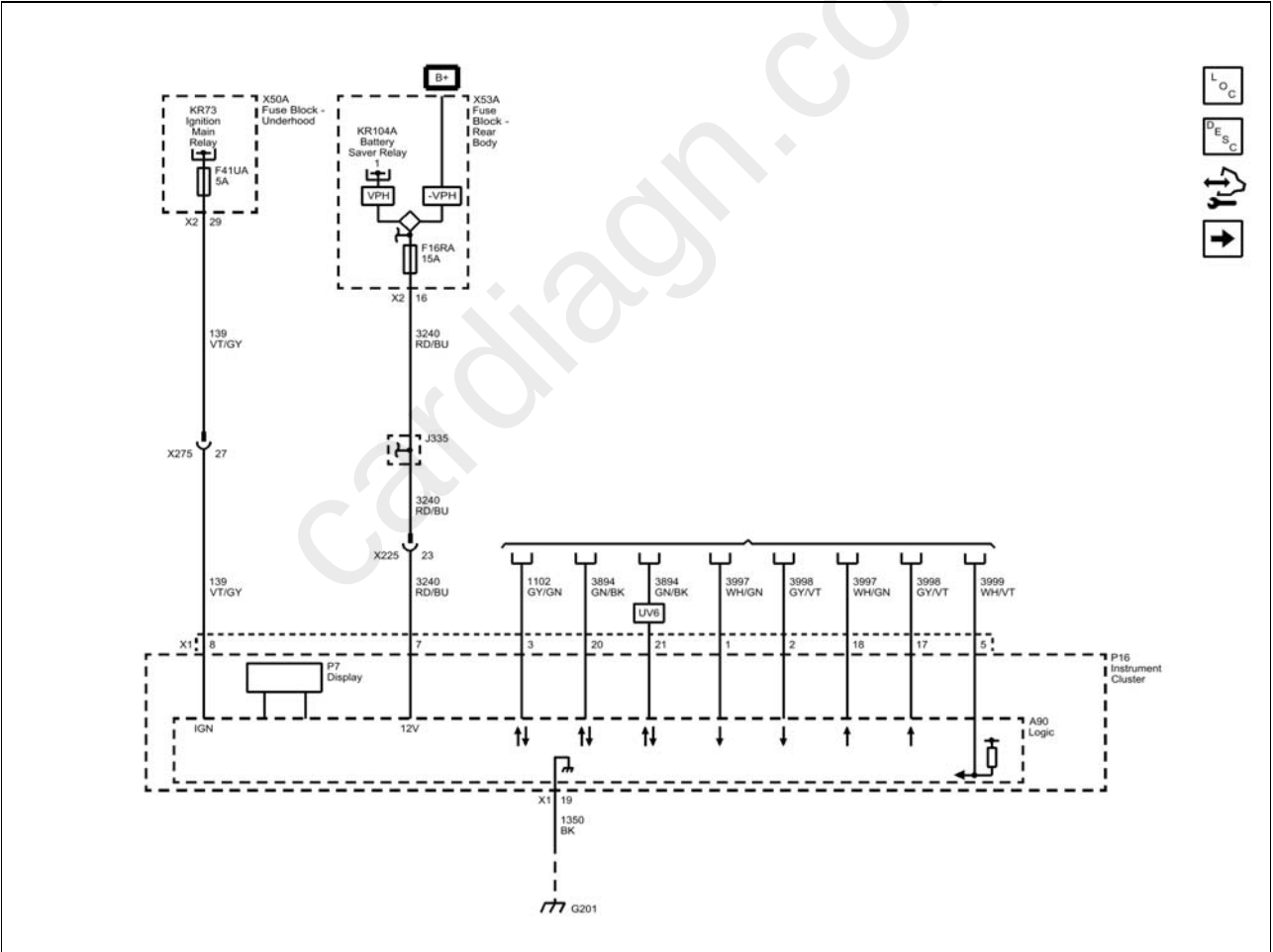


Service Manual: INSTRUMENT PANEL SYSTEM DISPLAYS
AND GAUGES
SPECIFICATIONS > FASTENER SPECIFICATIONS

Application	Specification	
	Metric	English
Head-Up Display Bolt	2.5 N.m	22 lb in
Instrument Cluster Bolt	2.3 N.m	20 lb in

**SCHEMATIC WIRING DIAGRAMS > INSTRUMENT CLUSTER WIRING SCHEMATICS >
POWER, GROUND, SERIAL DATA AND DRIVER INFORMATION**

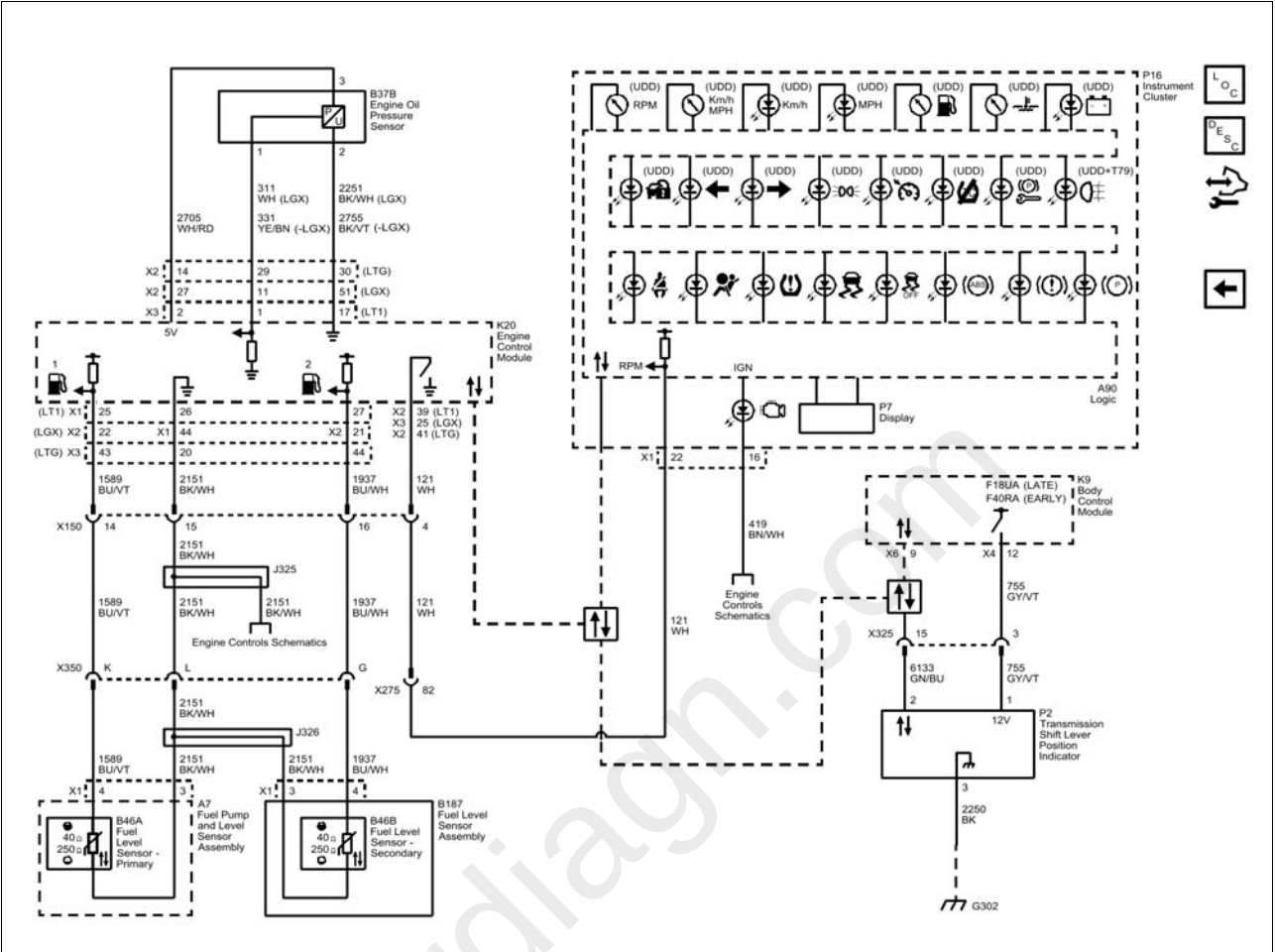
Fig 1: Power, Ground, Serial Data and Driver Information



Courtesy of GENERAL MOTORS COMPANY

SCHEMATIC WIRING DIAGRAMS > INSTRUMENT CLUSTER WIRING SCHEMATICS > INDICATORS AND SIGNALS

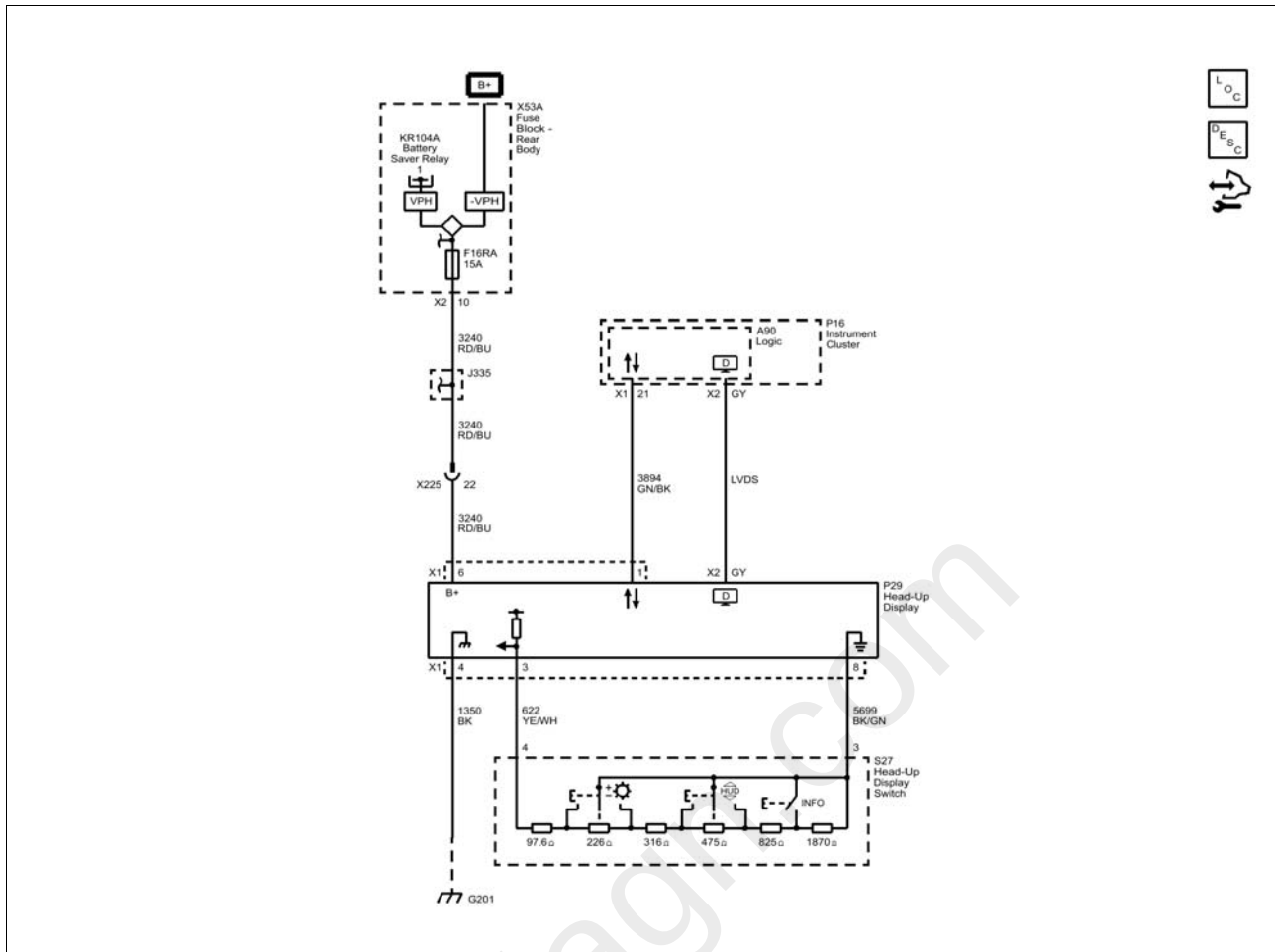
Fig 1: Indicators and Signals



Courtesy of GENERAL MOTORS COMPANY

SCHEMATIC WIRING DIAGRAMS > HEAD-UP DISPLAY WIRING SCHEMATICS > HEAD-UP DISPLAY (UV6)

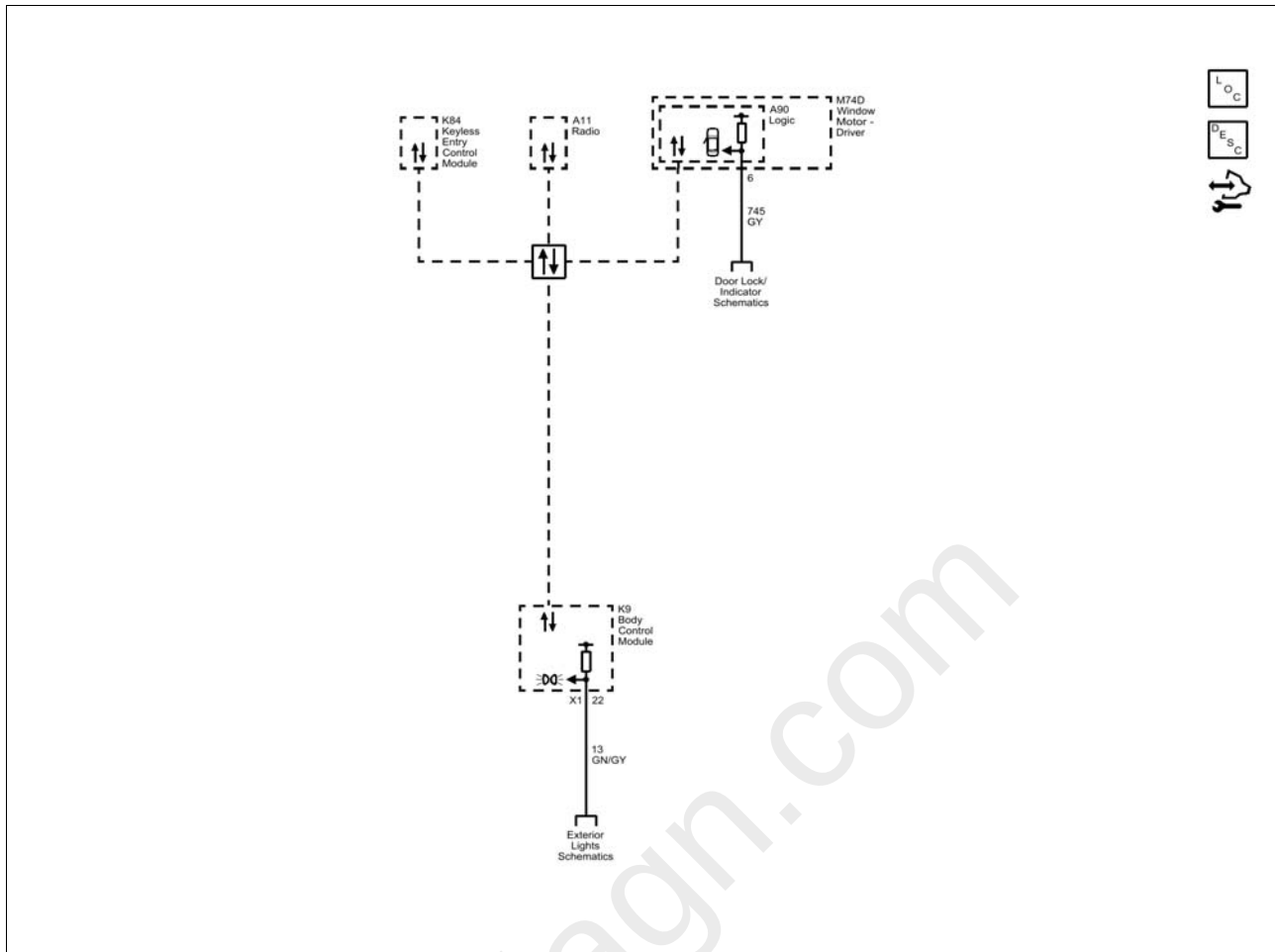
Fig 1: Head-Up Display (UV6)



Courtesy of GENERAL MOTORS COMPANY

SCHEMATIC WIRING DIAGRAMS > AUDIBLE WARNINGS WIRING SCHEMATICS > AUDIBLE WARNINGS

Fig 1: Audible Warnings



Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0158: AMBIENT AIR TEMPERATURE SENSOR CIRCUIT > DIAGNOSTIC INSTRUCTIONS

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0158: AMBIENT AIR TEMPERATURE SENSOR CIRCUIT > DTC DESCRIPTORS

DTC B0158 02

Ambient Air Temperature Sensor Circuit Short to Ground

DTC B0158 05

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0158: AMBIENT AIR TEMPERATURE SENSOR CIRCUIT > DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B0158 02	B0158 05	B0158 05	-
Low Reference	-	B0158 05	-	-

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0158: AMBIENT AIR TEMPERATURE SENSOR CIRCUIT > CIRCUIT/SYSTEM DESCRIPTION

The instrument cluster monitors the ambient air temperature sensor with a low reference circuit and signal circuit. The instrument cluster monitors the voltage drop across the sensor, which is inversely proportional to temperature. When the ambient air temperature is cold, the resistance of the sensor is high. When the ambient air temperature is warm, the resistance of the sensors is low. The instrument cluster converts the voltage value to a temperature value. Based on application, the Instrument Cluster either displays the temperature or sends the value via serial data to the Info Display Module for display.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0158: AMBIENT AIR TEMPERATURE SENSOR CIRCUIT > CONDITIONS FOR RUNNING THE DTC

The system voltage is between 9-16 V.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0158: AMBIENT AIR TEMPERATURE SENSOR CIRCUIT > CONDITIONS FOR SETTING THE DTC

B0158 02

The instrument cluster detects the sensor signal is more than 88°C (190°F).

B0158 05

The instrument cluster detects the sensor signal is less than -40°C (-40°F).

