

[Previous Screen](#)

< Product: GENERATOR SET
Model: 3508B GENERATOR SET CNB
Configuration: 3508B Generator Set CNB00001-UP

Troubleshooting

3500B and 3500C Generator Set Engines

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Engine Sensor Open/Short Test

SMCS - 1901-038

System Operation Description:

Use this procedure to troubleshoot any suspect problems with the following sensors:

- 94-03 Filtered Fuel Pressure open/short to +batt
- 94-04 Filtered Fuel Pressure short to ground
- 101-03 Crankcase Pressure open/short to +batt
- 101-04 Crankcase Pressure short to ground
- 110-03 Engine Coolant Temperature open/short to +batt
- 110-04 Engine Coolant Temperature short to ground
- 105-03 Inlet Manifold Air Temperature open/short to +batt
- 105-04 Inlet Manifold Air Temperature short to ground
- 1175-03 Engine Oil Temperature open/short to +batt
- 175-04 Engine Oil Temperature short to ground
- 273-03 Turbo Outlet Pressure open/short to +batt
- 273-04 Turbo Outlet Pressure short to ground
- 274-03 Atmospheric Pressure open/short to +batt
- 274-04 Atmospheric Pressure short to ground

- 275-03 Right Turbo Inlet Pressure open/short to +batt
- 275-04 Right Turbo Inlet Pressure short to ground
- 275-03 Left Turbo Inlet Pressure open/short to +batt
- 275-04 Left Turbo Inlet Pressure short to ground
- 279-03 Aftercooler Temperature open/short to +batt
- 279-04 Aftercooler Temperature short to ground
- 542-03 Unfiltered Engine Oil Pressure open/short to +batt
- 542-04 Unfiltered Engine Oil Pressure short to ground
- 543-03 Filtered Oil Pressure Sensor open/short to +batt
- 543-04 Filtered Oil Pressure Sensor short to ground
- 827-08 Left Exhaust Temperature signal abnormal
- 828-08 Right Exhaust Temperature signal abnormal

Engine sensors provide various signals to the engine's Electronic Control Module (ECM). These sensors receive a regulated voltage from the ECM. Analog sensors receive 5.0 ± 0.2 VDC and digital sensors receive 8.0 ± 0.4 VDC.

The ECM performs an automatic calibration of these sensors whenever the ECM is powered and the engine is off for at least five seconds. During an automatic calibration, the ECM calibrates pressure sensors to the value of the atmospheric pressure sensor and against an acceptable offset pressure range.

Pull-up Voltage

The ECM continuously outputs a pull-up voltage on the input terminal from an analog sensor. The ECM uses this pull-up voltage in order to detect an open in the signal circuit. When the ECM detects the presence of a voltage that is above a threshold on the signal circuit, the ECM will generate an open circuit diagnostic code 0-3 for that sensor. The presence of pull-up voltage at the sensor connector indicates that the wires from the sensor connector to the ECM are not open or shorted to ground.

Note: No pull-up voltage is present on the input from a digital sensor.

