CATERPILLAR®

SENR1065-05

Troubleshooting

3408E and 3412E Industrial Engines

S/N: 4CR1-UP

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3408E and 3412E Industrial Engines

Media Number -SENR1065-05 **Publication Date -01/03/2009** **Date Updated -02/03/2009**

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Analog Sensor Supply Circuit - Test

SMCS - 1408-081; 1900-081-NS

System Operation Description:

The analog sensor supply provides power to all analog sensors. The engine has the following analog sensors:

- Atmospheric pressure
- Auxiliary pressure
- Coolant temperature
- Engine oil pressure
- Engine oil temperature
- Fuel temperature
- Fuel pressure
- Injection actuation pressure
- Inlet air temperature
- Turbocharger outlet pressure

The ECM supplies 5.0 ± 0.5 VDC from J1:36 (Analog Sensor +5V) to each analog sensor. The analog sensor return connects to J1:30 (Analog Sensor Return).

The analog sensor supply is output short circuit protected. A short circuit to the battery will not damage the circuit inside the ECM.

Note: The analog sensors are not protected from overvoltage. Directly connecting the analog sensor to battery voltage can result in damage.

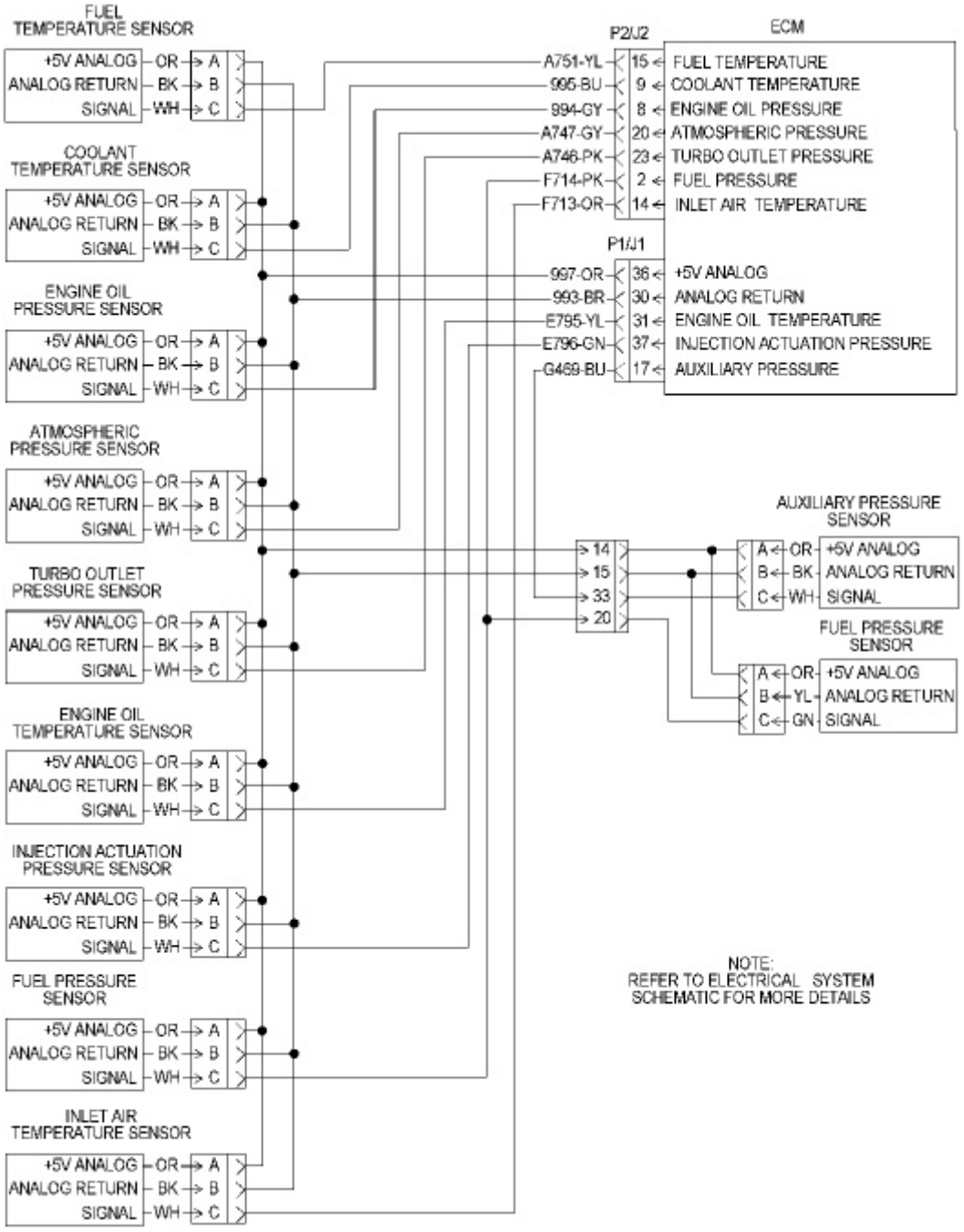

Illustration 1 g01852233

Schematic

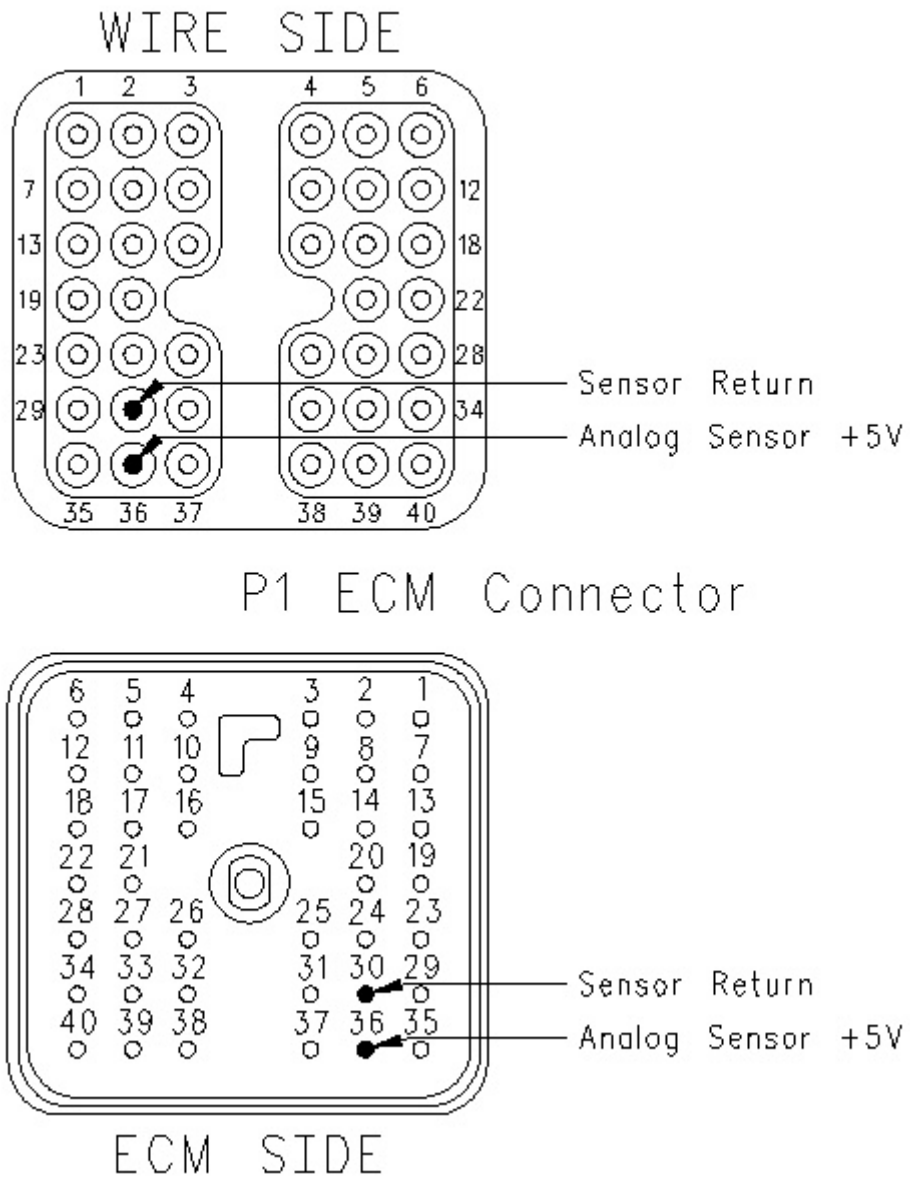

Illustration 2 g00886096

P1 ECM Connector

Test Step 1. Inspect Electrical Connectors and Wiring

A. Turn the keyswitch to the OFF/RESET position.

B. Thoroughly inspect ECM connector J1/P1, customer connector J3/P3, and all other connectors in the wiring harness. Refer to Troubleshooting, "Electrical Connectors - Inspect" for details.