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0158: AMBIENT AIR TEMPERATURE SENSOR CIRCUIT > ACTION TAKEN WHEN THE DTC SETS

The instrument cluster uses a default air temperature value for further calculations. The instrument cluster will display -°C (-°F). A/C compressor engagement may be disabled.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0158: AMBIENT AIR TEMPERATURE SENSOR CIRCUIT > CONDITIONS FOR CLEARING THE DTC

The DTC will become history if the instrument cluster no longer detects a malfunction.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0158: AMBIENT AIR TEMPERATURE SENSOR CIRCUIT > DIAGNOSTIC AIDS

The outside air temperature display on the Info Display Module is a buffered value. It is not a live value when the vehicle is parked, it periodically updates while driving the vehicle. For more information on how the display is updated, refer to Instrument Cluster Description and Operation .

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0158: AMBIENT AIR TEMPERATURE SENSOR CIRCUIT > REFERENCE INFORMATION

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0158: AMBIENT AIR TEMPERATURE SENSOR CIRCUIT > CIRCUIT/SYSTEM VERIFICATION

1. Ignition ON.
2. Verify the scan tool Ambient Air Temperature parameter is between -40°C (-40°F) and +88°C

(+190°F) and changes with air temperature changes.

1. **If not between -40°C (-40°F) and +88°C (+190°F) or changes with air temperature changes**

Refer to Circuit/System Testing.

1. **If between -40°C (-40°F) and +88°C (+190°F) and changes with air temperature changes**

3. Perform the Instrument Cluster Ambient Air Temperature Instant Update special function with the scan tool
4. Verify the scan tool Ambient Air Temperature parameter is within five degrees of actual ambient air temperature.

1. **If not within five degrees of actual ambient air temperature**

Refer to Circuit/System Testing.

1. **If within five degrees of actual ambient air temperature**

5. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0158: AMBIENT AIR TEMPERATURE SENSOR CIRCUIT > CIRCUIT/SYSTEM TESTING



NOTE:

Circuit/System Verification must be performed before proceeding with Circuit/System Testing.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B9 Ambient Air Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the low reference circuit terminal B (or 2) and ground.

1. **If 10 Ω or greater**

1. Ignition OFF, disconnect the harness connector at the P16 Instrument Cluster.

2. Test for less than 2 Ω in the low reference circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , replace the P16 Instrument Cluster.

1. **If less than 10 Ω**

3. Ignition ON.

4. Verify the scan tool Ambient Air Temperature parameter is greater than 98%.

1. If 98% or less

1. Ignition OFF, disconnect the harness connector at the P16 Instrument Cluster.
2. Test for infinite resistance between the signal circuit terminal A (or 1) and ground.
 1. If less than infinite resistance, repair the short to ground on the circuit.
 2. If infinite resistance, replace the P16 Instrument Cluster.

1. If greater than 98%

5. Install a 3 A fused jumper wire between the signal circuit terminal A (or 1) and the low reference circuit terminal B (or 2).
6. Verify the scan tool Ambient Air Temperature parameter is less than 8%.

1. If 8% or greater

1. Ignition OFF, disconnect the harness connector at the P16 Instrument Cluster, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 1. If 1 V or greater, repair the short to voltage on the circuit.
 1. If less than 1 V
3. Ignition OFF
4. Test for less than 2 Ω in the signal circuit end to end.
 1. If 2 Ω or greater, repair the open/high resistance in the circuit.
 2. If less than 2 Ω , replace the P16 Instrument Cluster.

1. If less than 8%

7. Test or replace the B9 Ambient Air Temperature Sensor.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0158: AMBIENT AIR TEMPERATURE SENSOR CIRCUIT > REPAIR INSTRUCTIONS

Perform the Diagnostic Repair Verification after completing the repair.

- Displays and Gauges Component Replacement Reference
- Control Module References for instrument cluster replacement, programming and setup

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0550: ODOMETER CIRCUIT GENERAL MEMORY MALFUNCTION > DIAGNOSTIC INSTRUCTIONS

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0550: ODOMETER CIRCUIT GENERAL MEMORY MALFUNCTION > DTC DESCRIPTOR

DTC B0550 32

Odometer Circuit General Memory Malfunction

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0550: ODOMETER CIRCUIT GENERAL MEMORY MALFUNCTION > CIRCUIT/SYSTEM DESCRIPTION

The instrument cluster is equipped with an odometer that indicate the distance traveled by the vehicle. This information is also stored in the body control module. In addition to storing the odometer value for the vehicle, the instrument cluster and the body control module both store the vehicle VIN. Software checks are performed to ensure these modules, and their stored odometer information, can not be moved or transferred between different vehicles.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0550: ODOMETER CIRCUIT GENERAL MEMORY MALFUNCTION > CONDITIONS FOR RUNNING THE DTC

Ignition ON/Vehicle in Service Mode.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0550: ODOMETER CIRCUIT GENERAL MEMORY MALFUNCTION > CONDITIONS FOR SETTING THE DTC

The body control module has detected an internal memory malfunction.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0550: ODOMETER CIRCUIT GENERAL MEMORY MALFUNCTION > ACTION TAKEN WHEN THE DTC SETS

The DTC is stored in the body control module memory.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0550: ODOMETER CIRCUIT GENERAL MEMORY MALFUNCTION > CONDITIONS FOR CLEARING THE DTC

The body control module no longer detects a malfunction.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0550: ODOMETER CIRCUIT GENERAL MEMORY MALFUNCTION > REFERENCE INFORMATION

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0550: ODOMETER CIRCUIT GENERAL MEMORY MALFUNCTION > CIRCUIT/SYSTEM VERIFICATION

1. Ignition ON/Vehicle in Service Mode/Vehicle in Service Mode.
2. Verify DTC B0550 is not set.

1. If the DTC is set

1. Program the K9 Body Control Module.
2. Verify the DTC is not set.
 1. If the DTC is set, replace the K9 Body Control Module.
 1. If the DTC is not set
3. All OK.

1. If the DTC is not set

3. All OK

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B0550: ODOMETER CIRCUIT GENERAL MEMORY MALFUNCTION > REPAIR INSTRUCTIONS

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for body control module replacement, programming and setup

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B071F: TRANSMISSION SHIFT INDICATOR INTERNAL MALFUNCTION > DIAGNOSTIC INSTRUCTIONS

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B071F: TRANSMISSION SHIFT INDICATOR INTERNAL MALFUNCTION > DTC DESCRIPTOR

DTC B071F 39

Transmission Shift Indicator Internal Malfunction

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B071F: TRANSMISSION SHIFT INDICATOR INTERNAL MALFUNCTION > CIRCUIT/SYSTEM DESCRIPTION

The transmission shift lever position indicator is located on the center console and indicates the current transmission shift level position. The transmission shift lever position indicator receives power and ground and is controlled by the body control module (BCM) via serial data.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B071F: TRANSMISSION SHIFT INDICATOR INTERNAL MALFUNCTION > CONDITIONS FOR RUNNING THE DTC

Ignition ON/Vehicle in Service Mode.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B071F: TRANSMISSION SHIFT INDICATOR INTERNAL MALFUNCTION > CONDITIONS FOR SETTING THE DTC

The BCM has detected an internal malfunction in the transmission shift lever position indicator

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B071F: TRANSMISSION SHIFT INDICATOR INTERNAL MALFUNCTION > ACTION TAKEN WHEN THE DTC SETS

No action is taken

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B071F: TRANSMISSION SHIFT INDICATOR INTERNAL MALFUNCTION > CONDITIONS FOR CLEARING THE DTC

The DTC will become history if the BCM no longer detects a malfunction

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B071F: TRANSMISSION SHIFT INDICATOR INTERNAL MALFUNCTION > REFERENCE INFORMATION

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

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Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B071F: TRANSMISSION SHIFT INDICATOR INTERNAL MALFUNCTION > CIRCUIT/SYSTEM VERIFICATION

1. Ignition ON/Vehicle in Service Mode/Vehicle in Service Mode.

2. Verify DTC B071F 39 is not set.

1. If the DTC is set

Replace the P2 Transmission Shift Lever Position Indicator.

1. If the DTC is not set

3. All OK.

**DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B071F: TRANSMISSION
SHIFT INDICATOR INTERNAL MALFUNCTION > REPAIR INSTRUCTIONS**

Perform the Diagnostic Repair Verification after completing the repair.

Displays and Gauges Component Replacement Reference

**DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B124F: UNIVERSAL SERIAL
BUS (USB) PROGRAMMING > DIAGNOSTIC INSTRUCTIONS**

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

**DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B124F: UNIVERSAL SERIAL
BUS (USB) PROGRAMMING > DTC DESCRIPTOR**

DTC B124F 41

Universal Serial Bus (USB) Programming Files Not Available

DTC B124F 42

Universal Serial Bus (USB) Programming Not Programmed

DTC B124F 44

Universal Serial Bus (USB) Programming Security Access Not Activated

DTC B124F 4A

Universal Serial Bus (USB) Programming Security Checksum Error

**DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B124F: UNIVERSAL SERIAL
BUS (USB) PROGRAMMING > CIRCUIT/SYSTEM DESCRIPTION**

The instrument cluster can communicate with other devices on a Media Oriented Systems Transport (MOST) bus. Some of the other devices may be connected to a USB port. This allows programming of the instrument cluster using a USB device via the MOST bus. Software checks are performed to ensure the internal MOST circuitry is operating properly.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B124F: UNIVERSAL SERIAL BUS (USB) PROGRAMMING > CONDITIONS FOR RUNNING THE DTC

Ignition ON/Vehicle in Service Mode.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B124F: UNIVERSAL SERIAL BUS (USB) PROGRAMMING > CONDITIONS FOR SETTING THE DTC

The instrument cluster has detected an internal memory malfunction or the programming event was incomplete, or completed with errors.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B124F: UNIVERSAL SERIAL BUS (USB) PROGRAMMING > ACTION TAKEN WHEN THE DTC SETS

The DTC is stored in the instrument cluster memory and may have limited or no functionality.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B124F: UNIVERSAL SERIAL BUS (USB) PROGRAMMING > CONDITIONS FOR CLEARING THE DTC

The instrument cluster no longer detects a malfunction.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B124F: UNIVERSAL SERIAL BUS (USB) PROGRAMMING > REFERENCE INFORMATION

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

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Description and Operation

Instrument Cluster Description and Operation

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- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B124F: UNIVERSAL SERIAL BUS (USB) PROGRAMMING > CIRCUIT/SYSTEM VERIFICATION

1. Ignition ON/Vehicle in Service Mode.
2. Verify DTC B124F is not set.

1. If the DTC is set

1. Program the P16 Instrument Cluster.
2. Verify the DTC is not set.
 1. If the DTC is set, replace the P16 Instrument Cluster.
 1. If the DTC is not set
3. All OK.

1. If the DTC is not set

3. All OK

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B124F: UNIVERSAL SERIAL BUS (USB) PROGRAMMING > REPAIR INSTRUCTIONS

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for instrument cluster replacement, programming and setup

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361A: HEAD-UP DISPLAY MODULE > DIAGNOSTIC INSTRUCTIONS

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361A: HEAD-UP DISPLAY MODULE > DTC DESCRIPTOR

DTC B361A 39

Head-Up Display Module Internal Malfunction

DTC B361A 4B

Head-Up Display Module Calibration Not Learned

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361A: HEAD-UP DISPLAY MODULE > CIRCUIT/SYSTEM DESCRIPTION

Internal fault detection and calibration of the head-up display is handled within the instrument cluster. No external circuit diagnosis is involved.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361A: HEAD-UP DISPLAY MODULE > CONDITIONS FOR RUNNING THE DTC

Ignition ON.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361A: HEAD-UP DISPLAY MODULE > CONDITIONS FOR SETTING THE DTC

B361A 39

An internal electrical malfunction has been detected in the head-up display.

B361A 4B

The instrument cluster has not learned a valid calibration for the head-up display.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361A: HEAD-UP DISPLAY MODULE > ACTION TAKEN WHEN THE DTC SETS

Head-up display function is disabled.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361A: HEAD-UP DISPLAY MODULE > CONDITIONS FOR CLEARING THE DTC

The DTC will clear when the conditions for setting the DTC are no longer present.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361A: HEAD-UP DISPLAY MODULE > REFERENCE INFORMATION

Schematic Reference

Head-Up Display Schematics

Connector End View Reference

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- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361A: HEAD-UP DISPLAY MODULE > CIRCUIT/SYSTEM VERIFICATION

1. Ignition ON.

2. Verify DTC B361A 4B is not set.

1. If DTC B361A 4B is set

1. Program the P16 Instrument Cluster.

2. Verify the DTC does not set.

1. If the DTC sets, replace the P29 Head-Up Display.

1. If the DTC does not set

3. All OK.

1. If DTC B361A 4B is not set

3. Verify DTC B361A 39 is not set.

1. If DTC B361A 39 is set

Replace the P29 Head-Up Display.

1. If DTC B361A 39 is not set

4. All OK

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361A: HEAD-UP DISPLAY MODULE > REPAIR INSTRUCTIONS

Perform the Diagnostic Repair Verification after completing the repair.

- Displays and Gauges Component Replacement Reference
- Control Module References for Instrument Cluster replacement, programming and setup

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361B: HEAD-UP DISPLAY SWITCH > DIAGNOSTIC INSTRUCTIONS

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361B: HEAD-UP DISPLAY SWITCH > DTC DESCRIPTOR

DTC B361B 02

Head-Up Display Switch Short to Ground

DTC B361B 05

Head-Up Display Switch High Voltage/Open

DTC B361B 59

Head-Up Display Switch Protection Time-Out

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361B: HEAD-UP DISPLAY SWITCH > DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
---------	-----------------	----------------------	------------------	--------------------

Signal	B361B 02	B361B 05	B361B 05	B361B 59
Low Reference	-	B361B 05	-	-

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361B: HEAD-UP DISPLAY SWITCH > CIRCUIT/SYSTEM DESCRIPTION

The head-up display switch is a multiplexed switch that controls the head-up display based on driver inputs. The head-up display provides the switch with a low reference and monitors a signal circuit. The head-up display switch is made up of a resistor ladder and three switches: Dim +/-, Up/Down, and Page. When a switch is pressed, the signal voltage is pulled low through the resistor ladder. When pressed, each of the switches will result in a different signal voltage seen by the head-up display, depending on the switch's location on the resistor ladder.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361B: HEAD-UP DISPLAY SWITCH > CONDITIONS FOR RUNNING THE DTC

Ignition ON/Vehicle in Service Mode.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361B: HEAD-UP DISPLAY SWITCH > CONDITIONS FOR SETTING THE DTC

B361B 02

The head-up display switch signal voltage is less than 1 V

B361B 05

The head-up display switch signal voltage is greater than 11.5 V

B361B 59

The head-up display switch is stuck

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361B: HEAD-UP DISPLAY SWITCH > ACTION TAKEN WHEN THE DTC SETS

The head-up display ignores the head-up display switch inputs

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361B: HEAD-UP DISPLAY SWITCH > CONDITIONS FOR CLEARING THE DTC

The DTC will become history if the head-up display no longer detects a malfunction

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361B: HEAD-UP DISPLAY SWITCH > REFERENCE INFORMATION

Schematic Reference

Head-Up Display Schematics

Connector End View Reference

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- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361B: HEAD-UP DISPLAY SWITCH > CIRCUIT/SYSTEM VERIFICATION

1. Ignition ON/Vehicle in Service Mode.
2. While holding each switch listed below, verify the scan tool Heads Up Display Switch State parameter changes from NOT PRESSED to PRESSED when each of the following buttons are pressed:

1. DIM + Switch
2. DIM - Switch
3. UP Switch
4. DOWN Switch
5. PAGE Switch

1. **If the scan tool parameter does not equal the expected result with the switch in the appropriate state**

Refer to Circuit/System Testing.

1. If the scan tool parameter equals the expected result with the switch in the appropriate state
3. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361B: HEAD-UP DISPLAY SWITCH > CIRCUIT/SYSTEM TESTING



NOTE:

Circuit/System Verification must be performed before proceeding with Circuit/System Testing.

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S27 Head-Up Display Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.
 1. **If 10 Ω or greater**
 1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the P29 Head-Up Display.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 1. If 2 Ω or greater, repair the open/high resistance in the circuit.
 2. If less than 2 Ω , replace the P29 Head-Up Display.
 1. **If less than 10 Ω**
3. Test for 4.8-5.2 V between the signal circuit terminal 4 and ground.
 1. **If less than 4.8 V**
 1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the P29 Head-Up Display.
 2. Test for infinite resistance between the signal circuit and ground.
 1. If less than infinite resistance, repair the short to ground on the circuit.
 1. If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 1. If 2 Ω or greater, repair the open/high resistance in the circuit.
 2. If less than 2 Ω , replace the P29 Head-Up Display.
 1. **If greater than 5.2 V**

1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 1. If 1 V or greater, repair the short to voltage on the circuit.
 2. If less than 1 V, replace the P29 Head-Up Display.

1. If between 4.8-5.2 V

4. Test or replace the S27 Head-Up Display switch.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361B: HEAD-UP DISPLAY SWITCH > COMPONENT TESTING

1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the S27 Head-Up Display Switch.
2. Test for 3.4K - 4.2K Ω between the signal terminal 4 and the low reference terminal 3.
 1. **If not between 3.4K - 4.2K Ω**
Replace the S27 Head-Up Display Switch.
 1. **If between 3.4K - 4.2K Ω**
3. Test for 87 - 107 Ω between the signal terminal 4 and the low reference terminal 3 with the DIM + Switch pressed.
 1. **If not between 87 - 107 Ω**
Replace the S27 Head-Up Display switch.
 1. **If between 87 - 107 Ω**
4. Test for 291 - 356 Ω between the signal terminal 4 and the low reference terminal 3 with the DIM - Switch pressed.
 1. **If not between 291 - 356 Ω**
Replace the S27 Head-Up Display switch.
 1. **If between 291 - 356 Ω**
5. Test for 575 - 704 Ω between the signal terminal 4 and the low reference terminal 3 with the UP Switch pressed.
 1. **If not between 575 - 704 Ω**
Replace the S27 Head-Up Display Switch.
 1. **If between 575 - 704 Ω**
6. Test for 1K - 1.2K Ω between the signal terminal 4 and the low reference terminal 3 with the DOWN Switch pressed.

1. If not between 1K - 1.2K Ω

Replace the S27 Head-Up Display Switch.

1. If between 1K - 1.2K Ω

7. Test for 1.7K - 2.1K Ω between the signal terminal 4 and the low reference terminal 3 with the PAGE (or INFO) Switch pressed.

1. If not between 1.7K - 2.1K Ω

Replace the S27 Head-Up Display Switch.