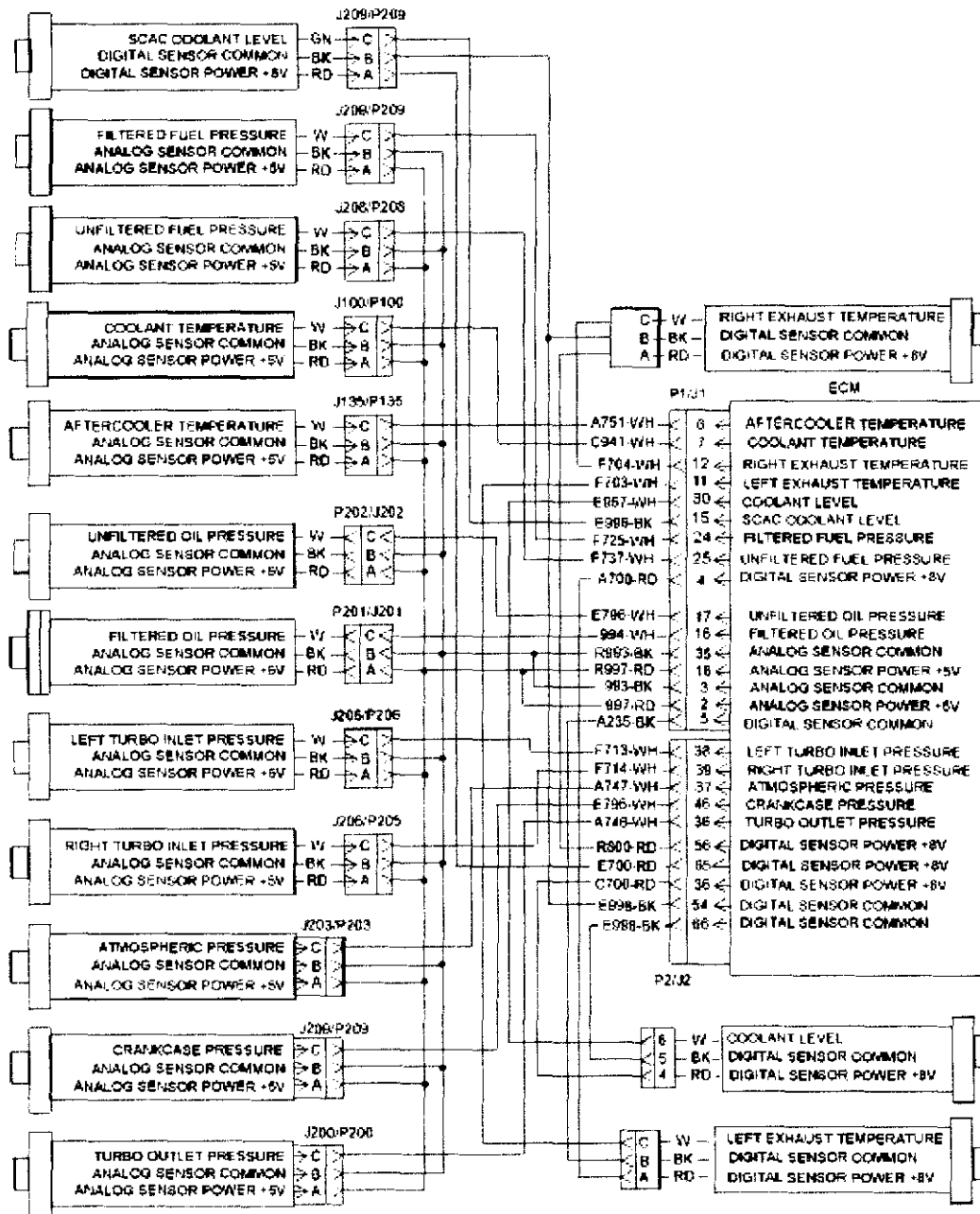


Illustration 1

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Test Step 1. Check for "Active" or "Logged" Diagnostic Codes

- A. Connect Caterpillar Electronic Technician (ET) to the service tool connector.
- B. Turn the engine control to the STOP mode.
- C. Turn the engine battery disconnect switch to the ON position.

D. Monitor the diagnostic codes on Cat ET. Check and record any diagnostic codes.

Note: Wait at least 15 seconds in order for the diagnostic codes to become active.

E. Determine if a diagnostic code has occurred several times.

Note: A diagnostic code that is logged several times is an indication of an intermittent problem. Most intermittent problems are the result of a bad connection between a socket and a pin in a connector or a bad connection between a wire and terminal.

F. Determine if the problem is active and related to one of the following diagnostic codes:

o 03

o 04

o 08

Expected Result:

A diagnostic code has occurred several times.

Results:

- **OK** - A diagnostic code has occurred several times. Proceed to Test Step 2.
- **Not OK - 0-3** - An active 0-3 diagnostic code is present. Proceed to Test Step 3.
- **Not OK - 0-4** - An active 0-4 diagnostic code is present. Proceed to Test Step 5.
- **Not OK - 0-8** - An active 0-8 diagnostic code is present. Proceed to Test Step 8.

