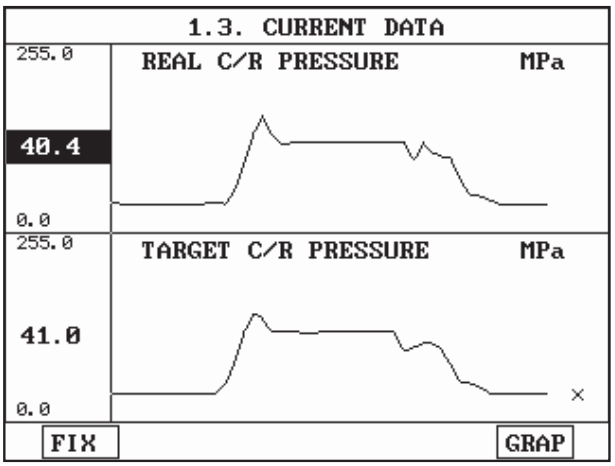


Fig. 1 Check with oscilloscope waveform



Reference Check with control information

Fig1) This is waveform checked together with accelerator pedal position sensor 1 and rail pressure sensor and it is confirmable that rail pressure sensor output is increased at sudden acceleration.

SUDFL8003L

MONITOR SCAN TOOL DATA E4068180

1. Connect scan tool to the self-diagnosis connector.
2. Warm up the engine to the normal operating temperature.
3. Turn the electric equipment and air conditioner OFF.
4. Monitor "Rail pressure" parameter on the scan tool.

■ Specification: 400±20 bar (at idle)

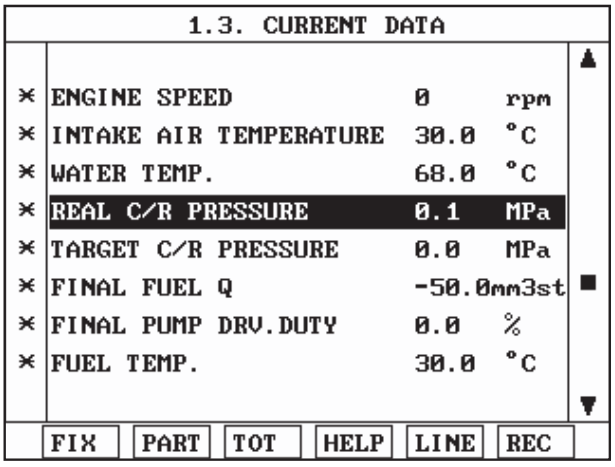


Fig. 1 Fuel pressure sensor data at ignition ON

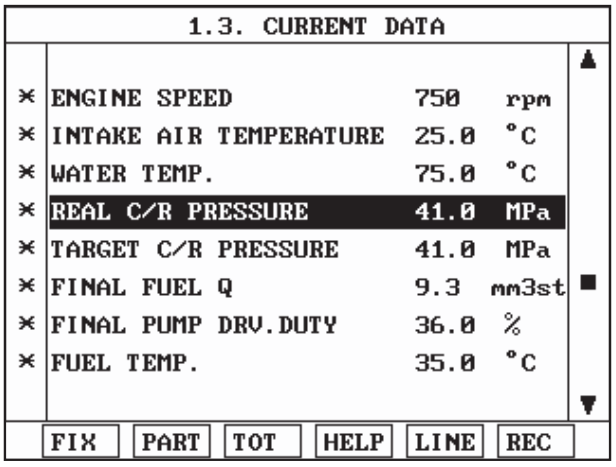


Fig. 2 Fuel pressure sensor data at idle

SUDFL8004L

Fig.1)~2) Check "Rail pressure" parameter at idle after warming-up the engine.