1. If between 1.7K - 2.1K Ω

8. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC B361B: HEAD-UP DISPLAY SWITCH > REPAIR INSTRUCTIONS

Perform the Diagnostic Repair Verification after completing the repair.

- Displays and Gauges Component Replacement Reference
- Control Module References for control module replacement, programming and setup

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0071-P0074: AMBIENT AIR TEMPERATURE SENSOR > DIAGNOSTIC INSTRUCTIONS

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0071-P0074: AMBIENT AIR TEMPERATURE SENSOR > DTC DESCRIPTORS

DTC P0071

Ambient Air Temperature Sensor Performance

DTC P0072

Ambient Air Temperature Sensor Circuit Low Voltage

DTC P0073

Ambient Air Temperature Sensor Circuit High Voltage

DTC P0074

Ambient Air Temperature Sensor Circuit Intermittent

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0071-P0074: AMBIENT AIR TEMPERATURE SENSOR > DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0072	P0073	P0073	P0071 or P0074
Low Reference	-	P0073	-	P0071

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0071-P0074: AMBIENT AIR TEMPERATURE SENSOR > CIRCUIT/SYSTEM DESCRIPTION

The ambient air temperature sensor is located behind the grille. The engine control module (ECM) monitors the ambient air temperature sensor utilizing a low reference circuit and signal circuit. The ECM monitors the voltage drop across the sensor, which is inversely proportional to temperature. When the ambient air temperature is cold, the resistance of the sensor is high. When the ambient air temperature is warm, the resistance of the sensor is low. The ECM converts the voltage value to a temperature value. The ECM also sends the temperature value to other control modules via serial data.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0071-P0074: AMBIENT AIR TEMPERATURE SENSOR > CONDITIONS FOR RUNNING THE DTC

- Ignition ON/Vehicle in Service Mode
- The 12 V battery voltage is greater than or equal to 10.2 V.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0071-P0074: AMBIENT AIR TEMPERATURE SENSOR > CONDITIONS FOR SETTING THE DTC

P0071

During the first 20 s of run time after the 1 hour soaking period, the difference between the outside air temperature and the engine intake air temperature is greater than 30°C(86°F).

P0072

The ECM detects the sensor signal is more than 88°C (190°F).

P0073

The ECM detects the sensor signal is less than -40°C (-40°F).

P0074

The ECM detects an unrealistic signal variance.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0071-P0074: AMBIENT AIR TEMPERATURE SENSOR > ACTION TAKEN WHEN THE DTC SETS

- DTC P0071-P0074 are type B DTCs.
- The DIC will display SERVICE A/C SYSTEM.
- The system operates using a default value.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0071-P0074: AMBIENT AIR TEMPERATURE SENSOR > CONDITIONS FOR CLEARING THE DTC

The DTC will become history if the ECM no longer detects a malfunction.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0071-P0074: AMBIENT AIR TEMPERATURE SENSOR > DIAGNOSTIC AIDS

Following a Ambient Air Temperature Sensor disconnect or circuit fault, the temperature displayed in the vehicle can take several ignition cycles to update to the current temperature. Driving the vehicle may also be necessary.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0071-P0074: AMBIENT AIR TEMPERATURE SENSOR > REFERENCE INFORMATION

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Instrument Cluster Schematics

Connector End View Reference

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Instrument Cluster Description and Operation

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- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections

- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0071-P0074: AMBIENT AIR TEMPERATURE SENSOR > CIRCUIT/SYSTEM VERIFICATION

1. Ignition ON/Vehicle in Service Mode.
2. Verify the scan tool ECM Ambient Air Temperature parameter is between -40°C (-40°F) and +88°C (+190°F) and changes with air temperature changes.
 1. **If not between -40°C (-40°F) and +88°C (+190°F) or changes with air temperature changes**
Refer to Circuit/System Testing.
 1. **If between -40°C (-40°F) and +88°C (+190°F) and changes with air temperature changes**
3. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0071-P0074: AMBIENT AIR TEMPERATURE SENSOR > CIRCUIT/SYSTEM TESTING



NOTE:

Circuit/System Verification must be performed before proceeding with Circuit/System Testing.

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B9 Ambient Air Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal B (or 2) and ground.
 1. **If 10 Ω or greater**
 1. Ignition OFF/Vehicle OFF, disconnect the harness connectors at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If less than 10 Ω

3. Ignition ON/Vehicle in Service Mode.

4. Verify the scan tool Ambient Air Temperature parameter is less than -39°C (-38°F).

1. If -39°C (-38°F) or greater

1. Ignition OFF/Vehicle OFF, disconnect the harness connectors at the K20 Engine Control Module.

2. Test for infinite resistance between the signal circuit terminal A (or 1) and ground.

1. If less than infinite resistance, repair the short to ground on the circuit.

2. If infinite resistance, replace the K20 Engine Control Module.

1. If less than -39°C (-38°F)

5. Install a 3 A fused jumper wire between the signal circuit terminal A (or 1) and the low reference circuit terminal B (or 2).

6. Verify the scan tool Ambient Air Temperature parameter is greater than 88°C (190°F).

1. If 88°C (190°F) or less

1. Ignition OFF/Vehicle OFF, remove the jumper wire and disconnect the harness connectors at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the signal circuit and ground.

1. If 1 V or greater, repair the short to voltage on the circuit.

1. If less than 1 V

3. Ignition OFF/Vehicle OFF.

4. Test for less than 2 Ω in the signal circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If warmer than 88°C (190°F)

7. Test or replace the B9 Ambient Air Temperature Sensor.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0071-P0074: AMBIENT AIR TEMPERATURE SENSOR > REPAIR INSTRUCTIONS

Perform the Diagnostic Repair Verification after completing the repair.

- Displays and Gauges Component Replacement Reference
- Control Module References for control module replacement, programming and setup

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0197 OR P0198: ENGINE OIL TEMPERATURE (EOT) SENSOR CIRCUIT VOLTAGE > DIAGNOSTIC INSTRUCTIONS

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0197 OR P0198: ENGINE OIL TEMPERATURE (EOT) SENSOR CIRCUIT VOLTAGE > DTC DESCRIPTORS

DTC P0197

Engine Oil Temperature (EOT) Sensor Circuit Low Voltage

DTC P0198

Engine Oil Temperature (EOT) Sensor Circuit High Voltage

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0197 OR P0198: ENGINE OIL TEMPERATURE (EOT) SENSOR CIRCUIT VOLTAGE > DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0197	P0197, P0198	P0198*	-
Low Reference	-	P0197, P0198	-	-
*ECM or sensor damage may occur if the circuit is shorted to B+.				

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0197 OR P0198: ENGINE OIL TEMPERATURE (EOT) SENSOR CIRCUIT VOLTAGE > TYPICAL SCAN TOOL DATA

ECT Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine operating in Closed Loop Parameter Normal Range: Varies with oil temperature			
ECT Sensor Signal	140°C (284°F)	-40°C (-40°F)	-40°C (-40°F)
Low Reference	-	-40°C (-40°F)	-

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0197 OR P0198: ENGINE OIL TEMPERATURE (EOT) SENSOR CIRCUIT VOLTAGE > CIRCUIT/SYSTEM DESCRIPTION

The engine oil temperature (EOT) sensor is a variable resistor that measures the temperature of the engine oil. The engine control module (ECM) supplies 5 volts on the EOT sensor signal circuit and a ground for the low reference circuit. This diagnostic checks for an open, short to ground, or an intermittent circuit condition between the ECM and EOT sensor.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0197 OR P0198: ENGINE OIL TEMPERATURE (EOT) SENSOR CIRCUIT VOLTAGE > CONDITIONS FOR RUNNING THE DTC

P0197

This DTC runs continuously.

P0198

- The engine is running for greater than 20 s.
- OR
- The ignition is ON and the engine coolant temperature (ECT) is greater than -20°C (-4°F).
- This DTC runs continuously when the above conditions are met.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0197 OR P0198: ENGINE OIL TEMPERATURE (EOT) SENSOR CIRCUIT VOLTAGE > CONDITIONS FOR SETTING THE DTC

P0197

The ECM detects that the EOT circuit resistance is less than 25 Ω for greater than 50 s.

P0198

The ECM detects that the EOT circuit resistance is greater than 450 k Ω for greater than 50 s.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0197 OR P0198: ENGINE OIL TEMPERATURE (EOT) SENSOR CIRCUIT VOLTAGE > ACTION TAKEN WHEN THE DTC SETS

DTCs P0197 and P0198 are Type C DTCs.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0197 OR P0198: ENGINE OIL TEMPERATURE (EOT) SENSOR CIRCUIT VOLTAGE > CONDITIONS FOR CLEARING THE MIL/DTC

DTCs P0197 and P0198 are Type C DTCs.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0197 OR P0198: ENGINE OIL TEMPERATURE (EOT) SENSOR CIRCUIT VOLTAGE > REFERENCE INFORMATION

Schematic Reference

Engine Controls Schematics

Connector End View Reference

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DTC Type Definitions

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0197 OR P0198: ENGINE OIL TEMPERATURE (EOT) SENSOR CIRCUIT VOLTAGE > CIRCUIT/SYSTEM VERIFICATION

1. Ignition ON.
2. Verify the scan tool EOT Sensor parameter is between -39 to +120°C (-38 to +248°F) and changes with engine run time.
 1. **If not between -39 to +120°C (-38 to +248°F) or does not change**

Refer to Circuit/System Testing.
 1. **If between -39 to +120°C (-38 to +248°F) and changes**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 1. **If the DTC sets**

Refer to Circuit/System Testing.
 1. **If the DTC does not set**
5. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0197 OR P0198: ENGINE OIL TEMPERATURE (EOT) SENSOR CIRCUIT VOLTAGE > CIRCUIT/SYSTEM TESTING

NOTE:

You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B36 Engine Oil Temperature Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal A and ground.
 1. **If 10 Ω or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 1. If 2 Ω or greater, repair the open/high resistance in the circuit.
 2. If less than 2 Ω , replace the K20 Engine Control Module.
 1. **If less than 10 Ω**
3. Ignition ON.

4. Verify the scan tool EOT Sensor parameter is at -40°C (-40°F).

1. If warmer than -40°C (-40°F)

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the signal circuit terminal B and ground.
 1. If less than infinite resistance, repair the short to ground on the circuit.
 2. If infinite resistance, replace the K20 Engine Control Module.

1. If -40°C (-40°F)

5. Install a 3 A fused jumper wire between the signal circuit terminal B and ground.

6. Verify the scan tool EOT Sensor parameter is at 140°C (284°F).

1. If colder than 140°C (284°F)

1. Ignition OFF, remove the jumper, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the signal circuit terminal B and ground.
 1. If 1 V or greater, repair the short to voltage on the circuit.
 1. If less than 1 V
3. Ignition OFF.
4. Test for less than 2 Ω in the signal circuit end to end.
 1. If 2 Ω or greater, repair the open/high resistance in the circuit.
 2. If less than 2 Ω, replace the K20 Engine Control Module.

1. if 140°C (284°F)

7. Test or replace the B36 Engine Oil Temperature Sensor.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0197 OR P0198: ENGINE OIL TEMPERATURE (EOT) SENSOR CIRCUIT VOLTAGE > COMPONENT TESTING

1. Ignition OFF, disconnect the harness connector at the B36 Engine Oil Temperature Sensor.
2. Test the EOT sensor by varying the sensor temperature while monitoring the sensor resistance. Compare the readings with the Temperature Versus Resistance (Engine Coolant Temperature Sensor) table. The resistance values should be in range of the table values.

1. If not within the specified range

Replace the B36 Engine Oil Temperature Sensor.

1. If within the specified range

3. Test for infinite resistance between each terminal and the sensor housing.

1. If less than infinite resistance

Replace the B36 Engine Oil Temperature Sensor.

1. If infinite resistance

4. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0197 OR P0198: ENGINE OIL TEMPERATURE (EOT) SENSOR CIRCUIT VOLTAGE > REPAIR INSTRUCTIONS

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Displays and Gauges Component Replacement Reference
- Control Module References for control module replacement, programming, and setup

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0461-P0464, P2066, P2067, OR P2068: FUEL LEVEL SENSOR > DIAGNOSTIC INSTRUCTIONS

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0461-P0464, P2066, P2067, OR P2068: FUEL LEVEL SENSOR > DTC DESCRIPTORS

DTC P0461

Fuel Level Sensor 1 Performance

DTC P0462

Fuel Level Sensor 1 Circuit Low Voltage

DTC P0463

Fuel Level Sensor 1 Circuit High Voltage

DTC P0464

Fuel Level Sensor 1 Circuit Intermittent

DTC P2066

Fuel Level Sensor 2 Performance

DTC P2067

Fuel Level Sensor 2 Circuit Low Voltage

DTC P2068

Fuel Level Sensor 2 Circuit High Voltage

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0461-P0464, P2066, P2067, OR P2068: FUEL LEVEL SENSOR > DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fuel Level Sensor 1/Primary /Right Signal	P0462	P0463	P0463	P0461, 1
Fuel Level Sensor 2/Secondary/Left Signal	P2067	P2068	P2068	P2066, 1
Low Reference	-	P0463, P2068	P0463, P2068	P0461, P2066, 1
1. Fuel Gauge Malfunction				

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0461-P0464, P2066, P2067, OR P2068: FUEL LEVEL SENSOR > CIRCUIT/SYSTEM DESCRIPTION

The primary fuel level sensor and the secondary fuel level sensor change resistance based on fuel level. The engine control module (ECM) monitors the signal circuits of both sensor to determine the fuel level. When the fuel tank is full, the resistances of both fuel level sensors are low. When the fuel tank is empty, the resistances of the fuel level sensors are high. The ECM uses the signal voltages of the primary fuel level sensor and the secondary fuel level sensor to calculate the percentage of remaining fuel in the tank. The ECM sends the fuel level percentage via serial data to the body control module (BCM). The BCM then sends the fuel level percentage via serial data to the instrument cluster to control the fuel gauge.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0461-P0464, P2066, P2067, OR P2068: FUEL LEVEL SENSOR > CONDITIONS FOR RUNNING THE DTC

- Ignition ON
- The system voltage is between 11-16 V

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0461-P0464, P2066, P2067, OR P2068: FUEL LEVEL SENSOR > CONDITIONS FOR SETTING THE DTC

P0461 or P2066

The ECM detects a change in fuel level of less than a specified amount (typically 3-10 L or 0.8-2.6 gal) over a specified driving distance (typically 240-320 km or 150-200 miles).

P0462 or P2067

- The signal voltage is less than 0.25 V.
- The above conditions must be met for 5 seconds.

P0463 or P2068

- The signal voltage is greater than 4.7 V.
- The above conditions must be met for 5 seconds.

P0464

- The fuel level change is greater than 10% for a duration lasting less than 30 seconds.
- DTC P0464 runs and fails 2 out of 3 test cycles.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0461-P0464, P2066, P2067, OR P2068: FUEL LEVEL SENSOR > ACTION TAKEN WHEN THE DTC SETS

- P0461, P0462, P0463, P2066, P2067 and P2068 are Type B DTCs
- The fuel gauge defaults to empty
- The low fuel indicator illuminates

P0464

- P0464 is a Type A DTC

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0461-P0464, P2066, P2067, OR P2068: FUEL LEVEL SENSOR > CONDITIONS FOR CLEARING THE DTC

- P0461, P0462, P0463, P2066, P2067 and P2068 are Type B DTCs
- P0464 is a Type A DTC

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0461-P0464, P2066, P2067, OR P2068: FUEL LEVEL SENSOR > REFERENCE INFORMATION

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Instrument Cluster Schematics

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Scan Tool Reference

Control Module References for scan tool information

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0461-P0464, P2066, P2067, OR P2068: FUEL LEVEL SENSOR > CIRCUIT/SYSTEM VERIFICATION

Without UHS or UDV

1. Ignition ON.
2. Verify the fuel level gauge sweeps when performing the scan tool Instrument Cluster Gauge Sweep control function.
 1. **If the fuel level gauge does not sweep**
Replace the P16 Instrument Cluster
 1. **If the fuel level gauge sweeps**
3. Verify the low fuel level indicator turns ON and OFF when commanding the scan tool All Indicators control function ON and OFF.
 1. **If the low fuel level indicator does not turn ON and OFF**
Replace the P16 Instrument Cluster
 1. **If the low fuel level indicator turns ON and OFF**
4. Verify the ECM scan tool Fuel Level Sensor Right Tank parameter is between 0.5-3.5 V and varies with fuel level.
 1. **If not between 0.5-3.5 V or does not vary with fuel level**

Refer to Primary Fuel Level Sensor Malfunction in Circuit/System Testing

1. If between 0.5-3.5 V and varies with fuel level

5. Verify the ECM scan tool Fuel Level Sensor Left Tank parameter is between 0.5-3.5 V and varies with fuel level.

1. If not between 0.5-3.5 V or does not vary with fuel level

Refer to Secondary Fuel Level Sensor Malfunction in Circuit/System Testing

1. If between 0.5-3.5 V and varies with fuel level

6. All OK.

With UHS or UDV

1. Ignition ON.

2. Verify the ECM scan tool Fuel Level Sensor Right Tank parameter is between 0.5-3.5 V and varies with fuel level.

1. If not between 0.5-3.5 V or does not vary with fuel level

Refer to Primary Fuel Level Sensor Malfunction in Circuit/System Testing

1. If between 0.5-3.5 V and varies with fuel level

3. Verify the ECM scan tool Fuel Level Sensor Left Tank parameter is between 0.5-3.5 V and varies with fuel level.

1. If not between 0.5-3.5 V or does not vary with fuel level

Refer to Secondary Fuel Level Sensor Malfunction in Circuit/System Testing

1. If between 0.5-3.5 V and varies with fuel level

4. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0461-P0464, P2066, P2067, OR P2068: FUEL LEVEL SENSOR > CIRCUIT/SYSTEM TESTING



NOTE:

Circuit/System Verification must be performed before proceeding with Circuit/System Testing.

Primary Fuel Level Sensor Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the A7 Fuel Pump and Level Sensor Assembly. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.

1. If 10 Ω or greater

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If less than 10 Ω

3. Ignition ON.

4. Verify the ECM scan tool Fuel Level Sensor Left Tank parameter is greater than 4.8 V.

1. If 4.8 V or less

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the signal circuit terminal 4 and ground.

1. If less than infinite resistance, repair the short to ground on the circuit.

2. If infinite resistance, replace the K20 Engine Control Module.

1. If greater than 4.8 V

5. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the low reference circuit terminal 3.