C. Verify that all wires that are associated with the analog sensors are connected in the correct location.

Expected Result:

All connectors, pins, and sockets should be completely inserted and coupled. The harness and wiring should be free of corrosion, abrasion, and pinch points. All connections and grounds should be tight and free of corrosion.

Results:

- **OK -** Proceed to Test Step 2.
- **Not OK -**

  Repair: Repair the circuit.Verify that the repair eliminates the problem.

  STOP

Test Step 2. Check Power Supply to the ECM

A. Connect the Caterpillar Electronic Technician (Cat ET) to the service tool connector.

B. Turn the keyswitch to the ON position.

C. Monitor "Battery Voltage" on the status screen of Cat ET.

Expected Result:

The ECM is receiving the correct voltage from the battery.

Results:

- **OK -** The ECM is receiving the correct voltage from the battery. Proceed to Test Step 3.
- **Not OK -** The ECM is not receiving the correct voltage from the battery.

  Repair: Troubleshoot the ECM power supply before continuing with this test.

  STOP

Test Step 3. Check the Analog Sensors for Internal Shorts

A. Turn the keyswitch to the OFF/RESET position and install a **7X-1715** Adapter Cable (40-Pin Breakout T) at the J1/P1 ECM connector.

B. Turn the keyswitch to the ON position.

C. Measure the voltage across terminal 36 (Analog Sensor +5V) and terminal 30 (Sensor Return) of the breakout T.

D. Monitor the voltage while you disconnect each analog sensor.

Expected Result:

The analog sensor supply voltage will increase to 5 ± 0.5 VDC when the bad sensor is disconnected.

Results:

- **OK -** One of the sensors appear to be internally shorted.

Repair: Temporarily connect a new sensor.Verify that the replacement sensor solves the problem before you permanently install the new sensor.

STOP

- **Not OK -** None of the analog sensors are internally shorted. Leave the sensors disconnected. Proceed to Test Step 4.

Test Step 4. Check the Analog Sensor Supply Voltage at the Sensor Connectors

A. Turn the keyswitch to the OFF/RESET position.

B. Reconnect the J1/P1 ECM connector.

C. Turn the keyswitch to the ON position.

D. Measure the voltage across terminal A (+5V Analog) and terminal B (Sensor Return) on the harness side of each sensor connector.

Expected Result:

The analog sensor supply voltage should be 5.0 ± 0.5 VDC at each sensor connector.

Results:

- **OK -** The supply voltage is reaching the sensors. The circuit appears to be working correctly at this time.

  Repair: If the problem is intermittent refer to Troubleshooting, "Electrical Connectors - Inspect".

  STOP

- **Not OK -** The supply voltage is not reaching the sensors. Leave the sensors disconnected. Proceed to Test Step 5.

Test Step 5. Check for Shorts in the Harness

A. Turn the keyswitch to the OFF/RESET position.

B. Disconnect the J1/P1 ECM connector and all of the analog sensors.

C. Measure the resistance between P1:36 (Analog Sensor +5V) and P1:30 (Analog Sensor Return).

D. Measure the resistance between P1:36 (Analog Sensor +5V) and engine ground.

Expected Result:

The resistance should be greater than 20,000 Ohms.