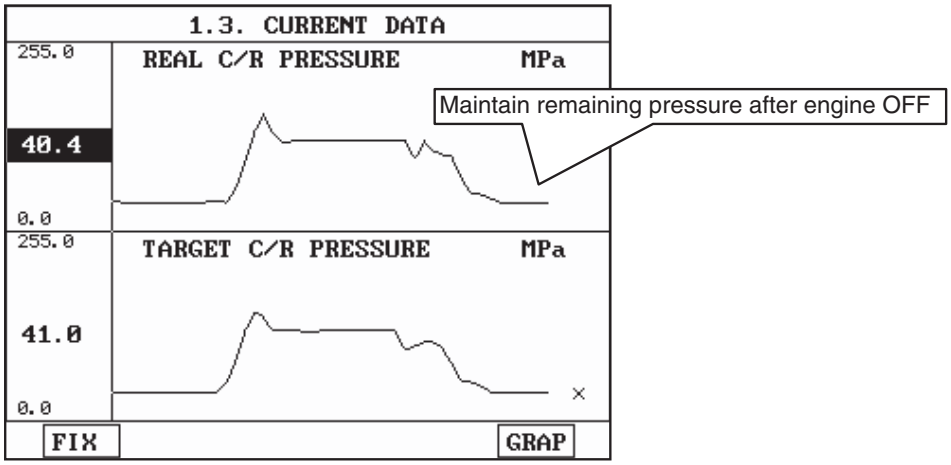
Monitor the pressure change of rail pressure sensor after starting the engine. Approx. 400 bar is produced at Idle after warming-up and also it is important to check duty of rail pressure regulator. Check that duty of 36.5% is displayed like above service data. The data rise depending on acceleration or load and rail pressure rises to max. 1,400 bar and the duty of rail pressure regulator rises to 95%.

TROUBLESHOOTING AIDS E220D345

It is necessary for DTC related to rail pressure malfunction to comprehensively diagnose high pressure fuel system(the bad high pressure formation of high pressure pump, the poor air tightness, the stuck of ball valve seat, the clogging of overflow valve, the fuel leak of injector nozzle or return line) and low pressure fuel system(the bad fuel supply of low pressure pump, the clogging of fuel filter).

NOTE

When common rail fuel pressure is "2,210 bar" or more excessively, the overflow valve opens valve and plays a role to return fuel to fuel tank to protect fuel system.



SUDFL8005L

Above waveform graph is the data indicating pressure change of rail pressure sensor at starting and ignition OFF. It is possible to comprehensively diagnose fuel system by checking time that pressure is made up to approx. 400 bar to common rail at starting and pressure condition to maintain inside common rail at the ignition OFF.

1. It is important that rail pressure rises rapidly
   It is easy to check the supply condition of low pressure pump, the high pressure formation of high fuel pressure and the air tightness condition of rail pressure regulator, injector nozzle and return side

2. It is important that air tightness is maintained below 101 bar of spring tension of common rail pressure regulator at ignition OFF and fuel pressure is lowered slowly.
   It is easy to diagnose air tightness state of rail pressure regulator, injector nozzle and return side.

CAUTION

The main relay is turned off if the ignition key is in OFF position. Therefore, the ignition key should be in ON position not to loose data and not to cut off communication.

TERMINAL & CONNECTOR INSPECTION E6E439E3

Refer to DTC P0112.

COMPONENT INSPECTION E2F4B9BC

1. Fuel Supply System Visual Inspection
   1) Turn the ignition OFF.
   2) Check fuel hose, pipe for crack, bending, deformation, burned or clogging etc.
   3) Check fuel filter for clogging, damage or contamination.
   4) Check SCV connector for connection.
   5) Check that common rail is good or not.
   6) Check fuel.
   7) Is there any problem in fuel and fuel supply system?

      YES

      ▶ Repair if there is problem and then go to "Verification of Vehicle Repair" procedure.

      NO

      ▶ Go to "Verification of Vehicle Repair" procedure.

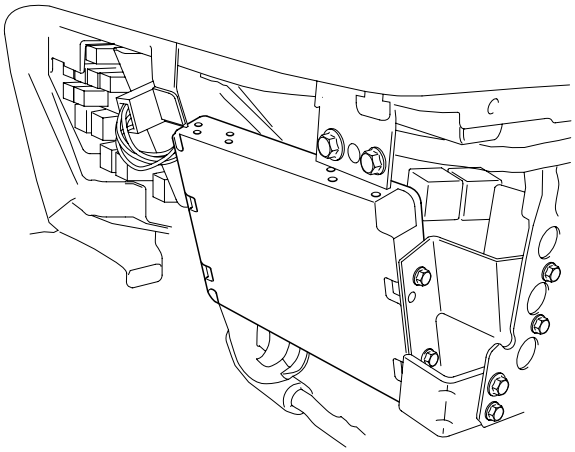
VERIFICATION OF VEHICLE REPAIR E360AD73

Refer to DTC P0112.