6. Verify the ECM scan tool Fuel Level Sensor Left Tank parameter is less than 0.2 V.

1. If 0.2 V or greater

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the signal circuit and ground.

1. If 1 V or greater, repair the short to voltage on the circuit.

1. If less than 1 V

3. Ignition OFF

4. Test for less than 2 Ω in the signal circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If less than 0.2 V

7. Test or replace the B46 Fuel Level Sensor.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B46B Fuel Level Sensor - Secondary. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.

1. If 10 Ω or greater

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for less than 2 Ω in the low reference circuit end to end.
 1. If 2 Ω or greater, repair the open/high resistance in the circuit.
 2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If less than 10 Ω

3. Ignition ON.
4. Verify the ECM scan tool Fuel Level Sensor Right Tank parameter is greater than 4.8 V.

1. If 4.8 V or less

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the signal circuit terminal 4 and ground.
 1. If less than infinite resistance, repair the short to ground on the circuit.
 2. If infinite resistance, replace the K20 Engine Control Module.

1. If greater than 4.8 V

5. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the low reference circuit terminal 3.
6. Verify the ECM scan tool Fuel Level Sensor Right Tank parameter is less than 0.2 V.

1. If 0.2 V or greater

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 1. If 1 V or greater, repair the short to voltage on the circuit.
 1. If less than 1 V
3. Ignition OFF
4. Test for less than 2 Ω in the signal circuit end to end.
 1. If 2 Ω or greater, repair the open/high resistance in the circuit.
 2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If less than 0.2 V

7. Test or replace the B46B Fuel Level Sensor - Secondary.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0461-P0464, P2066, P2067, OR P2068: FUEL LEVEL SENSOR > COMPONENT TESTING

1. Ignition OFF, remove the appropriate Fuel Level Sender.
2. Sweep the Fuel Level Sensor through its full range of motion while measuring resistance between the signal terminal 4 and the low reference terminal 3.
3. Test for a minimum resistance value of 37-43 Ω and a maximum value of 245-255 Ω without any spikes or dropouts.
 1. **If minimum resistance is not 37-43 Ω , maximum resistance is not 245-255 Ω , or if there are any spikes or dropouts**

Replace the appropriate Fuel Level Sensor.
 1. **If minimum resistance is 37-43 Ω , maximum resistance is 245-255 Ω , and if there are no spikes or dropouts**
4. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0461-P0464, P2066, P2067, OR P2068: FUEL LEVEL SENSOR > REPAIR INSTRUCTIONS

Perform the Diagnostic Repair Verification after completing the repair.

- Displays and Gauges Component Replacement Reference
- Control Module References for Engine Control Module or Instrument Cluster replacement, programming, and setup

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LTG, LGX, LT1, OR LT4): ENGINE OIL PRESSURE SENSOR > DIAGNOSTIC INSTRUCTIONS

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LTG, LGX, LT1, OR LT4): ENGINE OIL PRESSURE SENSOR > DTC DESCRIPTORS

DTC P0521

Engine Oil Pressure Sensor Performance

DTC P0522

Engine Oil Pressure Sensor Circuit Low Voltage.

DTC P0523

Engine Oil Pressure Sensor Circuit High Voltage

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LTG, LGX, LT1, OR LT4): ENGINE OIL PRESSURE SENSOR > DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Engine Oil Pressure 5 V Reference	P0522	1	P0522	P0523	P0521
Engine Oil Pressure Sensor Signal	P0522	1	P0522	P0523	P0521
Low Reference	-	1	P0523	-	P0521
1. Engine Oil Pressure Indicator Malfunction					

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LTG, LGX, LT1, OR LT4): ENGINE OIL PRESSURE SENSOR > CIRCUIT/SYSTEM DESCRIPTION

The engine oil pressure sensor changes voltage based on the engine oil pressure. The engine oil pressure sensor is a 3-wire sensor comprising of the signal circuit, the low reference circuit and the 5 V reference circuit. The engine control module (ECM) supplies 5 V to the engine oil pressure sensor via the 5 V reference circuit and provides ground via the low reference circuit. The ECM monitors the signal circuit of the engine oil pressure sensor to determine if the engine oil pressure sensor voltage is within the normal operating range of approximately 1-4 V. When the engine oil pressure is high, the engine oil pressure sensor voltage is high and the ECM senses a high signal voltage. When the engine oil pressure is low, the engine oil pressure sensor voltage is low and the ECM senses a low signal voltage. The ECM sends the engine oil pressure information to the instrument cluster via serial data. The instrument cluster will illuminate or display the engine oil pressure indicator when the engine oil pressure is low.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LTG, LGX, LT1, OR LT4): ENGINE OIL PRESSURE SENSOR > CONDITIONS FOR

RUNNING THE DTC

The engine is running.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LTG, LGX, LT1, OR LT4): ENGINE OIL PRESSURE SENSOR > CONDITIONS FOR SETTING THE DTC

P0521

- The ECM detects that measured oil pressure is at least 47 kPa (6.8 psi) less than or 50 kPa (7.3 psi) higher than the predicted oil pressure.
- The engine oil pressure is outside of a calculated working range determined by engine speed and temperature.
- The above condition is present for greater than 10 s.

P0522

- The ECM detects that the engine oil pressure sensor signal circuit is less than 0.2 V.
- The above condition is present for greater than 10 s.

P0523

- The ECM detects that the engine oil pressure sensor signal circuit is greater than 4.8 V.
- The above condition is present for greater than 10 s.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LTG, LGX, LT1, OR LT4): ENGINE OIL PRESSURE SENSOR > ACTION TAKEN WHEN THE DTC SETS

- The ECM records the operating conditions at the time the diagnostics test fails. The ECM displays this information in the Failure Records on the scan tool.
- The instrument cluster illuminates the engine oil pressure indicator.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LTG, LGX, LT1, OR LT4): ENGINE OIL PRESSURE SENSOR > CONDITIONS FOR CLEARING THE DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction-free warm-up cycles.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LTG, LGX, LT1, OR LT4): ENGINE OIL PRESSURE SENSOR > DIAGNOSTIC AIDS

DTC P0521 can set if engine oil pressure is outside the calculated engine oil pressure model stored in the engine control module. This can be an indication of mechanical engine issues causing lower than expected engine oil pressure.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LTG, LGX, LT1, OR LT4): ENGINE OIL PRESSURE SENSOR > REFERENCE INFORMATION

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Instrument Cluster Schematics

Connector End View Reference

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- Instrument Cluster Description and Operation

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- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LTG, LGX, LT1, OR LT4): ENGINE OIL PRESSURE SENSOR > CIRCUIT/SYSTEM VERIFICATION

With UDD

1. Ignition ON.
2. Verify the engine oil pressure indicator turns on and off when commanding the All Indicators ON and OFF with a scan tool.

1. If the engine oil pressure indicator does not turn on and off.

Replace the P16 Instrument Cluster.

1. If the engine oil pressure indicator turns on and off

3. Verify the scan tool Engine Oil Pressure Sensor parameter is 0 psi (0 kPa).

1. If not 0 psi (0 kPa)

Refer to Circuit/System Testing.

1. If 0 psi (0 kPa)

4. Engine running.

5. Verify actual engine oil pressure is within specified range. Refer to Oil Pressure Diagnosis and Testing in Displays and Gauges Component Replacement Reference .

6. Verify the scan tool Engine Oil Pressure parameter is within specified range.

1. If not within specified range

Refer to Circuit/System Testing.

1. If within specified range

7. Verify the engine oil pressure displayed on Instrument Cluster is within specified range.

1. If not within specified range

Test or replace the P16 Instrument Cluster.

1. If within specified range

8. All OK.

With UDV or UHS

1. Ignition ON.

2. Verify the scan tool Engine Oil Pressure Sensor parameter is 0 psi (0 kPa).

1. If not 0 psi (0 kPa)

Refer to Circuit/System Testing.

1. If 0 psi (0 kPa)

3. Engine running.

4. Verify actual engine oil pressure is within specified range. Refer to Oil Pressure Diagnosis and Testing in Displays and Gauges Component Replacement Reference .

5. Verify the scan tool Engine Oil Pressure parameter is within specified range.

1. If not within specified range

Refer to Circuit/System Testing.

1. If within specified range

6. Verify the engine oil pressure displayed on Instrument Cluster is within specified range.

1. If not within specified range

Test or replace the P16 Instrument Cluster.

1. If within specified range

7. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LTG, LGX, LT1, OR LT4): ENGINE OIL PRESSURE SENSOR > CIRCUIT/SYSTEM TESTING



NOTE:

Circuit/System Verification must be performed before proceeding with Circuit/System Testing.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B37B Engine Oil Pressure Sensor. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.

1. If 10 Ω or greater

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If less than 10 Ω

3. Ignition ON.

4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 3 and ground.

1. If less than 4.8 V

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the 5 V reference circuit and ground.

1. If less than infinite resistance, repair the short to ground on the circuit.

1. If infinite resistance

3. Test for less than 2 Ω in the 5 V reference circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If greater than 5.2 V

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the 5 V reference circuit and ground.

1. If 1 V or greater, repair the short to voltage on the circuit.

2. If less than 1 V, replace the K20 Engine Control Module.

1. If between 4.8-5.2 V

5. Verify the scan tool Engine Oil Pressure parameter is less than 35kPa (5psi).

1. If 35kPa (5psi) or above

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the signal circuit terminal 1 and ground.

1. If 1 V or greater, repair the short to voltage on the circuit.

2. If less than 1 V, replace the K20 Engine Control Module.

1. If below 35kPa (5psi)

6. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the 5 V reference circuit terminal 3.

7. Engine running.

8. Verify the scan tool Engine Oil Pressure parameter is greater than 800kPa (116psi).

1. If 800kPa (116psi) or less

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the signal circuit terminal 1 and ground.

1. If less than infinite resistance, repair the short to ground on the circuit.

1. If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If greater than 800kPa (116psi)

9. Test or replace the B37B Engine Oil Pressure Sensor.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LTG, LGX, LT1, OR LT4): ENGINE OIL PRESSURE SENSOR > REPAIR INSTRUCTIONS

Perform the Diagnostic Repair Verification after completing the repair.

- Displays and Gauges Component Replacement Reference
- Control Module References for control module replacement, programming and setup

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LS7): ENGINE OIL PRESSURE SENSOR > DIAGNOSTIC INSTRUCTIONS

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LS7): ENGINE OIL PRESSURE SENSOR > DTC DESCRIPTORS

DTC P0521

Engine Oil Pressure Sensor Performance

DTC P0522

Engine Oil Pressure Sensor Circuit Low Voltage.

DTC P0523

Engine Oil Pressure Sensor Circuit High Voltage

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LS7): ENGINE OIL PRESSURE SENSOR > DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Engine Oil Pressure 5 V Reference	P0522	1	P0522	P0523	P0521

Engine Oil Pressure Sensor Signal	P0522	1	P0522	P0523	P0521
Low Reference	-	1	P0523	-	P0521
1. Engine Oil Pressure Indicator Malfunction					

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LS7): ENGINE OIL PRESSURE SENSOR > CIRCUIT/SYSTEM DESCRIPTION

The engine oil pressure sensor changes voltage based on the engine oil pressure. The engine oil pressure sensor is a 3-wire sensor comprising of the signal circuit, the low reference circuit and the 5 V reference circuit. The engine control module (ECM) supplies 5 V to the engine oil pressure sensor via the 5 V reference circuit and provides ground via the low reference circuit. The ECM monitors the signal circuit of the engine oil pressure sensor to determine if the engine oil pressure sensor voltage is within the normal operating range of approximately 1-4 V. When the engine oil pressure is high, the engine oil pressure sensor voltage is high and the ECM senses a high signal voltage. When the engine oil pressure is low, the engine oil pressure sensor voltage is low and the ECM senses a low signal voltage. The ECM sends the engine oil pressure information to the instrument cluster via serial data. The instrument cluster will illuminate or display the engine oil pressure indicator when the engine oil pressure is low.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LS7): ENGINE OIL PRESSURE SENSOR > CONDITIONS FOR RUNNING THE DTC

The engine is running.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LS7): ENGINE OIL PRESSURE SENSOR > CONDITIONS FOR SETTING THE DTC

P0521

- The ECM detects that the difference between the predicted oil pressure and the actual oil pressure is either less than 47 kPa (6.8 psi) or greater than 50 kPa (7.3 psi).
- The engine oil pressure is outside of a calculated working range determined by engine speed and temperature.
- The above condition is present for greater than 10 s.

P0522

- The ECM detects that the engine oil pressure sensor signal circuit is less than 0.2 V.
- The above condition is present for greater than 10 s.

P0523

- The ECM detects that the engine oil pressure sensor signal circuit is greater than 4.8 V.
- The above condition is present for greater than 10 s.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LS7): ENGINE OIL PRESSURE SENSOR > ACTION TAKEN WHEN THE DTC SETS

- The ECM records the operating conditions at the time the diagnostics test fails. The ECM displays this information in the Failure Records on the scan tool.
- The instrument cluster illuminates the engine oil pressure indicator.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LS7): ENGINE OIL PRESSURE SENSOR > CONDITIONS FOR CLEARING THE DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction-free warm-up cycles.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LS7): ENGINE OIL PRESSURE SENSOR > DIAGNOSTIC AIDS

DTC P0521 can set if engine oil pressure is outside the calculated engine oil pressure model stored in the engine control module. This can be an indication of mechanical engine issues causing lower than expected engine oil pressure.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LS7): ENGINE OIL PRESSURE SENSOR > REFERENCE INFORMATION

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Instrument Cluster Schematics

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Scan Tool Reference

Control Module References for scan tool information

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LS7): ENGINE OIL PRESSURE SENSOR > CIRCUIT/SYSTEM VERIFICATION

With UDD

1. Ignition ON.
2. Verify the engine oil pressure indicator turns on and off when commanding the All Indicators ON and OFF with a scan tool.
 1. **If the engine oil pressure indicator does not turn on and off.**
Replace the P16 Instrument Cluster.
 1. **If the engine oil pressure indicator turns on and off**
3. Verify the scan tool Engine Oil Pressure Switch parameter is Low.
 1. **If not Low**
Refer to Circuit/System Testing.
 1. **If Low**
4. Engine running.
5. Verify the scan tool Engine Oil Pressure Switch parameter is OK.
 1. **If not OK**
Refer to Circuit/System Testing.
 1. **If OK**
6. All OK.

With UDV or UHS

1. Ignition ON.
2. Verify the scan tool Engine Oil Pressure Switch parameter is Low.
 1. **If not Low**
Refer to Circuit/System Testing.

1. If Low

3. Engine running.
4. Verify the scan tool Engine Oil Pressure Switch parameter is OK.

1. If not OK

Refer to Circuit/System Testing.

1. If OK

5. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LS7): ENGINE OIL PRESSURE SENSOR > CIRCUIT/SYSTEM TESTING



NOTE:

Circuit/System Verification must be performed before proceeding with Circuit/System Testing.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B37B Engine Oil Pressure Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.

1. If 10 Ω or greater

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for less than 2 Ω in the low reference circuit end to end.
 1. If 2 Ω or greater, repair the open/high resistance in the circuit.
 2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If less than 10 Ω

3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 2 and ground.

1. If less than 4.8 V

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the 5 V reference circuit and ground.
 1. If less than infinite resistance, repair the short to ground on the circuit.
 1. If infinite resistance

3. Test for less than 2 Ω in the 5 V reference circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If greater than 5.2 V

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the 5 V reference circuit and ground.

1. If 1 V or greater, repair the short to voltage on the circuit.

2. If less than 1 V, replace the K20 Engine Control Module.

1. If between 4.8-5.2 V

5. Verify the scan tool Engine Oil Pressure Switch parameter is Low.

1. If not Low

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the signal circuit terminal 1 and ground.

1. If 1 V or greater, repair the short to voltage on the circuit.

2. If less than 1 V, replace the K20 Engine Control Module.

1. If Low

6. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the 5 V reference circuit terminal 2.

7. Engine running.

8. Verify the scan tool Engine Oil Pressure Switch parameter is OK.

1. If not OK

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the signal circuit terminal 1 and ground.

1. If less than infinite resistance, repair the short to ground on the circuit.

1. If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If OK

9. Test or replace the B37B Engine Oil Pressure Sensor.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P0521, P0522, OR P0523 (LS7): ENGINE OIL PRESSURE SENSOR > REPAIR INSTRUCTIONS

Perform the Diagnostic Repair Verification after completing the repair.

- Displays and Gauges Component Replacement Reference
- Control Module References for the control module replacement, programming and setup

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4): ENGINE OIL LEVEL SWITCH CIRCUIT > DIAGNOSTIC INSTRUCTIONS

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4): ENGINE OIL LEVEL SWITCH CIRCUIT > DTC DESCRIPTOR

DTC P250A

Engine Oil Level Switch Circuit

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4): ENGINE OIL LEVEL SWITCH CIRCUIT > DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Engine Oil Level Sensor Signal	2	P250A, 1	-
Engine Oil Level Sensor Ground	-	P250A, 1	-
1. DIC message Engine Oil Level Low always ON 2. DIC message Engine Oil Level Low always OFF			

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4): ENGINE OIL LEVEL SWITCH CIRCUIT > TYPICAL SCAN TOOL DATA

Engine Oil Level Switch

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON Parameter Normal Range: OK			
Engine Oil Level Sensor/Switch Signal	OK	Low	OK
Engine Oil Level Sensor/Switch Ground	-	Low	-

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4): ENGINE OIL LEVEL SWITCH CIRCUIT > CIRCUIT/SYSTEM DESCRIPTION

The engine oil level sensor/switch is normally-closed with proper engine oil level. The switch opens when the engine oil level drops below a calibrated level. The engine control module (ECM) monitors the engine oil level signal circuit when the ignition is ON, and the engine is OFF. With the switch in the closed position, the ECM detects a low voltage on the signal circuit. With the switch in the open position, the ECM detects a high voltage on the signal circuit. When high voltage is detected on the signal circuit, the ECM will send a serial data message to the instrument panel cluster (IPC). The IPC will then display a message on the driver information center (DIC) or illuminate a low engine oil level lamp.