Results:

- **OK -** Proceed to Test Step 6.

- **Not OK -** There is a short between the ECM and the analog sensors.

Repair: Repair the circuit.Verify that the repair eliminates the problem.

STOP

Test Step 6. Check the Analog Sensor Supply Voltage at the ECM

A. Turn the keyswitch to the OFF/RESET position.

B. Remove the wires from P1:36 (Analog Sensor +5V) and P1:30 (Sensor Return).

C. Turn the keyswitch to the ON position.

D. Measure the voltage across P1:36 (Analog Sensor +5V) and P1:30 (Sensor Return) at the P1 ECM connector.

Expected Result:

The supply voltage should be 5.0 ± 0.5 VDC.

Results:

- **OK -** The ECM is supplying the correct voltage, but there is an open in the harness between the ECM and the analog sensors.

  Repair: Repair the circuit.Verify that the repair eliminates the problem.

  STOP

- **Not OK -** The ECM is not supplying the correct voltage.

  Repair: Verify your results.Replace the ECM. Refer to Troubleshooting, "Replacing the ECM" before replacing the ECM.Verify that the repair eliminates the problem.

  STOP

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Engine Wiring Information

SMCS - 1408

The wiring schematics are revised periodically. The wiring schematics will change as updates are made to the engine's harness. For the most current information, always check the revision number of the schematic. Use the schematic with the latest revision number.

Harness Wire Identification

Caterpillar identifies all wires with eleven solid colors. The circuit number is stamped on the wire at a 25 mm (1 inch) spacing. Table 1 lists the wire colors and the color codes.

Table 1

Color Codes for the Harness Wire			
Color Code	**Color**	**Color Code**	**Color**
BK	Black	GN	Green
BR	Brown	BU	Blue
RD	Red	PU	Purple
OR	Orange	GY	Gray
YL	Yellow	WH	White
		PK	Pink

For example, a wire identification of A701-GY on the schematic would signify a gray wire with the circuit number A701. A701-GY identifies the power circuit for the No. 1 Injector solenoid.

Another wire identification on the schematic is the size of the wire. The size of the wire will follow the wire color. Wire size or gauge is referred to as AWG (American Wire Gauge). AWG is a description of the diameter of the wire.

For example, a code of 150-OR-14 on the schematic would indicate that the orange wire in circuit 150 is a 14 AWG wire.

If the gauge of the wire is not listed, the wire is 16 AWG.

Conversion of AWG Numbers to Metric Measurements

Table 2 shows the various AWG numbers that are used for the wires. The metric equivalent for the diameter of each AWG number are also shown.

Table 2

Metric Equivalents for AWG Numbers			
AWG Number	**Diameter (mm)**	**AWG Number**	**Diameter (mm)**
20	0.8	14	1.6
18	1.0	12	2.0
16	1.3	4	3.2

Welding on Applications that are Equipped with an Electronic Control Module (ECM)

Proper welding procedures are necessary in order to avoid damage to the engine's electronic control module, sensors, and associated components. Remove the component that requires welding. When welding on an application that is equipped with an ECM and removal of the component is not possible, the following procedure must be followed. This procedure provides the minimum amount of risk to the electronic components.

NOTICE

Do not ground the welder to electrical components such as the ECM or sensors. Improper grounding can cause damage to the drive train bearings, hydraulic components, electrical components, and other components.

Clamp the ground cable from the welder to the component that will be welded. Place the clamp as close as possible to the weld. This will help reduce the possibility of damage.

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1. Stop the engine. Remove the electrical power from the ECM.
2. Disconnect the negative battery cable from the battery. If a battery disconnect switch is installed, open the switch.