Test Step 2. Perform the "Wiggle Test" on Caterpillar Electronic Technician (ET)

A. Select the "Wiggle Test" from the diagnostic tests on Cat ET.

B. Choose the appropriate group of parameters to monitor.

C. Press the "Start" button. Wiggle the wiring harness for the suspect sensor in order to reproduce an intermittent problem.

If an intermittent problem exists, the status will be highlighted and an audible beep will be heard.

Expected Result:

No intermittent problems were indicated during the "Wiggle Test".

Results:

- **OK** - No intermittent problems were found. The harness and connectors appear to be OK. If a diagnostic code is still active, proceed to Test Step 1 and continue to troubleshoot the active diagnostic code.
- **Not OK** - At least one intermittent problem was indicated.

Repair: Repair the harness or the connector. Refer to the diagnostic functional test Troubleshooting, "Inspecting Electrical Connectors". Verify that the repair eliminates the problem.

STOP

Test Step 3. Check the Analog Supply Voltage at the Sensor Connectors

- Turn the engine control to the OFF/RESET mode.
- Turn the engine battery disconnect switch to the OFF position.
- Disconnect the suspect sensor(s) at the sensor connector:
- Turn the engine control to the STOP mode.
- Turn the engine battery disconnect switch to the ON position.
- Measure the voltage on the ECM side of the sensor connector between pin A and pin B for the suspect sensor(s).

Expected Result:

The supply voltage is 5.0 ± 0.2 VDC.

Results:

- **OK** - The voltage is 5.0 ± 0.2 VDC. Proceed to Test Step 6.
- **Not OK** - The voltage is not 5.0 ± 0.2 VDC. Proceed to Test Step 4.

Test Step 4. Check the Analog Supply Voltage at the ECM

- Turn the engine control to the OFF/RESET mode.
- Turn the engine battery disconnect switch to the OFF position.
- Check the supply voltage by removing the supply wires from P1-2 and P1-18.

Note: The same 5 V supply provides power to both pins on ECM connector P1.

- Install a **208-0059** Adapter Cable As (70-PIN BREAKOUT) at the J1/P1 ECM connector.

- E. Turn the engine control to the STOP mode.
- F. Turn the engine battery disconnect switch to the ON position.
- G. Measure the voltage between terminal P1-2 and terminal P1-3 of the breakout T.
- H. Turn the engine control to the OFF/RESET mode.
- I. Turn the engine battery disconnect switch to the OFF position.
- J. Remove the wire jumpers and replace all wires. Remove the breakout T. Reconnect ECM connector J1/P1.

Expected Result:

The supply voltage is 5.0 ± 0.2 VDC.

Results:

- **OK** - The supply voltage is 5.0 ± 0.2 VDC. The supply voltage at the ECM is correct. There is a problem in the wiring between the ECM and the suspect sensor.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP

- **Not OK** - The supply voltage is not 5.0 ± 0.2 VDC. The voltage at the ECM is not correct.

Repair: Replace the ECM. Refer to Troubleshooting, "Replacing the ECM". Verify that the problem is resolved.

STOP**Test Step 5. Create an Open at the Suspect Sensor Connector**

- A. Turn the engine control to the OFF/RESET mode.
- B. Turn the engine battery disconnect switch to the OFF position.
- C. Disconnect the sensor connector of the suspect sensor(s) with the active 04 diagnostic code.
- D. Turn the engine control to the STOP mode. Wait at least 15 seconds for activation of the diagnostic codes.
- E. Turn the engine battery disconnect switch to the ON position.
- F. Access the "Active Diagnostic Code" screen on Cat ET. Check for an active 0-3 diagnostic code.

Expected Result:

The 03 diagnostic code is now active for the suspect sensor(s).

Results:

- **OK** - The 04 diagnostic code was active before disconnecting the sensor. The 03 diagnostic code became active after disconnecting the sensor.