The following information determines the message sent from the ECM to the IPC:

- The Low Engine Oil Level message lamp is displayed only after the ECM detects a high voltage on the signal circuit for three consecutive ignition cycles, followed by an ignition OFF event from 15 minutes to greater than 50 minutes, depending on engine oil temperatures.
- The Low Engine Oil Level message is turned OFF when the ECM detects a low voltage on the signal circuit after an ignition OFF event for greater than 90 seconds, followed by an ignition ON event for less than 1 second.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4): ENGINE OIL LEVEL SWITCH CIRCUIT > CONDITIONS FOR RUNNING THE DTC

Ignition ON.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4): ENGINE OIL LEVEL SWITCH CIRCUIT > CONDITIONS

FOR SETTING THE DTC

The ECM detects a high voltage on the signal circuit for three consecutive ignition cycles, followed by an ignition OFF event from 15 minutes to greater than 50 minutes, depending on engine oil temperatures.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4): ENGINE OIL LEVEL SWITCH CIRCUIT > ACTION TAKEN WHEN THE DTC SETS

Engine Oil Level Low message activated.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4): ENGINE OIL LEVEL SWITCH CIRCUIT > CONDITIONS FOR CLEARING THE DTC

The ECM detects a low voltage on the signal circuit after an ignition OFF event for greater than 90 seconds, followed by an ignition ON event for less than 1 second.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4): ENGINE OIL LEVEL SWITCH CIRCUIT > REFERENCE INFORMATION

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Scan Tool Reference

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4): ENGINE OIL LEVEL SWITCH CIRCUIT > CIRCUIT/SYSTEM VERIFICATION

1. Verify proper engine oil level.

1. If not at proper level

Add oil as necessary.

1. If at proper level

2. Ignition ON, verify the scan tool Engine Oil Level parameter reads OK.

1. If not OK

Refer to Circuit/System Testing.

1. If OK

3. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4): ENGINE OIL LEVEL SWITCH CIRCUIT > CIRCUIT/SYSTEM TESTING



NOTE:

Verify proper engine oil level before continuing with diagnosis.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B35 Engine Oil Level Switch. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 5 Ω between the ground circuit terminal 1 and ground.

1. If 5 Ω or greater

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the ground circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , repair the open/high resistance in the ground connection.

1. If less than 5 Ω

3. Ignition ON.
4. Verify the scan tool Engine Oil Level Switch parameter reads Low.

1. If the Engine Oil Level Switch parameter reads OK

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the signal circuit terminal 2 and ground.
 1. If less than infinite resistance, repair the short to ground on the circuit.
 2. If infinite resistance, replace the K20 Engine Control Module.

1. If the Engine Oil Level Switch parameter reads Low

 NOTE:

If a short to voltage is found on the signal circuit, the fuse in the 3A jumper wire will open.

5. Install a 3A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 1.
6. Verify the scan tool Engine Oil Level Switch parameter reads OK.

1. If the Engine Oil Level Switch parameter reads Low

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 1. If 1 V or greater, repair the short to voltage on the circuit.
 2. If less than 1 V
3. Test for less than 2 Ω in the signal circuit end to end.
 1. If 2 Ω or greater, repair the open/high resistance on the circuit.
 2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If the Engine Oil Level Switch parameter reads OK

7. Test or replace the B35 Engine Oil Level Switch.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4): ENGINE OIL LEVEL SWITCH CIRCUIT > REPAIR INSTRUCTIONS

Perform the Diagnostic Repair Verification after completing the repair.

- Displays and Gauges Component Replacement Reference
- Control Module References for control module replacement, programming, and setup

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LGX): ENGINE OIL LEVEL SWITCH CIRCUIT > DIAGNOSTIC INSTRUCTIONS

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LGX): ENGINE OIL LEVEL SWITCH CIRCUIT > DTC DESCRIPTOR

DTC P250A

Engine Oil Level Switch Circuit

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LGX): ENGINE OIL LEVEL SWITCH CIRCUIT > DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Engine Oil Level Sensor Signal	2	P250A, 1	-
Engine Oil Level Sensor Ground	-	P250A, 1	-
1. DIC message Engine Oil Level Low always ON 2. DIC message Engine Oil Level Low always OFF			

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LGX): ENGINE OIL LEVEL SWITCH CIRCUIT > TYPICAL SCAN TOOL DATA

Engine Oil Level Switch

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON Parameter Normal Range: OK			
Engine Oil Level Sensor/Switch Signal	OK	Low	OK

Engine Oil Level Sensor/Switch Ground	-	Low	-
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DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LGX): ENGINE OIL LEVEL SWITCH CIRCUIT > CIRCUIT/SYSTEM DESCRIPTION

The engine oil level sensor/switch is normally-closed with proper engine oil level. The switch opens when the engine oil level drops below a calibrated level. The engine control module (ECM) monitors the engine oil level signal circuit when the ignition is ON, and the engine is OFF. With the switch in the closed position, the ECM detects a low voltage on the signal circuit. With the switch in the open position, the ECM detects a high voltage on the signal circuit. When high voltage is detected on the signal circuit, the ECM will send a serial data message to the instrument panel cluster (IPC). The IPC will then display a message on the driver information center (DIC) or illuminate a low engine oil level lamp.

The following information determines the message sent from the ECM to the IPC:

- The Low Engine Oil Level message lamp is displayed only after the ECM detects a high voltage on the signal circuit for three consecutive ignition cycles, followed by an ignition OFF event from 15 minutes to greater than 50 minutes, depending on engine oil temperatures.
- The Low Engine Oil Level message is turned OFF when the ECM detects a low voltage on the signal circuit after an ignition OFF event for greater than 90 seconds, followed by an ignition ON event for less than 1 second.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LGX): ENGINE OIL LEVEL SWITCH CIRCUIT > CONDITIONS FOR RUNNING THE DTC

Ignition ON.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LGX): ENGINE OIL LEVEL SWITCH CIRCUIT > CONDITIONS FOR SETTING THE DTC

The ECM detects a high voltage on the signal circuit for three consecutive ignition cycles, followed by an ignition OFF event from 15 minutes to greater than 50 minutes, depending on engine oil temperatures.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LGX): ENGINE OIL LEVEL SWITCH CIRCUIT > ACTION TAKEN WHEN THE DTC SETS

Engine Oil Level Low message activated.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LGX): ENGINE OIL LEVEL SWITCH CIRCUIT > CONDITIONS FOR CLEARING THE DTC

The ECM detects a low voltage on the signal circuit after an ignition OFF event for greater than 90 seconds, followed by an ignition ON event for less than 1 second.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LGX): ENGINE OIL LEVEL SWITCH CIRCUIT > REFERENCE INFORMATION

Schematic Reference

- Engine Mechanical Schematics
- Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- Instrument Cluster Description and Operation
- Indicator/Warning Message Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LGX): ENGINE OIL LEVEL SWITCH CIRCUIT > CIRCUIT/SYSTEM VERIFICATION

1. Verify proper engine oil level.

1. **If not at proper level**

Add oil as necessary.

1. **If at proper level**

2. Ignition ON, verify the scan tool Engine Oil Level parameter reads OK.

1. **If not OK**

Refer to Circuit/System Testing.

1. If OK
3. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LGX): ENGINE OIL LEVEL SWITCH CIRCUIT > CIRCUIT/SYSTEM TESTING



NOTE:

Verify proper engine oil level before continuing with diagnosis.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B35 Engine Oil Level Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 2 and ground.

1. If 5 Ω or greater

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for less than 2 Ω in the ground circuit end to end.
 1. If 2 Ω or greater, repair the open/high resistance in the circuit.
 2. If less than 2 Ω , repair the open/high resistance in the ground connection.

1. If less than 5 Ω

3. Ignition ON.
4. Verify the scan tool Engine Oil Level Switch parameter reads Low.

1. If the Engine Oil Level Switch parameter reads OK

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 1. If less than infinite resistance, repair the short to ground on the circuit.
 2. If infinite resistance, replace the K20 Engine Control Module.

1. If the Engine Oil Level Switch parameter reads Low



NOTE:

If a short to voltage is found on the signal circuit, the fuse in the 3A jumper wire will open.

5. Install a 3A fused jumper wire between the signal circuit terminal 1 and the ground circuit

terminal 2.

6. Verify the scan tool Engine Oil Level Switch parameter reads OK.

1. If the Engine Oil Level Switch parameter reads Low

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 1. If 1 V or greater, repair the short to voltage on the circuit.
 2. If less than 1 V
3. Test for less than 2 Ω in the signal circuit end to end.
 1. If 2 Ω or greater, repair the open/high resistance on the circuit.
 2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If the Engine Oil Level Switch parameter reads OK

7. Test or replace the B35 Engine Oil Level Switch.

DIAGNOSTIC INFORMATION AND PROCEDURES > DTC P250A (WITH LGX): ENGINE OIL LEVEL SWITCH CIRCUIT > REPAIR INSTRUCTIONS

Perform the Diagnostic Repair Verification after completing the repair.

- Displays and Gauges Component Replacement Reference
- Control Module References for control module replacement, programming, and setup

DIAGNOSTIC INFORMATION AND PROCEDURES > DISPLAYS AND GAUGES COMPONENT REPLACEMENT REFERENCE

Component	Repair Instruction
B9 Ambient Air Temperature Sensor	Ambient Air Temperature Sensor Replacement (LT1) Ambient Air Temperature Sensor Replacement (LGX LTG)
B35 Engine Oil Level Switch	{3.6L LGX engine} Engine Oil Level Sensor and/or Switch Replacement {6.2L LT1 engine} Engine Oil Level Indicator Switch Replacement
B37D Engine Oil Pressure Sensor	{3.6L LGX engine} Engine Oil Pressure Sensor and/or Switch Replacement {6.2L LT1 engine} Engine Oil Pressure Sensor Replacement

B46 Fuel Level Sensor	{3.6L LGX engine} Fuel Level Sensor Replacement {6.2L LT1 engine} Fuel Level Sensor Replacement
P2 Transmission Shift Lever Position Indicator	Transmission Control Replacement
P29 Head-up Display	Head-Up Display Replacement
S27 Head-Up Display switch	Head Up Display Switch Replacement
S39 Ignition Switch	Ignition and Start Switch Replacement
Oil Pressure Diagnosis and Testing	{2.0L LTG engine} Oil Pressure Diagnosis and Testing {3.6L LGX engine} Oil Pressure Diagnosis and Testing {6.2L LT1 engine} Oil Pressure Diagnosis and Testing

DIAGNOSTIC INFORMATION AND PROCEDURES > SYMPTOMS - DISPLAYS AND GAUGES



NOTE:

The following steps must be completed before using the symptom diagnostic tables.

1. Before using the symptom diagnostic tables, perform the Diagnostic System Check - Vehicle in order to determine that there are no DTCs set, and that the control modules can communicate via the serial data link.
2. Review the system operation in order to understand the system functions. Refer to the following description and operations:
 1. Instrument Cluster Description and Operation
 2. Indicator/Warning Message Description and Operation
 3. Driver Information Center (DIC) Description and Operation
 4. Audible Warnings Description and Operation
 5. Head-Up Display Description and Operation

DIAGNOSTIC INFORMATION AND PROCEDURES > SYMPTOMS - DISPLAYS AND GAUGES > VISUAL/PHYSICAL INSPECTION

- Inspect for aftermarket devices which can affect the operation of the instrument panel cluster or the audible warning systems. Refer to Checking Aftermarket Accessories .
- Inspect the accessible system components or the visible system components for obvious damage

or for obvious conditions which can cause the symptom.

- Inspect for the proper fluid levels.

DIAGNOSTIC INFORMATION AND PROCEDURES > SYMPTOMS - DISPLAYS AND GAUGES > INTERMITTENT

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to Testing for Intermittent Conditions and Poor Connections

DIAGNOSTIC INFORMATION AND PROCEDURES > SYMPTOMS - DISPLAYS AND GAUGES > SYMPTOM LIST

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- Fuel Gauge Malfunction
- Engine Oil Pressure Gauge Inaccurate or Inoperative (LTG, LGX, LT1, or LT4) Engine Oil Pressure Gauge Inaccurate or Inoperative (LS7)
- Engine Oil Temperature Indicator Malfunction
- Head-Up Display Malfunction
- Outside Air Temperature Display Malfunction

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LTG, LGX, LT1, OR LT4) > DIAGNOSTIC INSTRUCTIONS

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LTG, LGX, LT1, OR LT4) > DTC DESCRIPTORS

DTC P0521

Engine Oil Pressure Sensor Performance

DTC P0522

Engine Oil Pressure Sensor Circuit Low Voltage.

DTC P0523

Engine Oil Pressure Sensor Circuit High Voltage

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LTG, LGX, LT1, OR LT4) > DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Engine Oil Pressure 5 V Reference	P0522	1	P0522	P0523	P0521
Engine Oil Pressure Sensor Signal	P0522	1	P0522	P0523	P0521
Low Reference	-	1	P0523	-	P0521
1. Engine Oil Pressure Indicator Malfunction					

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LTG, LGX, LT1, OR LT4) > CIRCUIT/SYSTEM DESCRIPTION

The engine oil pressure sensor changes voltage based on the engine oil pressure. The engine oil pressure sensor is a 3-wire sensor comprising of the signal circuit, the low reference circuit and the 5 V reference circuit. The engine control module (ECM) supplies 5 V to the engine oil pressure sensor via the 5 V reference circuit and provides ground via the low reference circuit. The ECM monitors the signal circuit of the engine oil pressure sensor to determine if the engine oil pressure sensor voltage is within the normal operating range of approximately 1-4 V. When the engine oil pressure is high, the engine oil pressure sensor voltage is high and the ECM senses a high signal voltage. When the engine oil pressure is low, the engine oil pressure sensor voltage is low and the ECM senses a low signal voltage. The ECM sends the engine oil pressure information to the instrument cluster via serial data. The instrument cluster will illuminate or display the engine oil pressure indicator when the engine oil pressure is low.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LTG, LGX, LT1, OR LT4) > CONDITIONS FOR RUNNING THE DTC

The engine is running.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE

INACCURATE OR INOPERATIVE (LTG, LGX, LT1, OR LT4) > CONDITIONS FOR SETTING THE DTC

P0521

- The ECM detects that measured oil pressure is at least 47 kPa (6.8 psi) less than or 50 kPa (7.3 psi) higher than the predicted oil pressure.
- The engine oil pressure is outside of a calculated working range determined by engine speed and temperature.
- The above condition is present for greater than 10 s.

P0522

- The ECM detects that the engine oil pressure sensor signal circuit is less than 0.2 V.
- The above condition is present for greater than 10 s.

P0523

- The ECM detects that the engine oil pressure sensor signal circuit is greater than 4.8 V.
- The above condition is present for greater than 10 s.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LTG, LGX, LT1, OR LT4) > ACTION TAKEN WHEN THE DTC SETS

- The ECM records the operating conditions at the time the diagnostics test fails. The ECM displays this information in the Failure Records on the scan tool.
- The instrument cluster illuminates the engine oil pressure indicator.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LTG, LGX, LT1, OR LT4) > CONDITIONS FOR CLEARING THE DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction-free warm-up cycles.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LTG, LGX, LT1, OR LT4) > DIAGNOSTIC AIDS

DTC P0521 can set if engine oil pressure is outside the calculated engine oil pressure model stored in the engine control module. This can be an indication of mechanical engine issues causing lower than expected engine oil pressure.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LTG, LGX, LT1, OR LT4) > REFERENCE INFORMATION

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- Indicator/Warning Message Description and Operation
- Instrument Cluster Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LTG, LGX, LT1, OR LT4) > CIRCUIT/SYSTEM VERIFICATION

With UDD

1. Ignition ON.
2. Verify the engine oil pressure indicator turns on and off when commanding the All Indicators ON and OFF with a scan tool.
 1. **If the engine oil pressure indicator does not turn on and off.**

Replace the P16 Instrument Cluster.
 1. **If the engine oil pressure indicator turns on and off**
3. Verify the scan tool Engine Oil Pressure Sensor parameter is 0 psi (0 kPa).
 1. **If not 0 psi (0 kPa)**

Refer to Circuit/System Testing.

1. If 0 psi (0 kPa)

4. Engine running.

5. Verify actual engine oil pressure is within specified range. Refer to Oil Pressure Diagnosis and Testing in Displays and Gauges Component Replacement Reference .

6. Verify the scan tool Engine Oil Pressure parameter is within specified range.

1. If not within specified range

Refer to Circuit/System Testing.

1. If within specified range

7. Verify the engine oil pressure displayed on Instrument Cluster is within specified range.

1. If not within specified range

Test or replace the P16 Instrument Cluster.

1. If within specified range

8. All OK.

With UDV or UHS

1. Ignition ON.

2. Verify the scan tool Engine Oil Pressure Sensor parameter is 0 psi (0 kPa).

1. If not 0 psi (0 kPa)

Refer to Circuit/System Testing.

1. If 0 psi (0 kPa)

3. Engine running.

4. Verify actual engine oil pressure is within specified range. Refer to Oil Pressure Diagnosis and Testing in Displays and Gauges Component Replacement Reference .

5. Verify the scan tool Engine Oil Pressure parameter is within specified range.

1. If not within specified range

Refer to Circuit/System Testing.

1. If within specified range

6. Verify the engine oil pressure displayed on Instrument Cluster is within specified range.

1. If not within specified range

Test or replace the P16 Instrument Cluster.

1. If within specified range

7. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LTG, LGX, LT1, OR LT4) > CIRCUIT/SYSTEM TESTING



NOTE:

Circuit/System Verification must be performed before proceeding with Circuit/System Testing.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B37B Engine Oil Pressure Sensor. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.

1. If 10 Ω or greater

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If less than 10 Ω

3. Ignition ON.

4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 3 and ground.

1. If less than 4.8 V

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the 5 V reference circuit and ground.

1. If less than infinite resistance, repair the short to ground on the circuit.

1. If infinite resistance

3. Test for less than 2 Ω in the 5 V reference circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If greater than 5.2 V

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the 5 V reference circuit and ground.

1. If 1 V or greater, repair the short to voltage on the circuit.

2. If less than 1 V, replace the K20 Engine Control Module.

1. If between 4.8-5.2 V

5. Verify the scan tool Engine Oil Pressure parameter is less than 35kPa (5psi).

1. If 35kPa (5psi) or above

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the signal circuit terminal 1 and ground.

1. If 1 V or greater, repair the short to voltage on the circuit.

2. If less than 1 V, replace the K20 Engine Control Module.

1. If below 35kPa (5psi)

6. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the 5 V reference circuit terminal 3.

7. Engine running.

8. Verify the scan tool Engine Oil Pressure parameter is greater than 800kPa (116psi).

1. If 800kPa (116psi) or less

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the signal circuit terminal 1 and ground.