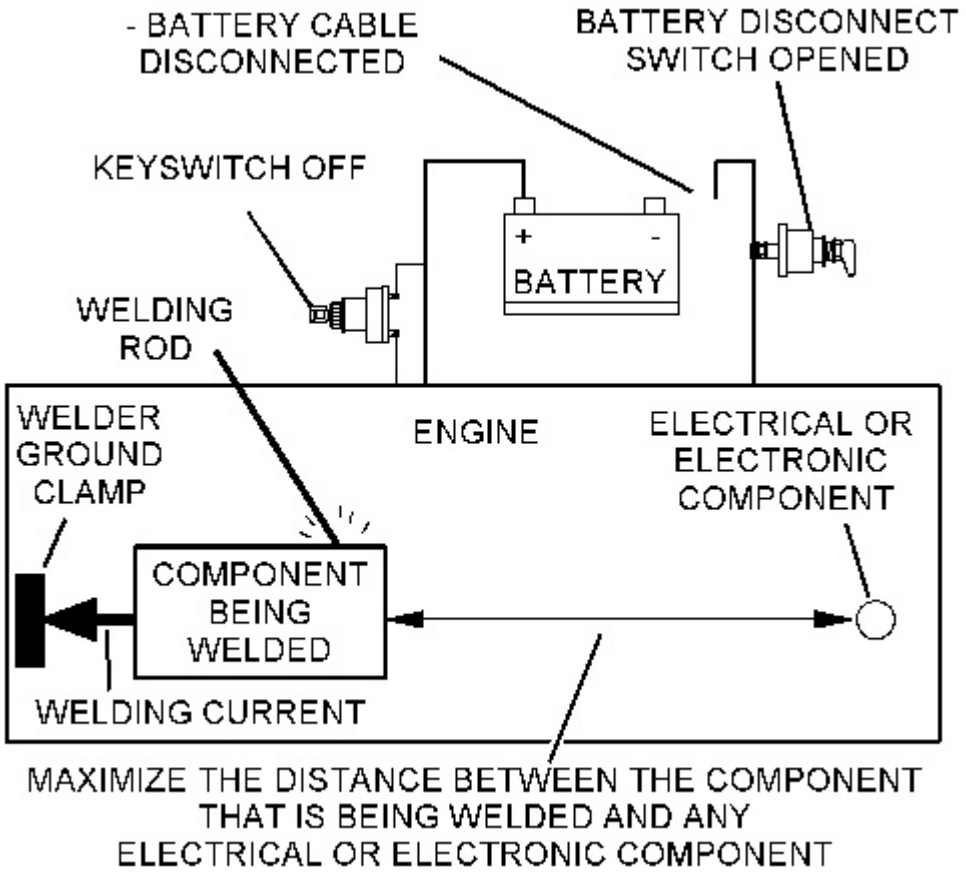

Illustration 1 g01143634

Service welding guide (typical diagram)

3. Connect the welding ground cable as close as possible to the area that will be welded. Components which may be damaged by welding include bearings, hydraulic components, and electrical/electronic components.
4. Protect the wiring harness from welding debris and spatter.
5. Weld the materials by using standard welding methods.

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Event Codes

SMCS - 1900

The Electronic Control Module (ECM) monitors engine operating conditions such as low oil pressure or high coolant temperature. If an operating condition exceeds the normal condition, an event code is generated. The event code will be active until the condition returns to normal. The ECM also logs the event. Events usually indicate a mechanical problem instead of an electronic system problem.

Events can be in the form of a warning, a derate or a shutdown. The events that are available for this application can be found in this section of the document.