Repair: Temporarily connect a new sensor to the harness, but do not install the new sensor in the engine. Verify that there are no active diagnostic codes for the sensor. If there are no active diagnostic codes for the sensor, permanently install the new sensor. Clear any logged diagnostic codes.

STOP

- **Not OK** - The 04 diagnostic code is still active for the suspect sensor. There is a short circuit between the sensor harness connector and the ECM. Leave the sensor disconnected. Proceed to Test Step 7.

Test Step 6. Check the Pull-up Voltage at the Sensor Connector

- Turn the engine control to the STOP mode.
- Turn the engine battery disconnect switch to the ON position.
- Disconnect the suspect sensor.
- Measure the voltage between terminal C (signal) and terminal B (sensor return) at the sensor connector.
- Turn the engine control to the OFF/RESET mode.
- Turn the engine battery disconnect switch to the OFF position.

Expected Result:

The voltage is 11 ± 2 VDC.

Results:

- **OK** - The voltage is 11 ± 2 VDC. The signal wire to the ECM from the sensor connector is OK.

Repair: The open circuit is in the sensor or the wire between the sensor and the sensor connector. Replace the sensor. Do not install the sensor in the engine. Verify that no diagnostic codes are active for the suspect sensor before permanently installing the sensor.

STOP

- **Not OK** - The voltage is not 11 ± 2 VDC. There is an open or a short between the sensor and the ECM. Proceed to Test Step 7.

Test Step 7. Check the Operation of the ECM

- A. Turn the engine control to the OFF/RESET mode.
- B. Turn the engine battery disconnect switch to the OFF position.
- C. Check the operation of the ECM by creating an open at the ECM.
 - a. Disconnect the appropriate suspect sensor signal wire from the P1 or P2 ECM connector. Remove the signal wire for the suspect sensor from the ECM connector.
 - b. Install a jumper wire on each end into the socket for the signal wire of the suspect sensor.
 - c. Reconnect the ECM connectors.
 - d. Turn the EMCP to the ON position. Monitor the "Active Diagnostic Code" screen on Cat ET. Wait at least 15 seconds for activation of the code.

The 03 should be active for the suspect sensor.

- D. Check the operation of the ECM by creating a short at the ECM.
 - a. Install a wire jumper between the wire jumper for the signal wire for the suspect sensor and engine ground.
 - b. Monitor the "Active Diagnostic Code" screen on Cat ET. Wait at least 15 seconds for activation of the code.

The 04 diagnostic code should be active when the wire jumper is installed.
 - c. Remove the wire jumper. Reconnect all wires and connectors.

Expected Result:

The 03 diagnostic code is active when the sensor signal wire is removed from the ECM connector. The 04 diagnostic code is active when the signal wire is connected to the sensor return.

Results:

- **OK** - The ECM is operating properly. The problem is in the wiring between the ECM and the sensor connector.

Repair: If the code is active for more than one sensor, the problem is most likely in the return wire for the sensor. Repair the return wire for the sensor or replace the harness. If the code is only active for one sensor, the problem is most likely in the signal wire for the sensor. Repair the signal wire for the sensor.

STOP

- **Not OK** - One of the following conditions exists: The 03 diagnostic code is not active when the

sensor signal wire is disconnected. The 04 diagnostic code is not active when the wire jumper is installed.

Repair: Replace the ECM. Refer to Troubleshooting, "Replacing the ECM". Verify that the problem is resolved.

STOP

Test Step 8. Check the Digital Supply Voltage at the Sensor Connector

- A. Turn the engine control to the OFF/RESET mode.
- B. Turn the engine battery disconnect switch to the OFF position.
- C. Disconnect the suspect sensor(s) at the sensor connector:
- D. Turn the engine control to the STOP mode.
- E. Turn the engine battery disconnect switch to the ON position.
- F. Measure the voltage on the ECM side of the sensor connector between pin A and pin B for the suspect sensor(s).

Expected Result:

The supply voltage is 8.0 ± 0.4 VDC.