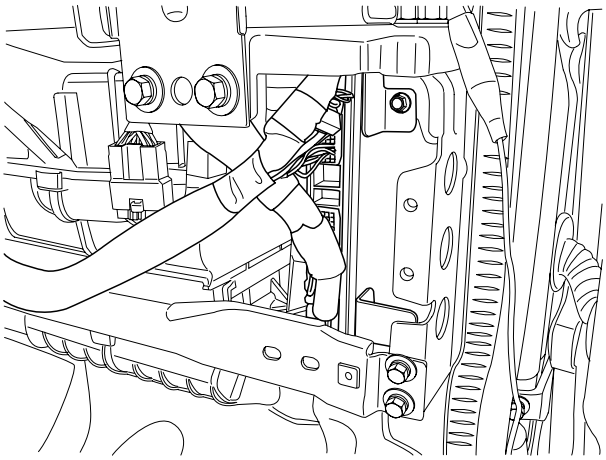
DTC P2503 CHARGING SYSTEM VOLTAGE LOW

COMPONENT LOCATION E5EAC544

ECM location-Under glove box



[Narrow cab vehicle]



[Wide cab]

SUDFL8342L

DESCRIPTION E1A5E2A5

1. The ECM should be able to effectively control the injector that hydraulic pressure of max. 1,800 bar is applied. The injector, electronic diesel engine, is current control type and the change of driving voltage converts into change of current and compensates for injector driving current value by detecting injector driving voltage.
   When the voltage change of range that exceeds current compensation limit according to the change of injector driving voltage of ECM occurs, fuel injection control that the ECM targets is impossible and ECM controls fuel and fuel pressure supplied to engine with a certain amount and limits vehicle output.

2. DTC DESCRIPTION
   If "No charge" in the circuit inside ECM is detected for 360CA or more, the ECM judges this as a fault and DTC is set. The probable cause may be bad booster system in voltage, poor charging of alternator, faulty ECM. In case of fail safe, lack of engine power will occur since fuel amount is limited to below 40mm³/st, fuel pressure is limited to 400 bar. PTO(if equipped) operation stops and engine power is restricted, starting is impossible.

DTC DETECTING CONDITION E64D86B1

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Alternator • Charging circuit • Faulty ECM inside
Enable Conditions	• IG ON/ Running			
Threshold Value	• "No charge" in the circuit inside ECM is detected			
Diagnosis Time	• 360 CA or more			
Fail Safe	Fuel Cut	No	• Fuel amount is limited below 40mm³/st. • Fuel pressure is limited to 400 bar. • PTO control stops. • Engine power is restricted and starting is impossible.	
	Fuel Limit	Yes		
	MIL	ON		

TERMINAL & CONNECTOR INSPECTION EC9EC06C

Refer to DTC P0112.

COMPONENT INSPECTION E56F2115

1. Turn the ignition OFF. The engine stops.
2. Remove the ECM from the vehicle.
3. Check that the vehicle is in normal operation after replacing the suspected ECM with a good one temporarily.
4. If the problem is solved, replace the ECM.

TROUBLESHOOTING AID EF5C76E1

There is no special diagnosis procedure about this DTC because of the internal error of ECM. Check that the vehicle is in normal operation after replacing the suspected ECM with a good one temporarily. If the problem is solved, replace the ECM.

NOTE

Be sure to correct injector QR correction value(30 digits) ECM data mentioned below by using the scan tool When replacing the ECM. In case correction value marked in the injector is not corrected in the ECM, there may be problems in engine performance and exhaust gas.

1. *Input the upgrade when replacing the ECM*
2. *Correct ECM data*
   a) *Input QR code data*
   b) *Gear ratio correction value*
   c) *Input final reduction ratio/ tire*
   d) *Input VIN*

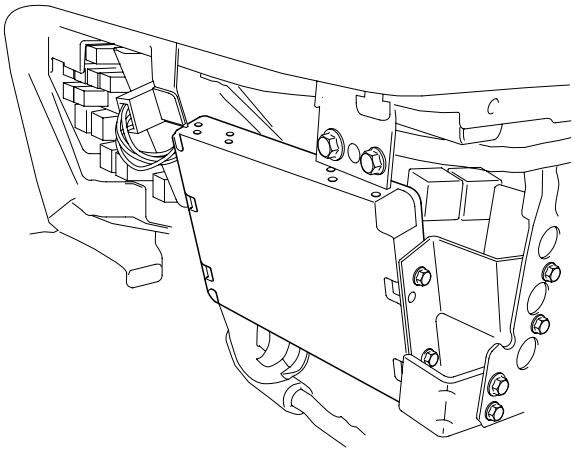
VERIFICATION OF VEHICLE REPAIR E8E38374

Refer to DTC P0112.