1. If less than infinite resistance, repair the short to ground on the circuit.

1. If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If greater than 800kPa (116psi)

9. Test or replace the B37B Engine Oil Pressure Sensor.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LTG, LGX, LT1, OR LT4) > REPAIR INSTRUCTIONS

Perform the Diagnostic Repair Verification after completing the repair.

- Displays and Gauges Component Replacement Reference

- Control Module References for control module replacement, programming and setup

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LS7) > DIAGNOSTIC INSTRUCTIONS

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LS7) > DTC DESCRIPTORS

DTC P0521

Engine Oil Pressure Sensor Performance

DTC P0522

Engine Oil Pressure Sensor Circuit Low Voltage.

DTC P0523

Engine Oil Pressure Sensor Circuit High Voltage

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LS7) > DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Engine Oil Pressure 5 V Reference	P0522	1	P0522	P0523	P0521
Engine Oil Pressure Sensor Signal	P0522	1	P0522	P0523	P0521
Low Reference	-	1	P0523	-	P0521
1. Engine Oil Pressure Indicator Malfunction					

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LS7) > CIRCUIT/SYSTEM DESCRIPTION

The engine oil pressure sensor changes voltage based on the engine oil pressure. The engine oil

pressure sensor is a 3-wire sensor comprising of the signal circuit, the low reference circuit and the 5 V reference circuit. The engine control module (ECM) supplies 5 V to the engine oil pressure sensor via the 5 V reference circuit and provides ground via the low reference circuit. The ECM monitors the signal circuit of the engine oil pressure sensor to determine if the engine oil pressure sensor voltage is within the normal operating range of approximately 1-4 V. When the engine oil pressure is high, the engine oil pressure sensor voltage is high and the ECM senses a high signal voltage. When the engine oil pressure is low, the engine oil pressure sensor voltage is low and the ECM senses a low signal voltage. The ECM sends the engine oil pressure information to the instrument cluster via serial data. The instrument cluster will illuminate or display the engine oil pressure indicator when the engine oil pressure is low.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LS7) > CONDITIONS FOR RUNNING THE DTC

The engine is running.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LS7) > CONDITIONS FOR SETTING THE DTC

P0521

- The ECM detects that the difference between the predicted oil pressure and the actual oil pressure is either less than 47 kPa (6.8 psi) or greater than 50 kPa (7.3 psi).
- The engine oil pressure is outside of a calculated working range determined by engine speed and temperature.
- The above condition is present for greater than 10 s.

P0522

- The ECM detects that the engine oil pressure sensor signal circuit is less than 0.2 V.
- The above condition is present for greater than 10 s.

P0523

- The ECM detects that the engine oil pressure sensor signal circuit is greater than 4.8 V.
- The above condition is present for greater than 10 s.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LS7) > ACTION TAKEN WHEN THE DTC SETS

- The ECM records the operating conditions at the time the diagnostics test fails. The ECM displays this information in the Failure Records on the scan tool.
- The instrument cluster illuminates the engine oil pressure indicator.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LS7) > CONDITIONS FOR CLEARING THE DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction-free warm-up cycles.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LS7) > DIAGNOSTIC AIDS

DTC P0521 can set if engine oil pressure is outside the calculated engine oil pressure model stored in the engine control module. This can be an indication of mechanical engine issues causing lower than expected engine oil pressure.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LS7) > REFERENCE INFORMATION

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- Indicator/Warning Message Description and Operation
- Instrument Cluster Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LS7) > CIRCUIT/SYSTEM VERIFICATION

With UDD

1. Ignition ON.
2. Verify the engine oil pressure indicator turns on and off when commanding the All Indicators ON and OFF with a scan tool.
 1. **If the engine oil pressure indicator does not turn on and off.**
Replace the P16 Instrument Cluster.
 1. **If the engine oil pressure indicator turns on and off**
3. Verify the scan tool Engine Oil Pressure Switch parameter is Low.
 1. **If not Low**
Refer to Circuit/System Testing.
 1. **If Low**
4. Engine running.
5. Verify the scan tool Engine Oil Pressure Switch parameter is OK.
 1. **If not OK**
Refer to Circuit/System Testing.
 1. **If OK**
6. All OK.

With UDV or UHS

1. Ignition ON.
2. Verify the scan tool Engine Oil Pressure Switch parameter is Low.
 1. **If not Low**
Refer to Circuit/System Testing.
 1. **If Low**
3. Engine running.
4. Verify the scan tool Engine Oil Pressure Switch parameter is OK.
 1. **If not OK**
Refer to Circuit/System Testing.
 1. **If OK**
5. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LS7) > CIRCUIT/SYSTEM TESTING



NOTE:

Circuit/System Verification must be performed before proceeding with Circuit/System Testing.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B37B Engine Oil Pressure Sensor. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.

1. If 10 Ω or greater

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If less than 10 Ω

3. Ignition ON.

4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 2 and ground.

1. If less than 4.8 V

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the 5 V reference circuit and ground.

1. If less than infinite resistance, repair the short to ground on the circuit.

1. If infinite resistance

3. Test for less than 2 Ω in the 5 V reference circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If greater than 5.2 V

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the 5 V reference circuit and ground.

1. If 1 V or greater, repair the short to voltage on the circuit.

2. If less than 1 V, replace the K20 Engine Control Module.

1. If between 4.8-5.2 V

5. Verify the scan tool Engine Oil Pressure Switch parameter is Low.

1. If not Low

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the signal circuit terminal 1 and ground.
 1. If 1 V or greater, repair the short to voltage on the circuit.
 2. If less than 1 V, replace the K20 Engine Control Module.

1. If Low

6. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the 5 V reference circuit terminal 2.
7. Engine running.
8. Verify the scan tool Engine Oil Pressure Switch parameter is OK.

1. If not OK

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 1. If less than infinite resistance, repair the short to ground on the circuit.
 1. If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
 1. If 2 Ω or greater, repair the open/high resistance in the circuit.
 2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If OK

9. Test or replace the B37B Engine Oil Pressure Sensor.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (LS7) > REPAIR INSTRUCTIONS

Perform the Diagnostic Repair Verification after completing the repair.

- Displays and Gauges Component Replacement Reference
- Control Module References for the control module replacement, programming and setup

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL TEMPERATURE INDICATOR MALFUNCTION > DIAGNOSTIC INSTRUCTIONS

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL TEMPERATURE INDICATOR MALFUNCTION > DTC DESCRIPTORS

DTC P0197

Engine Oil Temperature (EOT) Sensor Circuit Low Voltage

DTC P0198

Engine Oil Temperature (EOT) Sensor Circuit High Voltage

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL TEMPERATURE INDICATOR MALFUNCTION > DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0197	P0197, P0198	P0198*	-
Low Reference	-	P0197, P0198	-	-
*ECM or sensor damage may occur if the circuit is shorted to B+.				

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL TEMPERATURE INDICATOR MALFUNCTION > TYPICAL SCAN TOOL DATA

ECT Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine operating in Closed Loop Parameter Normal Range: Varies with oil temperature			
ECT Sensor Signal	140°C (284°F)	-40°C (-40°F)	-40°C (-40°F)
Low Reference	-	-40°C (-40°F)	-

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL TEMPERATURE INDICATOR MALFUNCTION > CIRCUIT/SYSTEM DESCRIPTION

The engine oil temperature (EOT) sensor is a variable resistor that measures the temperature of the engine oil. The engine control module (ECM) supplies 5 volts on the EOT sensor signal circuit and a ground for the low reference circuit. This diagnostic checks for an open, short to ground, or an intermittent circuit condition between the ECM and EOT sensor.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL TEMPERATURE INDICATOR MALFUNCTION > CONDITIONS FOR RUNNING THE DTC

P0197

This DTC runs continuously.

P0198

- The engine is running for greater than 20 s.
- OR
- The ignition is ON and the engine coolant temperature (ECT) is greater than -20°C (-4°F).
- This DTC runs continuously when the above conditions are met.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL TEMPERATURE INDICATOR MALFUNCTION > CONDITIONS FOR SETTING THE DTC

P0197

The ECM detects that the EOT circuit resistance is less than 25 Ω for greater than 50 s.

P0198

The ECM detects that the EOT circuit resistance is greater than 450 k Ω for greater than 50 s.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL TEMPERATURE INDICATOR MALFUNCTION > ACTION TAKEN WHEN THE DTC SETS

DTCs P0197 and P0198 are Type C DTCs.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL TEMPERATURE INDICATOR MALFUNCTION > CONDITIONS FOR CLEARING THE MIL/DTC

DTCs P0197 and P0198 are Type C DTCs.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL TEMPERATURE INDICATOR MALFUNCTION > REFERENCE INFORMATION

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Definitions

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL TEMPERATURE INDICATOR MALFUNCTION > CIRCUIT/SYSTEM VERIFICATION

1. Ignition ON.
2. Verify the scan tool EOT Sensor parameter is between -39 to +120°C (-38 to +248°F) and changes with engine run time.
 1. **If not between -39 to +120°C (-38 to +248°F) or does not change**
Refer to Circuit/System Testing.
 1. **If between -39 to +120°C (-38 to +248°F) and changes**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 1. **If the DTC sets**
Refer to Circuit/System Testing.
 1. **If the DTC does not set**

5. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL TEMPERATURE INDICATOR MALFUNCTION > CIRCUIT/SYSTEM TESTING

 NOTE:

You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B36 Engine Oil Temperature Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal A and ground.
 1. **If 10 Ω or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 1. If 2 Ω or greater, repair the open/high resistance in the circuit.
 2. If less than 2 Ω , replace the K20 Engine Control Module.
 1. **If less than 10 Ω**
3. Ignition ON.
4. Verify the scan tool EOT Sensor parameter is at -40°C (-40°F).
 1. **If warmer than -40°C (-40°F)**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal B and ground.
 1. If less than infinite resistance, repair the short to ground on the circuit.
 2. If infinite resistance, replace the K20 Engine Control Module.
 1. **If -40°C (-40°F)**
5. Install a 3 A fused jumper wire between the signal circuit terminal B and ground.
6. Verify the scan tool EOT Sensor parameter is at 140°C (284°F).
 1. **If colder than 140°C (284°F)**
 1. Ignition OFF, remove the jumper, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the signal circuit terminal B and ground.

1. If 1 V or greater, repair the short to voltage on the circuit.

1. If less than 1 V

3. Ignition OFF.

4. Test for less than 2 Ω in the signal circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , replace the K20 Engine Control Module.

1. if 140°C (284°F)

7. Test or replace the B36 Engine Oil Temperature Sensor.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL TEMPERATURE INDICATOR MALFUNCTION > COMPONENT TESTING

1. Ignition OFF, disconnect the harness connector at the B36 Engine Oil Temperature Sensor.

2. Test the EOT sensor by varying the sensor temperature while monitoring the sensor resistance. Compare the readings with the Temperature Versus Resistance (Engine Coolant Temperature Sensor) table. The resistance values should be in range of the table values.

1. If not within the specified range

Replace the B36 Engine Oil Temperature Sensor.

1. If within the specified range

3. Test for infinite resistance between each terminal and the sensor housing.

1. If less than infinite resistance

Replace the B36 Engine Oil Temperature Sensor.

1. If infinite resistance

4. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL TEMPERATURE INDICATOR MALFUNCTION > REPAIR INSTRUCTIONS

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Displays and Gauges Component Replacement Reference
- Control Module References for control module replacement, programming, and setup

DIAGNOSTIC INFORMATION AND PROCEDURES > FUEL GAUGE MALFUNCTION > DIAGNOSTIC INSTRUCTIONS

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DIAGNOSTIC INFORMATION AND PROCEDURES > FUEL GAUGE MALFUNCTION > DTC DESCRIPTORS

DTC P0461

Fuel Level Sensor 1 Performance

DTC P0462

Fuel Level Sensor 1 Circuit Low Voltage

DTC P0463

Fuel Level Sensor 1 Circuit High Voltage

DTC P0464

Fuel Level Sensor 1 Circuit Intermittent

DTC P2066

Fuel Level Sensor 2 Performance

DTC P2067

Fuel Level Sensor 2 Circuit Low Voltage

DTC P2068

Fuel Level Sensor 2 Circuit High Voltage

DIAGNOSTIC INFORMATION AND PROCEDURES > FUEL GAUGE MALFUNCTION > DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fuel Level Sensor 1/Primary /Right Signal	P0462	P0463	P0463	P0461, 1

Fuel Level Sensor 2/Secondary/Left Signal	P2067	P2068	P2068	P2066, 1
Low Reference	-	P0463, P2068	P0463, P2068	P0461, P2066, 1
1. Fuel Gauge Malfunction				

DIAGNOSTIC INFORMATION AND PROCEDURES > FUEL GAUGE MALFUNCTION > CIRCUIT/SYSTEM DESCRIPTION

The primary fuel level sensor and the secondary fuel level sensor change resistance based on fuel level. The engine control module (ECM) monitors the signal circuits of both sensor to determine the fuel level. When the fuel tank is full, the resistances of both fuel level sensors are low. When the fuel tank is empty, the resistances of the fuel level sensors are high. The ECM uses the signal voltages of the primary fuel level sensor and the secondary fuel level sensor to calculate the percentage of remaining fuel in the tank. The ECM sends the fuel level percentage via serial data to the body control module (BCM). The BCM then sends the fuel level percentage via serial data to the instrument cluster to control the fuel gauge.

DIAGNOSTIC INFORMATION AND PROCEDURES > FUEL GAUGE MALFUNCTION > CONDITIONS FOR RUNNING THE DTC

- Ignition ON
- The system voltage is between 11-16 V

DIAGNOSTIC INFORMATION AND PROCEDURES > FUEL GAUGE MALFUNCTION > CONDITIONS FOR SETTING THE DTC

P0461 or P2066

The ECM detects a change in fuel level of less than a specified amount (typically 3-10 L or 0.8-2.6 gal) over a specified driving distance (typically 240-320 km or 150-200 miles).

P0462 or P2067

- The signal voltage is less than 0.25 V.
- The above conditions must be met for 5 seconds.

P0463 or P2068

- The signal voltage is greater than 4.7 V.
- The above conditions must be met for 5 seconds.

P0464

- The fuel level change is greater than 10% for a duration lasting less than 30 seconds.

- DTC P0464 runs and fails 2 out of 3 test cycles.

DIAGNOSTIC INFORMATION AND PROCEDURES > FUEL GAUGE MALFUNCTION > ACTION TAKEN WHEN THE DTC SETS

- P0461, P0462, P0463, P2066, P2067 and P2068 are Type B DTCs
- The fuel gauge defaults to empty
- The low fuel indicator illuminates

P0464

- P0464 is a Type A DTC

DIAGNOSTIC INFORMATION AND PROCEDURES > FUEL GAUGE MALFUNCTION > CONDITIONS FOR CLEARING THE DTC

- P0461, P0462, P0463, P2066, P2067 and P2068 are Type B DTCs
- P0464 is a Type A DTC

DIAGNOSTIC INFORMATION AND PROCEDURES > FUEL GAUGE MALFUNCTION > REFERENCE INFORMATION

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

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Instrument Cluster Description and Operation

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- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

DIAGNOSTIC INFORMATION AND PROCEDURES > FUEL GAUGE MALFUNCTION > CIRCUIT/SYSTEM VERIFICATION

Without UHS or UDV

1. Ignition ON.
2. Verify the fuel level gauge sweeps when performing the scan tool Instrument Cluster Gauge Sweep control function.
 1. **If the fuel level gauge does not sweep**
Replace the P16 Instrument Cluster
 1. **If the fuel level gauge sweeps**
3. Verify the low fuel level indicator turns ON and OFF when commanding the scan tool All Indicators control function ON and OFF.
 1. **If the low fuel level indicator does not turn ON and OFF**
Replace the P16 Instrument Cluster
 1. **If the low fuel level indicator turns ON and OFF**
4. Verify the ECM scan tool Fuel Level Sensor Right Tank parameter is between 0.5-3.5 V and varies with fuel level.
 1. **If not between 0.5-3.5 V or does not vary with fuel level**
Refer to Primary Fuel Level Sensor Malfunction in Circuit/System Testing
 1. **If between 0.5-3.5 V and varies with fuel level**
5. Verify the ECM scan tool Fuel Level Sensor Left Tank parameter is between 0.5-3.5 V and varies with fuel level.
 1. **If not between 0.5-3.5 V or does not vary with fuel level**
Refer to Secondary Fuel Level Sensor Malfunction in Circuit/System Testing
 1. **If between 0.5-3.5 V and varies with fuel level**
6. All OK.

With UHS or UDV

1. Ignition ON.
2. Verify the ECM scan tool Fuel Level Sensor Right Tank parameter is between 0.5-3.5 V and varies with fuel level.

1. If not between 0.5-3.5 V or does not vary with fuel level

Refer to Primary Fuel Level Sensor Malfunction in Circuit/System Testing

1. If between 0.5-3.5 V and varies with fuel level

3. Verify the ECM scan tool Fuel Level Sensor Left Tank parameter is between 0.5-3.5 V and varies with fuel level.

1. If not between 0.5-3.5 V or does not vary with fuel level

Refer to Secondary Fuel Level Sensor Malfunction in Circuit/System Testing

1. If between 0.5-3.5 V and varies with fuel level

4. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > FUEL GAUGE MALFUNCTION > CIRCUIT/SYSTEM TESTING



NOTE:

Circuit/System Verification must be performed before proceeding with Circuit/System Testing.

Primary Fuel Level Sensor Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the A7 Fuel Pump and Level Sensor Assembly. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.

1. If 10 Ω or greater

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for less than 2 Ω in the low reference circuit end to end.
 1. If 2 Ω or greater, repair the open/high resistance in the circuit.
 2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If less than 10 Ω

3. Ignition ON.
4. Verify the ECM scan tool Fuel Level Sensor Left Tank parameter is greater than 4.8 V.

1. If 4.8 V or less

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the signal circuit terminal 4 and ground.

1. If less than infinite resistance, repair the short to ground on the circuit.

2. If infinite resistance, replace the K20 Engine Control Module.

1. If greater than 4.8 V

5. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the low reference circuit terminal 3.

6. Verify the ECM scan tool Fuel Level Sensor Left Tank parameter is less than 0.2 V.

1. If 0.2 V or greater

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the signal circuit and ground.