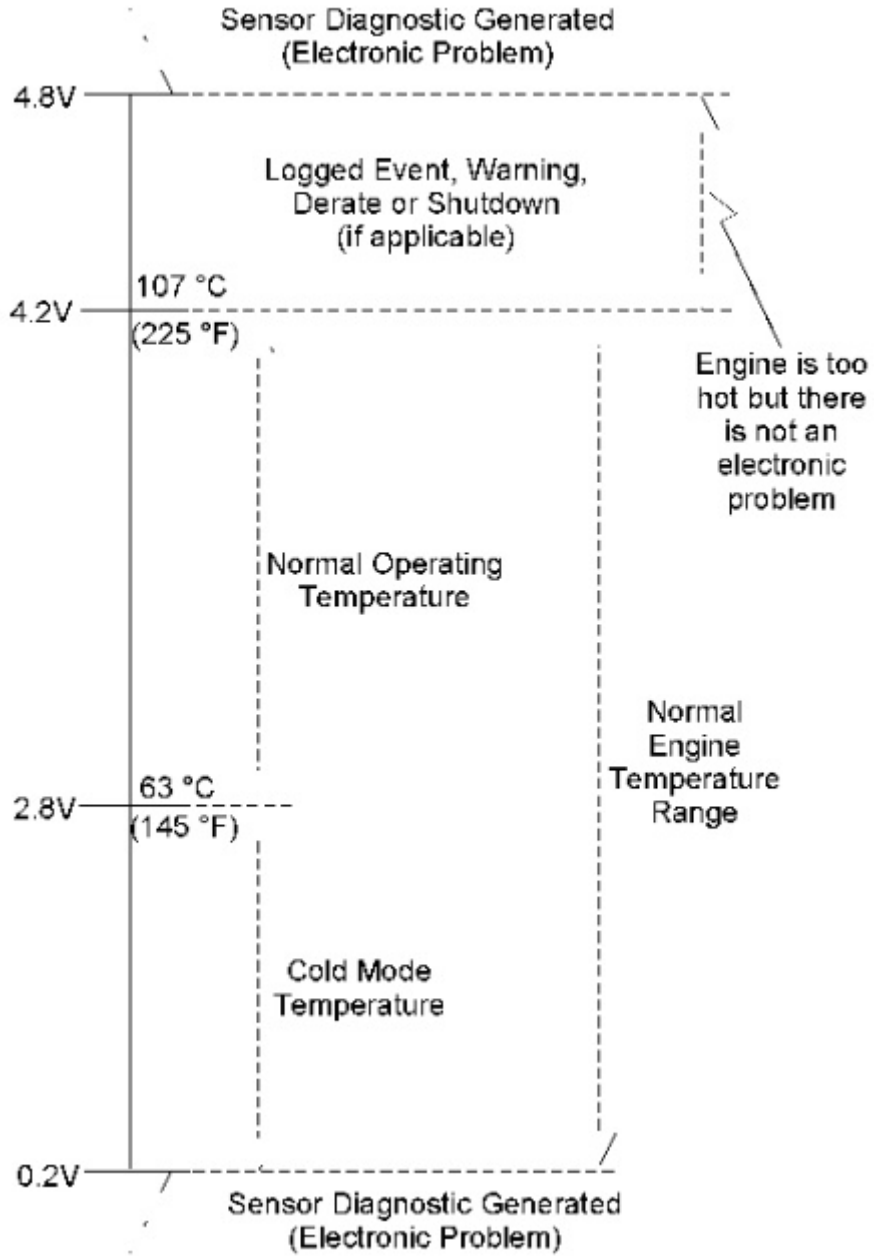

Illustration 1 g01040769

Output voltage from a typical analog temperature sensor

Illustration 1 shows the typical output voltage from an analog sensor. If the output signal voltage is between 4.2 VDC and 4.8 VDC, the ECM will generate an event code.

Monitoring System

The Caterpillar Electronic Technician (ET) can be used to program certain monitoring system parameters. Certain features can be enabled or disabled and some of the trip points can be set.

Refer to the table for monitoring system parameters in Troubleshooting, "System Configuration Parameters" for the various features that can be programmed.

One of the following actions will be taken if an event occurs:

"Warning" - The warning lamp will illuminate continuously while the event is occurring.

"Derate" - The warning lamp will flash while the event is occurring and engine power will be derated.

"Shutdown" - The warning lamp will flash while the event is occurring and the engine will be shutdown.

If multiple derates are active, the derate that limits the most power will be the derate that is shown.

When a selected monitoring system parameter is programmed to "Off", the ECM will not take any action on the event. For example, the warning lamp will not illuminate.