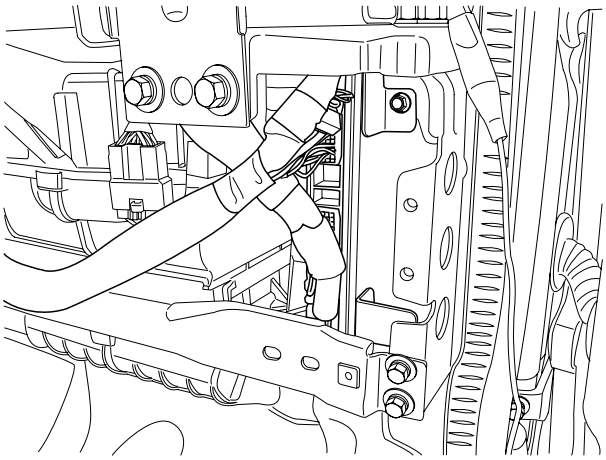
DTC P2504 CHARGING SYSTEM VOLTAGE HIGH

COMPONENT LOCATION E7F66502

ECM location-Under glove box



[Narrow cab vehicle]



[Wide cab]

SUDFL8342L

DESCRIPTION E049BC68

1. The ECM should be able to effectively control the injector that hydraulic pressure of max. 1,800 bar is applied. The injector, electronic diesel engine, is current control type and the change of driving voltage converts into change of current and compensates for injector driving current value by detecting injector driving voltage.
   When the voltage change of range that exceeds current compensation limit according to the change of injector driving voltage of ECM occurs, fuel injection control that the ECM targets is impossible and ECM controls fuel and fuel pressure supplied to engine with a certain amount and limits vehicle output.

2. DTC DESCRIPTION
   If "Over charge" in the circuit inside ECM is detected for 360CA or more, the ECM judges this as a fault and DTC is set. The probable cause may be bad booster system in voltage, poor charging of alternator, faulty ECM. In case of fail safe, lack of engine power will occur since fuel amount is limited to below 40mm³/st, fuel pressure is limited to 400 bar.

DTC DETECTING CONDITION EFE948A2

Item	Detecting Condition			Possible Cause
DTC Strategy	• Voltage monitoring			• Alternator • Charging circuit • Faulty ECM inside
Enable Conditions	• IG ON/ Running			
Threshold Value	• "Over charge" in the circuit inside ECM is detected			
Diagnosis Time	• 360 CA or more			
Fail Safe	Fuel Cut	No	• Fuel amount is limited below 40mm³/st. • Fuel pressure is limited to 400 bar. • PTO control stops. • Engine power is restricted and starting is impossible.	
	Fuel Limit	Yes		
	MIL	ON		

TERMINAL & CONNECTOR INSPECTION ECF89C74

Refer to DTC P0112.

COMPONENT INSPECTION EEE50A12

1. Turn the ignition OFF. The engine stops.
2. Remove the ECM from the vehicle.
3. Check that the vehicle is in normal operation after replacing the suspected ECM with a good one temporarily.
4. If the problem is solved, replace the ECM.

TROUBLESHOOTING AID E3C24C32

There is no special diagnosis procedure about this DTC because of the internal error of ECM. Check that the vehicle is in normal operation after replacing the suspected ECM with a good one temporarily. If the problem is solved, replace the ECM.

NOTE

Be sure to correct injector QR correction value(30 digits) ECM data mentioned below by using the scan tool When replacing the ECM. In case correction value marked in the injector is not corrected in the ECM, there may be problems in engine performance and exhaust gas.

1. *Input the upgrade when replacing the ECM*
2. *Correct ECM data*
   a) *Input QR code data*
   b) *Gear ratio correction value*
   c) *Input final reduction ratio/ tire*
   d) *Input VIN*

VERIFICATION OF VEHICLE REPAIR E38EAE8C

Refer to DTC P0112.