1. If 1 V or greater, repair the short to voltage on the circuit.

1. If less than 1 V

3. Ignition OFF

4. Test for less than 2 Ω in the signal circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If less than 0.2 V

7. Test or replace the B46 Fuel Level Sensor.

Secondary Fuel Level Sensor Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B46B Fuel Level Sensor - Secondary. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.

1. If 10 Ω or greater

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If less than 10 Ω

3. Ignition ON.

4. Verify the ECM scan tool Fuel Level Sensor Right Tank parameter is greater than 4.8 V.

1. If 4.8 V or less

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the signal circuit terminal 4 and ground.
 1. If less than infinite resistance, repair the short to ground on the circuit.
 2. If infinite resistance, replace the K20 Engine Control Module.

1. If greater than 4.8 V

5. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the low reference circuit terminal 3.
6. Verify the ECM scan tool Fuel Level Sensor Right Tank parameter is less than 0.2 V.

1. If 0.2 V or greater

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 1. If 1 V or greater, repair the short to voltage on the circuit.
 1. If less than 1 V
3. Ignition OFF
4. Test for less than 2 Ω in the signal circuit end to end.
 1. If 2 Ω or greater, repair the open/high resistance in the circuit.
 2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If less than 0.2 V

7. Test or replace the B46B Fuel Level Sensor - Secondary.

DIAGNOSTIC INFORMATION AND PROCEDURES > FUEL GAUGE MALFUNCTION > COMPONENT TESTING

1. Ignition OFF, remove the appropriate Fuel Level Sender.
2. Sweep the Fuel Level Sensor through its full range of motion while measuring resistance between the signal terminal 4 and the low reference terminal 3.
3. Test for a minimum resistance value of 37-43 Ω and a maximum value of 245-255 Ω without any spikes or dropouts.
 1. **If minimum resistance is not 37-43 Ω , maximum resistance is not 245-255 Ω , or if there are any spikes or dropouts**
Replace the appropriate Fuel Level Sensor.

1. If minimum resistance is 37-43 Ω , maximum resistance is 245-255 Ω , and if there are no spikes or dropouts

4. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > FUEL GAUGE MALFUNCTION > REPAIR INSTRUCTIONS

Perform the Diagnostic Repair Verification after completing the repair.

- Displays and Gauges Component Replacement Reference
- Control Module References for Engine Control Module or Instrument Cluster replacement, programming, and setup

DIAGNOSTIC INFORMATION AND PROCEDURES > HEAD-UP DISPLAY MALFUNCTION > DIAGNOSTIC INSTRUCTIONS

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DIAGNOSTIC INFORMATION AND PROCEDURES > HEAD-UP DISPLAY MALFUNCTION > DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1518 00	U1518 00	-	-
Serial Data	1, U1518 00	U1518 00	1, U1518 00	-
Video Signal	1	1	1	1
Switch Signal	B361B 02	B361B 05	B361B 05	B361B 59
Switch Low Reference	-	B361B 05	-	-
Ground	-	U1518 00	-	-
1. Head-Up Display Malfunction				

DIAGNOSTIC INFORMATION AND PROCEDURES > HEAD-UP DISPLAY MALFUNCTION > CIRCUIT/SYSTEM DESCRIPTION

The head-up display projects a full color image onto the windshield and is only viewable from the driver seat. The image location and brightness is adjustable using the head-up display switch. The image information is received from the instrument cluster through a video cable.

The head-up display is a slave device to the instrument cluster. The head-up display is powered through ignition voltage and ground. It communicates directly with instrument cluster via serial data and only has limited self-diagnosis capacity. Head-up display DTCs are reported through the Instrument Cluster.

The head-up display switch is a multiplexed switch that controls the head-up display based on driver inputs. The head-up display provides the switch with a low reference and monitors a signal circuit. The head-up display switch is made up of a resistor ladder and three switches: Dim +/-, Up/Down, and Page. When a switch is pressed, the signal voltage is pulled low through the resistor ladder. When pressed, each of the switches will result in a different signal voltage seen by the head-up display, depending on the switch's location on the resistor ladder.

DIAGNOSTIC INFORMATION AND PROCEDURES > HEAD-UP DISPLAY MALFUNCTION > REFERENCE INFORMATION

Schematic Reference

Head-Up Display Schematics

Steering Wheel Secondary/Configurable Control Schematics

Connector End View Reference

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Instrument Cluster Description and Operation

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- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

DIAGNOSTIC INFORMATION AND PROCEDURES > HEAD-UP DISPLAY MALFUNCTION > CIRCUIT/SYSTEM VERIFICATION

1. Ignition ON.
2. Verify a test pattern is displayed on the P29 Head-Up Display when performing the Head-Up

Display Pattern Check on the scan tool.

1. If the test pattern is not displayed

Refer to Inoperative Head-Up display Circuit/System Testing.

1. If the test pattern is displayed

3. While holding each switch listed below, verify the scan tool Head-Up Display Switch parameter is as follows:

1. DIM + Switch - HUD Dimming Up/Down Pressed
2. DIM - Switch - HUD Dimming Up/Down Pressed
3. UP Switch - HUD Movement
4. DOWN Switch - HUD Movement
5. PAGE Switch - HUD Page Switch

1. If the scan tool parameter does not equal the expected result with the switch in the appropriate state

Refer to Inoperative Head-Up Display Switch Circuit/System Testing.

1. If the scan tool parameter equals the expected result with the switch in the appropriate state

4. Verify the P29 Head-Up Display performs the following function with the switch in the appropriate state:

1. DIM + Switch - Head-up display brightness increases
2. DIM - Switch - Head-up display brightness decreases
3. UP Switch - Head-up display image moves up
4. DOWN Switch - Head-up display image moves down
5. PAGE Switch - Head-up display image changes pages

1. If the P29 Head-Up Display does not perform the expected function with the switch in the appropriate state

Replace the P29 Head-Up Display.

1. If the P29 Head-Up Display performs the expected function with the switch in the appropriate state

5. All OK.



NOTE:

Circuit/System Verification must be performed before proceeding with Circuit/System Testing.

Inoperative Head-Up Display

1. Ignition OFF, disconnect the harness connector at the P16 Instrument Cluster and P29 Head-Up Display. Ignition ON.
2. Test for less than 1 V between the P16 Instrument Cluster harness connector X1 serial data circuit terminal 21 and ground.

1. If greater than 1 V

Repair the short to voltage on the circuit.

1. If less than 1 V

3. Ignition OFF.
4. Test for infinite resistance between the P16 Instrument Cluster harness connector X1 serial data circuit terminal 21 and ground.

1. If less than infinite resistance repair the short to ground on the circuit.

1. If infinite resistance

5. Disconnect the harness connector at the S70R Steering Wheel Controls Switch - Right. Ignition ON.
6. Test for less than 1 V between the S70R Steering Wheel Controls Switch - Right serial data circuit terminal 2 and ground.

1. If greater than 1 V

Repair the short to voltage on the circuit.

1. If less than 1 V

7. Ignition OFF.
8. Test for infinite resistance between the serial data circuit terminal 2 and ground.

1. If less than infinite resistance

Repair the short to ground on the circuit.

1. If infinite resistance

9. Replace the video cable between the P29 Head-Up Display and the P16 Instrument Cluster. Ignition ON.
10. Verify a test pattern is displayed on the P29 Head-Up Display when performing the Head-Up Display Pattern Check on the scan tool.

1. If the test pattern is displayed

All OK.

1. If the test pattern is not displayed

11. Connect the harness connector at the P16 Instrument Cluster and S70R Steering Wheel Controls Switch - Right. Ignition ON.

12. Verify steering wheel controls function properly.

1. If steering wheel controls function properly

Replace P29 Head-Up Display.

1. If steering wheel controls do not function properly

13. Ignition OFF. Disconnect harness connector at the S70R Steering Wheel Controls Switch - Right. Connect the harness connector at the and P29 Head-Up Display. Ignition ON.

14. Verify head-up display functions properly.

1. If head-up display functions properly

Replace S70R Steering Wheel Controls Switch - Right.

1. If head-up display does not function properly

15. Replace P16 Instrument Cluster.

Inoperative Head-Up Display Switch

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S27 Head-Up Display Switch. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.

1. If 10 Ω or greater

1. Ignition OFF, disconnect the harness connector at the P29 Head-Up Display.

2. Test for less than 2 Ω in the low reference circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , replace the P29 Head-Up Display.

1. If less than 10 Ω

3. Ignition ON.

4. Test for 4.8-5.2 V between the signal circuit terminal 4 and ground.

1. If less than 4.8 V

1. Ignition OFF, disconnect the harness connector at the P29 Head-Up Display.

2. Test for infinite resistance between the signal circuit and ground.

1. If less than infinite resistance, repair the short to ground on the circuit.

1. If infinite resistance.

3. Test for less than 2 Ω in the signal circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , replace the P29 Head-Up Display.

1. If greater than 5.2 V

1. Ignition OFF, disconnect the harness connector at the P29 Head-Up Display, ignition ON.

2. Test for less than 1 V between the signal circuit and ground.

1. If 1 V or greater, repair the short to voltage on the circuit.

2. If less than 1 V, replace the P29 Head-Up Display.

1. If between 4.8-5.2 V

5. Test or replace the S27 Head-Up Display Switch.

DIAGNOSTIC INFORMATION AND PROCEDURES > HEAD-UP DISPLAY MALFUNCTION > COMPONENT TESTING

1. Ignition OFF, disconnect the harness connector at the S27 Head-Up Display Switch.

2. Test for 3.4K - 4.2K Ω between the signal terminal 4 and the low reference terminal 3.

1. If not between 3.4K - 4.2K Ω

Replace the S27 Head-Up Display Switch.

1. If between 3.4K - 4.2K Ω

3. Test for 87 - 107 Ω between the signal terminal 4 and the low reference terminal 3 with the Dim + switch pressed.

1. If not between 87 - 107 Ω

Replace the S27 Head-Up Display Switch.

1. If between 87 - 107 Ω

4. Test for 291 - 356 Ω between the signal terminal 4 and the low reference terminal 3 with the Dim - switch pressed.

1. If not between 291 - 356 Ω

Replace the S27 Head-Up Display Switch.

1. If between 291 - 356 Ω

5. Test for 575 - 704 Ω between the signal terminal 4 and the low reference terminal 3 with the Up switch pressed.

1. If not between 575 - 704 Ω

Replace the S27 Head-Up Display Switch.

1. If between 575 - 704 Ω

6. Test for 1K - 1.2K Ω between the signal terminal 4 and the low reference terminal 3 with the Down switch pressed.

1. If not between 1K - 1.2K Ω

Replace the S27 Head-Up Display Switch.

1. If between 1K - 1.2K Ω

7. Test for 1.7K - 2.1K Ω between the signal terminal 4 and the low reference terminal 3 with the Page switch pressed.

1. If not between 1.7K - 2.1K Ω

Replace the S27 Head-Up Display Switch.

1. If between 1.7K - 2.1K Ω

8. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > HEAD-UP DISPLAY MALFUNCTION > REPAIR INSTRUCTIONS

Perform the Diagnostic Repair Verification after completing the repair.

- Displays and Gauges Component Replacement Reference
- Control Module References for instrument cluster replacement, programming, and setup

DIAGNOSTIC INFORMATION AND PROCEDURES > INSTRUMENT CLUSTER PROGRAMMING MALFUNCTION (WITH UDD ONLY) > DIAGNOSTIC INSTRUCTIONS

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DIAGNOSTIC INFORMATION AND PROCEDURES > INSTRUMENT CLUSTER PROGRAMMING MALFUNCTION (WITH UDD ONLY) > CIRCUIT/SYSTEM

DESCRIPTION

The X92 USB Receptacle is connected to the Instrument Cluster via a USB cable. The X92 USB Receptacle is only used for programming the Instrument Cluster via SPS programming.

DIAGNOSTIC INFORMATION AND PROCEDURES > INSTRUMENT CLUSTER PROGRAMMING MALFUNCTION (WITH UDD ONLY) > REFERENCE INFORMATION

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

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Instrument Cluster Description and Operation

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- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-50334-50 GM Infotainment Tester Kit

DIAGNOSTIC INFORMATION AND PROCEDURES > INSTRUMENT CLUSTER PROGRAMMING MALFUNCTION (WITH UDD ONLY) > CIRCUIT/SYSTEM TESTING

 **NOTE:**

This procedure should only be completed when the Instrument Cluster fails to read the USB thumb drive during a USB programming event.

1. Verify the USB cable is properly connected and there is no damage to the cable or connections.

1. If connection problems or cable damage is noted.

Perform the appropriate repair or replacement to correct any issues.

1. If no connection problems or cable damage is noted.

2. Connect the EL-50334-50 to the X92 USB Receptacle connector and the Instrument Cluster connector X2.

3. Ignition ON.

4. Verify the Instrument Cluster completes USB Programming properly following SPS instructions..

1. If Instrument Cluster does not program properly

1. Replace the X92 USB Receptacle.

2. Verify the Instrument Cluster completes USB Programming properly following SPS instructions.

1. If Instrument Cluster does not operate properly

Replace the P16 Instrument Cluster.

1. If Instrument Cluster programs properly

All OK

1. If Instrument Cluster programs properly

5. Replace the USB harness.

DIAGNOSTIC INFORMATION AND PROCEDURES > INSTRUMENT CLUSTER PROGRAMMING MALFUNCTION (WITH UDD ONLY) > REPAIR INSTRUCTIONS

Perform the Diagnostic Repair Verification after completing the repair.

- Displays and Gauges Component Replacement Reference
- Control Module References for control module replacement, programming, and setup.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR DIAGNOSIS (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4) > DIAGNOSTIC INSTRUCTIONS

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR DIAGNOSIS (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4) > DTC DESCRIPTOR

DTC P250A

Engine Oil Level Switch Circuit

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR DIAGNOSIS (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4) > DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Engine Oil Level Sensor Signal	2	P250A, 1	-
Engine Oil Level Sensor Ground	-	P250A, 1	-
1. DIC message Engine Oil Level Low always ON 2. DIC message Engine Oil Level Low always OFF			

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR DIAGNOSIS (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4) > TYPICAL SCAN TOOL DATA

Engine Oil Level Switch

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON Parameter Normal Range: OK			
Engine Oil Level Sensor/Switch Signal	OK	Low	OK
Engine Oil Level Sensor/Switch Ground	-	Low	-

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR DIAGNOSIS (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4) > CIRCUIT/SYSTEM DESCRIPTION

The engine oil level sensor/switch is normally-closed with proper engine oil level. The switch opens when the engine oil level drops below a calibrated level. The engine control module (ECM) monitors the engine oil level signal circuit when the ignition is ON, and the engine is OFF. With the switch in the closed position, the ECM detects a low voltage on the signal circuit. With the switch in the open position, the ECM detects a high voltage on the signal circuit. When high voltage is detected on the signal circuit, the

ECM will send a serial data message to the instrument panel cluster (IPC). The IPC will then display a message on the driver information center (DIC) or illuminate a low engine oil level lamp.

The following information determines the message sent from the ECM to the IPC:

- The Low Engine Oil Level message lamp is displayed only after the ECM detects a high voltage on the signal circuit for three consecutive ignition cycles, followed by an ignition OFF event from 15 minutes to greater than 50 minutes, depending on engine oil temperatures.
- The Low Engine Oil Level message is turned OFF when the ECM detects a low voltage on the signal circuit after an ignition OFF event for greater than 90 seconds, followed by an ignition ON event for less than 1 second.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR DIAGNOSIS (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4) > CONDITIONS FOR RUNNING THE DTC

Ignition ON.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR DIAGNOSIS (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4) > CONDITIONS FOR SETTING THE DTC

The ECM detects a high voltage on the signal circuit for three consecutive ignition cycles, followed by an ignition OFF event from 15 minutes to greater than 50 minutes, depending on engine oil temperatures.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR DIAGNOSIS (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4) > ACTION TAKEN WHEN THE DTC SETS

Engine Oil Level Low message activated.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR DIAGNOSIS (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4) > CONDITIONS FOR CLEARING THE DTC

The ECM detects a low voltage on the signal circuit after an ignition OFF event for greater than 90 seconds, followed by an ignition ON event for less than 1 second.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR DIAGNOSIS (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4) > REFERENCE

INFORMATION

Schematic Reference

- Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- Instrument Cluster Description and Operation
- Indicator/Warning Message Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR DIAGNOSIS (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4) > CIRCUIT/SYSTEM VERIFICATION

1. Verify proper engine oil level.

1. **If not at proper level**

Add oil as necessary.

1. **If at proper level**

2. Ignition ON, verify the scan tool Engine Oil Level parameter reads OK.

1. **If not OK**

Refer to Circuit/System Testing.

1. **If OK**

3. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR

DIAGNOSIS (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4) > CIRCUIT/SYSTEM TESTING



NOTE:

Verify proper engine oil level before continuing with diagnosis.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B35 Engine Oil Level Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 1 and ground.

1. If 5 Ω or greater

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for less than 2 Ω in the ground circuit end to end.
 1. If 2 Ω or greater, repair the open/high resistance in the circuit.
 2. If less than 2 Ω , repair the open/high resistance in the ground connection.

1. If less than 5 Ω

3. Ignition ON.
4. Verify the scan tool Engine Oil Level Switch parameter reads Low.

1. If the Engine Oil Level Switch parameter reads OK

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the signal circuit terminal 2 and ground.
 1. If less than infinite resistance, repair the short to ground on the circuit.
 2. If infinite resistance, replace the K20 Engine Control Module.

1. If the Engine Oil Level Switch parameter reads Low



NOTE:

If a short to voltage is found on the signal circuit, the fuse in the 3A jumper wire will open.

5. Install a 3A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 1.
6. Verify the scan tool Engine Oil Level Switch parameter reads OK.
 1. If the Engine Oil Level Switch parameter reads Low

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 1. If 1 V or greater, repair the short to voltage on the circuit.
 2. If less than 1 V
3. Test for less than 2 Ω in the signal circuit end to end.
 1. If 2 Ω or greater, repair the open/high resistance on the circuit.
 2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If the Engine Oil Level Switch parameter reads OK

7. Test or replace the B35 Engine Oil Level Switch.

**DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR
DIAGNOSIS (WITH LCV, LD4, LF3, LF4, LFX, LTG, LT1, OR LT4) > REPAIR
INSTRUCTIONS**

Perform the Diagnostic Repair Verification after completing the repair.