Results:

- **OK** - The voltage is 8.0 ± 0.4 VDC. Proceed to Test Step 10.
- **Not OK** - The voltage is not 8.0 ± 0.4 VDC. Proceed to Test Step 9.

Test Step 9. Check the Digital Supply Voltage at the ECM

- A. Turn the engine control to the OFF/RESET mode.
- B. Turn the engine battery disconnect switch to the OFF position.
- C. Check the supply voltage by removing the supply wire from P1-4.
- D. Install a **208-0059** Adapter Cable As (70-PIN BREAKOUT) at the J1/P1 ECM connector.
- E. Turn the engine control to the STOP mode.
- F. Turn the engine battery disconnect switch to the ON position.
- G. Measure the voltage between terminal P1-4 and terminal P1-5 of the breakout T.

- H. Turn the engine control to the OFF/RESET mode.
- I. Turn the engine battery disconnect switch to the OFF position.
- J. Remove the wire jumpers and replace all wires. Remove the breakout T. Reconnect ECM connector J1/P1.

Expected Result:

The supply voltage is 8.0 ± 0.4 VDC.

Results:

- **OK** - The supply voltage is 8.0 ± 0.4 VDC. The supply voltage at the ECM is correct. There is a problem in the wiring between the ECM and the suspect sensor.

Repair: Repair the connectors or wiring and/or replace the connectors or wiring.

STOP

- **Not OK** - The supply voltage is not 8.0 ± 0.4 VDC. The voltage at the ECM is not correct.

Repair: Replace the ECM. Refer to Troubleshooting, "Replacing the ECM". Verify that the problem is resolved.

STOP**Test Step 10. Check the Digital Sensor's Duty Cycle at the Sensor Connector**

- A. Turn the engine control to the OFF/RESET mode.
- B. Turn the engine battery disconnect switch to the OFF position.
- C. Remove the sensor's signal wire from pin C of the sensor connector.
- D. Turn the engine control to the STOP mode.
- E. Turn the engine battery disconnect switch to the ON position.
- F. Measure the duty cycle between the sensor's signal wire and pin B of the sensor connector.

Note: Set the multimeter to "VDC". Press the "Hz" button twice so that the % symbol is displayed.

- G. Turn the engine control to the OFF/RESET mode.
- H. Turn the engine battery disconnect switch to the OFF position.
- I. Replace the sensor's signal wire and reconnect the sensor.

Expected Result:

When the temperature is below 49 °C (120 °F), the duty cycle is below 22 percent.

When the temperature is between 49 °C (120 °F) and 851 °C (1564 °F), the duty cycle is between 22 to 88 percent.

Results:

- **OK** - The duty cycle is correct. Proceed to Test Step 11.
- **Not OK** - The duty cycle is incorrect.

Repair: Replace the sensor. Verify that no diagnostic codes are active for the suspect sensor before permanently installing the sensor.

STOP**Test Step 11. Check the Digital Sensor's Duty Cycle at the ECM**

- Install a **208-0059** Adapter Cable As (70-PIN BREAKOUT) at the J1/P1 ECM connector.
- Turn the engine control to the STOP mode.
- Turn the engine battery disconnect switch to the ON position.
- Measure the duty cycle between the terminal for the sensor's signal wire and terminal P1-5 on the breakout T.

Note: Set the multimeter to "VDC". Press the "Hz" button twice so that the % symbol is displayed.

- Turn the engine control to the OFF/RESET mode.
- Turn the engine battery disconnect switch to the OFF position.

Expected Result:

When the temperature is below 49 °C (120 °F), the duty cycle is below 22 percent.

When the temperature is between 49 °C (120 °F) and 851 °C (1564 °F), the duty cycle is between 22 to 88 percent.

Results:

- **OK** - The duty cycle is correct.

Repair: Replace the ECM. Refer to the diagnostic procedure Troubleshooting, "Replacing the ECM".

STOP

- **Not OK** - The duty cycle is not correct.

Repair: Repair the connectors and/or wiring between the ECM and the sensor.

STOP

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