- Displays and Gauges Component Replacement Reference
- Control Module References for control module replacement, programming, and setup

**DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR
DIAGNOSIS (WITH LGX) > DIAGNOSTIC INSTRUCTIONS**

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

**DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR
DIAGNOSIS (WITH LGX) > DTC DESCRIPTOR**

DTC P250A

Engine Oil Level Switch Circuit

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR

DIAGNOSIS (WITH LGX) > DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Engine Oil Level Sensor Signal	2	P250A, 1	-
Engine Oil Level Sensor Ground	-	P250A, 1	-
1. DIC message Engine Oil Level Low always ON 2. DIC message Engine Oil Level Low always OFF			

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR DIAGNOSIS (WITH LGX) > TYPICAL SCAN TOOL DATA

Engine Oil Level Switch

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON Parameter Normal Range: OK			
Engine Oil Level Sensor/Switch Signal	OK	Low	OK
Engine Oil Level Sensor/Switch Ground	-	Low	-

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR DIAGNOSIS (WITH LGX) > CIRCUIT/SYSTEM DESCRIPTION

The engine oil level sensor/switch is normally-closed with proper engine oil level. The switch opens when the engine oil level drops below a calibrated level. The engine control module (ECM) monitors the engine oil level signal circuit when the ignition is ON, and the engine is OFF. With the switch in the closed position, the ECM detects a low voltage on the signal circuit. With the switch in the open position, the ECM detects a high voltage on the signal circuit. When high voltage is detected on the signal circuit, the ECM will send a serial data message to the instrument panel cluster (IPC). The IPC will then display a message on the driver information center (DIC) or illuminate a low engine oil level lamp.

The following information determines the message sent from the ECM to the IPC:

- The Low Engine Oil Level message lamp is displayed only after the ECM detects a high voltage on the signal circuit for three consecutive ignition cycles, followed by an ignition OFF event from 15 minutes to greater than 50 minutes, depending on engine oil temperatures.
- The Low Engine Oil Level message is turned OFF when the ECM detects a low voltage on the signal circuit after an ignition OFF event for greater than 90 seconds, followed by an ignition ON event for less than 1 second.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR

DIAGNOSIS (WITH LGX) > CONDITIONS FOR RUNNING THE DTC

Ignition ON.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR

DIAGNOSIS (WITH LGX) > CONDITIONS FOR SETTING THE DTC

The ECM detects a high voltage on the signal circuit for three consecutive ignition cycles, followed by an ignition OFF event from 15 minutes to greater than 50 minutes, depending on engine oil temperatures.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR

DIAGNOSIS (WITH LGX) > ACTION TAKEN WHEN THE DTC SETS

Engine Oil Level Low message activated.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR

DIAGNOSIS (WITH LGX) > CONDITIONS FOR CLEARING THE DTC

The ECM detects a low voltage on the signal circuit after an ignition OFF event for greater than 90 seconds, followed by an ignition ON event for less than 1 second.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR

DIAGNOSIS (WITH LGX) > REFERENCE INFORMATION

Schematic Reference

- Engine Mechanical Schematics
- Instrument Cluster Schematics

Connector End View Reference

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- Instrument Cluster Description and Operation
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- Connector Repairs

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR DIAGNOSIS (WITH LGX) > CIRCUIT/SYSTEM VERIFICATION

1. Verify proper engine oil level.

1. If not at proper level

Add oil as necessary.

1. If at proper level

2. Ignition ON, verify the scan tool Engine Oil Level parameter reads OK.

1. If not OK

Refer to Circuit/System Testing.

1. If OK

3. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR DIAGNOSIS (WITH LGX) > CIRCUIT/SYSTEM TESTING



NOTE:

Verify proper engine oil level before continuing with diagnosis.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B35 Engine Oil Level Switch. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 5 Ω between the ground circuit terminal 2 and ground.

1. If 5 Ω or greater

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2 Ω in the ground circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , repair the open/high resistance in the ground connection.

1. If less than 5 Ω

3. Ignition ON.

4. Verify the scan tool Engine Oil Level Switch parameter reads Low.

1. If the Engine Oil Level Switch parameter reads OK

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the signal circuit terminal 1 and ground.

1. If less than infinite resistance, repair the short to ground on the circuit.

2. If infinite resistance, replace the K20 Engine Control Module.

1. If the Engine Oil Level Switch parameter reads Low

 **NOTE:**

If a short to voltage is found on the signal circuit, the fuse in the 3A jumper wire will open.

5. Install a 3A fused jumper wire between the signal circuit terminal 1 and the ground circuit terminal 2.

6. Verify the scan tool Engine Oil Level Switch parameter reads OK.

1. If the Engine Oil Level Switch parameter reads Low

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the signal circuit and ground.

1. If 1 V or greater, repair the short to voltage on the circuit.

2. If less than 1 V

3. Test for less than 2 Ω in the signal circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance on the circuit.

2. If less than 2 Ω , replace the K20 Engine Control Module.

1. If the Engine Oil Level Switch parameter reads OK

7. Test or replace the B35 Engine Oil Level Switch.

**DIAGNOSTIC INFORMATION AND PROCEDURES > ENGINE OIL LEVEL SENSOR
DIAGNOSIS (WITH LGX) > REPAIR INSTRUCTIONS**

Perform the Diagnostic Repair Verification after completing the repair.

- Displays and Gauges Component Replacement Reference
- Control Module References for control module replacement, programming, and setup

DIAGNOSTIC INFORMATION AND PROCEDURES > OUTSIDE AIR TEMPERATURE DISPLAY MALFUNCTION > DIAGNOSTIC INSTRUCTIONS

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DIAGNOSTIC INFORMATION AND PROCEDURES > OUTSIDE AIR TEMPERATURE DISPLAY MALFUNCTION > DTC DESCRIPTORS

DTC B0158 02

Ambient Air Temperature Sensor Circuit Short to Ground

DTC B0158 05

Ambient Air Temperature Sensor Circuit High Voltage/Open

DIAGNOSTIC INFORMATION AND PROCEDURES > OUTSIDE AIR TEMPERATURE DISPLAY MALFUNCTION > DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B0158 02	B0158 05	B0158 05	-
Low Reference	-	B0158 05	-	-

DIAGNOSTIC INFORMATION AND PROCEDURES > OUTSIDE AIR TEMPERATURE DISPLAY MALFUNCTION > CIRCUIT/SYSTEM DESCRIPTION

The instrument cluster monitors the ambient air temperature sensor with a low reference circuit and signal circuit. The instrument cluster monitors the voltage drop across the sensor, which is inversely proportional to temperature. When the ambient air temperature is cold, the resistance of the sensor is high. When the ambient air temperature is warm, the resistance of the sensors is low. The instrument cluster converts the voltage value to a temperature value. Based on application, the Instrument Cluster either displays the temperature or sends the value via serial data to the Info Display Module for display.

DIAGNOSTIC INFORMATION AND PROCEDURES > OUTSIDE AIR TEMPERATURE DISPLAY MALFUNCTION > CONDITIONS FOR RUNNING THE DTC

The system voltage is between 9-16 V.

DIAGNOSTIC INFORMATION AND PROCEDURES > OUTSIDE AIR TEMPERATURE DISPLAY MALFUNCTION > CONDITIONS FOR SETTING THE DTC

B0158 02

The instrument cluster detects the sensor signal is more than 88°C (190°F).

B0158 05

The instrument cluster detects the sensor signal is less than -40°C (-40°F).

DIAGNOSTIC INFORMATION AND PROCEDURES > OUTSIDE AIR TEMPERATURE DISPLAY MALFUNCTION > ACTION TAKEN WHEN THE DTC SETS

The instrument cluster uses a default air temperature value for further calculations. The instrument cluster will display -°C (-°F). A/C compressor engagement may be disabled.

DIAGNOSTIC INFORMATION AND PROCEDURES > OUTSIDE AIR TEMPERATURE DISPLAY MALFUNCTION > CONDITIONS FOR CLEARING THE DTC

The DTC will become history if the instrument cluster no longer detects a malfunction.

DIAGNOSTIC INFORMATION AND PROCEDURES > OUTSIDE AIR TEMPERATURE DISPLAY MALFUNCTION > DIAGNOSTIC AIDS

The outside air temperature display on the Info Display Module is a buffered value. It is not a live value when the vehicle is parked, it periodically updates while driving the vehicle. For more information on how the display is updated, refer to Instrument Cluster Description and Operation .

DIAGNOSTIC INFORMATION AND PROCEDURES > OUTSIDE AIR TEMPERATURE DISPLAY MALFUNCTION > REFERENCE INFORMATION

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

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Instrument Cluster Description and Operation

Electrical Information Reference

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- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

DIAGNOSTIC INFORMATION AND PROCEDURES > OUTSIDE AIR TEMPERATURE DISPLAY MALFUNCTION > CIRCUIT/SYSTEM VERIFICATION

1. Ignition ON.
2. Verify the scan tool Ambient Air Temperature parameter is between -40°C (-40°F) and +88°C (+190°F) and changes with air temperature changes.
 1. **If not between -40°C (-40°F) and +88°C (+190°F) or changes with air temperature changes**

Refer to Circuit/System Testing.
 1. **If between -40°C (-40°F) and +88°C (+190°F) and changes with air temperature changes**
3. Perform the Instrument Cluster Ambient Air Temperature Instant Update special function with the scan tool
4. Verify the scan tool Ambient Air Temperature parameter is within five degrees of actual ambient air temperature.
 1. **If not within five degrees of actual ambient air temperature**

Refer to Circuit/System Testing.
 1. **If within five degrees of actual ambient air temperature**
5. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > OUTSIDE AIR TEMPERATURE DISPLAY MALFUNCTION > CIRCUIT/SYSTEM TESTING



NOTE:

Circuit/System Verification must be performed before proceeding with Circuit/System Testing.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B9 Ambient Air Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal B (or 2) and ground.

1. If 10 Ω or greater

1. Ignition OFF, disconnect the harness connector at the P16 Instrument Cluster.
2. Test for less than 2 Ω in the low reference circuit end to end.
 1. If 2 Ω or greater, repair the open/high resistance in the circuit.
 2. If less than 2 Ω , replace the P16 Instrument Cluster.

1. If less than 10 Ω

3. Ignition ON.
4. Verify the scan tool Ambient Air Temperature parameter is greater than 98%.

1. If 98% or less

1. Ignition OFF, disconnect the harness connector at the P16 Instrument Cluster.
2. Test for infinite resistance between the signal circuit terminal A (or 1) and ground.
 1. If less than infinite resistance, repair the short to ground on the circuit.
 2. If infinite resistance, replace the P16 Instrument Cluster.

1. If greater than 98%

5. Install a 3 A fused jumper wire between the signal circuit terminal A (or 1) and the low reference circuit terminal B (or 2).
6. Verify the scan tool Ambient Air Temperature parameter is less than 8%.

1. If 8% or greater

1. Ignition OFF, disconnect the harness connector at the P16 Instrument Cluster, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 1. If 1 V or greater, repair the short to voltage on the circuit.
 1. If less than 1 V
3. Ignition OFF

4. Test for less than 2 Ω in the signal circuit end to end.

1. If 2 Ω or greater, repair the open/high resistance in the circuit.

2. If less than 2 Ω , replace the P16 Instrument Cluster.

1. If less than 8%

7. Test or replace the B9 Ambient Air Temperature Sensor.

DIAGNOSTIC INFORMATION AND PROCEDURES > OUTSIDE AIR TEMPERATURE DISPLAY MALFUNCTION > REPAIR INSTRUCTIONS

Perform the Diagnostic Repair Verification after completing the repair.

- Displays and Gauges Component Replacement Reference
- Control Module References for instrument cluster replacement, programming and setup

DIAGNOSTIC INFORMATION AND PROCEDURES > SPEEDOMETER AND/OR ODOMETER MALFUNCTION > DIAGNOSTIC INSTRUCTIONS

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DIAGNOSTIC INFORMATION AND PROCEDURES > SPEEDOMETER AND/OR ODOMETER MALFUNCTION > CIRCUIT/SYSTEM DESCRIPTION

The instrument cluster displays the engine coolant temperature, fuel level, vehicle speed and the engine speed based on the information from the engine control module (ECM). The ECM sends information via serial data to the body control module (BCM). The BCM then sends the information via serial data to the instrument cluster to display the engine coolant temperature, fuel level, the engine speed, the vehicle speed and the distance travelled, either in kilometers or miles, based on the vehicle requirements. The instrument cluster will display dashes when its VIN does not match the VIN received from the BCM.

DIAGNOSTIC INFORMATION AND PROCEDURES > SPEEDOMETER AND/OR ODOMETER MALFUNCTION > DIAGNOSTIC AIDS

If the VIN mismatch is corrected the odometer will once again be displayed in the instrument cluster. If the vehicle is driven for a calibrated distance with a VIN mismatch, it will cause the instrument cluster odometer to enter into an error mode and lock itself. When this occurs the dashes will remain on the display even after correcting the VIN mismatch. The vehicle odometer status data display on the scan tool can be used to identify a locked odometer. The only way to unlock the instrument cluster (clear the

dashes from the display) is to perform an SPS programming event. Failure to follow the diagnostic and programming procedures may result in either an improper odometer value or a module replacement.

DIAGNOSTIC INFORMATION AND PROCEDURES > SPEEDOMETER AND/OR ODOMETER MALFUNCTION > REFERENCE INFORMATION

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

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- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

DIAGNOSTIC INFORMATION AND PROCEDURES > SPEEDOMETER AND/OR ODOMETER MALFUNCTION > CIRCUIT/SYSTEM VERIFICATION

1. Ignition ON/Vehicle in Service Mode.

2. Verify no DTC is set.

1. If any DTC is set

Diagnose DTCs first. Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

1. If no DTCs are set

3. If applicable, verify the speedometer sweeps from low to high position when performing the Instrument Cluster Gauge Sweep with the scan tool.

1. If speedometer does not sweep

Replace the P16 Instrument Cluster.

1. If speedometer sweeps properly

4. Verify the speedometer gauge value matches the scan tool Vehicle Speed parameter while driving the vehicle.

1. If the values do not match

Replace the P16 Instrument Cluster.

1. If the speedometer value matches the scan tool parameter

5. Verify the odometer display and the displayed distance counts up while driving the vehicle.

1. If the odometer displays only "----" (dashes)

Refer to Circuit/System Testing.

2. If the odometer display does not count up

Replace the P16 Instrument Cluster.

1. If speedometer sweeps and displays the correct value, and the odometer display counts up

6. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > SPEEDOMETER AND/OR ODOMETER MALFUNCTION > CIRCUIT/SYSTEM TESTING



NOTE:

- *Circuit/System Verification must be performed before proceeding with Circuit/System Testing.*
- *If there are multiple modules not original to the vehicle and they are used or incorrectly configured service parts, SPS may not be able to properly read or recover the vehicle odometer value. Follow government rules and documentation (including vehicle identification) regarding inaccurate/unknown odometer values.*

Correcting VIN mismatch: Instrument Cluster is Showing "----" (Dashes), odometer is still unlocked

1. Ignition ON/Vehicle in Service Mode.

2. Verify the scan tool Odometer Status parameter is Unlocked.

1. If the reading is Locked

Refer to correcting VIN mismatch - odometer locked.

1. If the reading is Unlocked

3. Verify the scan tool BCM VIN parameter matches the vehicle's VIN placard.

1. If the VIN does not match

Reprogram the BCM, then proceed to Step 3.

1. If the VIN matches

4. Verify the scan tool Instrument Cluster Vehicle Identification Number (VIN) parameter matches the vehicle's VIN placard.

1. If the VIN does not match

Reprogram the instrument cluster. Then proceed with step 4.

1. If the VIN matches

5. Verify the instrument cluster is displaying the correct value.

1. If the instrument cluster is still displaying "----" (dashes)

Replace the P16 Instrument Cluster.

1. If the instrument cluster is displaying the correct value

6. All OK.

Correcting VIN mismatch: Instrument Cluster is Showing "----" (Dashes), odometer is locked

1. Ignition ON/Vehicle in Service Mode.

2. Verify the scan tool Odometer Status parameter is Locked.

1. If the reading is Unlocked

Refer to Correcting VIN mismatch - odometer unlocked.

1. If the reading is Locked

3. Verify the scan tool Instrument Cluster Vehicle Identification Number (VIN) parameter matches the vehicle's VIN placard.

1. If the VIN does not match

Reprogram the Instrument Cluster. Then proceed with step 3.

1. If the VIN matches

4. Perform the BCM setup procedure in SPS.

5. Verify the instrument cluster is displaying the correct value.

1. If the instrument cluster is still displaying "----" (dashes)

Replace the P16 Instrument Cluster.

1. If instrument cluster is displaying the correct value

6. All OK.

DIAGNOSTIC INFORMATION AND PROCEDURES > SPEEDOMETER AND/OR ODOMETER MALFUNCTION > REPAIR INSTRUCTIONS

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for instrument cluster, BCM or ECM replacement, programming, and setup.

DIAGNOSTIC INFORMATION AND PROCEDURES > TACHOMETER INACCURATE OR INOPERATIVE > DIAGNOSTIC INSTRUCTIONS

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DIAGNOSTIC INFORMATION AND PROCEDURES > TACHOMETER INACCURATE OR INOPERATIVE > CIRCUIT/SYSTEM DESCRIPTION

The engine control module creates the engine speed signal by pulsing the engine speed signal circuit to ground at a rate proportional to engine revolution speed. The instrument cluster converts the engine revolution signal to a tachometer position indicating the engine speed. The engine speed is sent to the instrument cluster over a discrete wire from the engine control module. The tachometer signal is pulled up to B+ in the instrument cluster. The engine control module monitors the voltage at the engine speed signal circuit to determine when the voltage is out of the normal operating range.

DIAGNOSTIC INFORMATION AND PROCEDURES > TACHOMETER INACCURATE OR INOPERATIVE > REFERENCE INFORMATION

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

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Instrument Cluster Description and Operation

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- Connector Repairs

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

DIAGNOSTIC INFORMATION AND PROCEDURES > TACHOMETER INACCURATE OR INOPERATIVE > CIRCUIT/SYSTEM TESTING

1. Ignition ON/Vehicle in Service Mode.
2. Verify the tachometer moves from the minimum to the maximum position and back to the minimum position when performing the Instrument Cluster Gauge Sweep Test with the scan tool.

1. If tachometer does not sweep

Replace the P16 Instrument Cluster.

1. If speedometer sweeps properly

3. Refer to DTC P2615 or P2616 , with LTG engine, DTC P2615 or P2616 , with LGX /LF3 engine, or DTC P2615 or P2616 with LT1/LT4 engine.

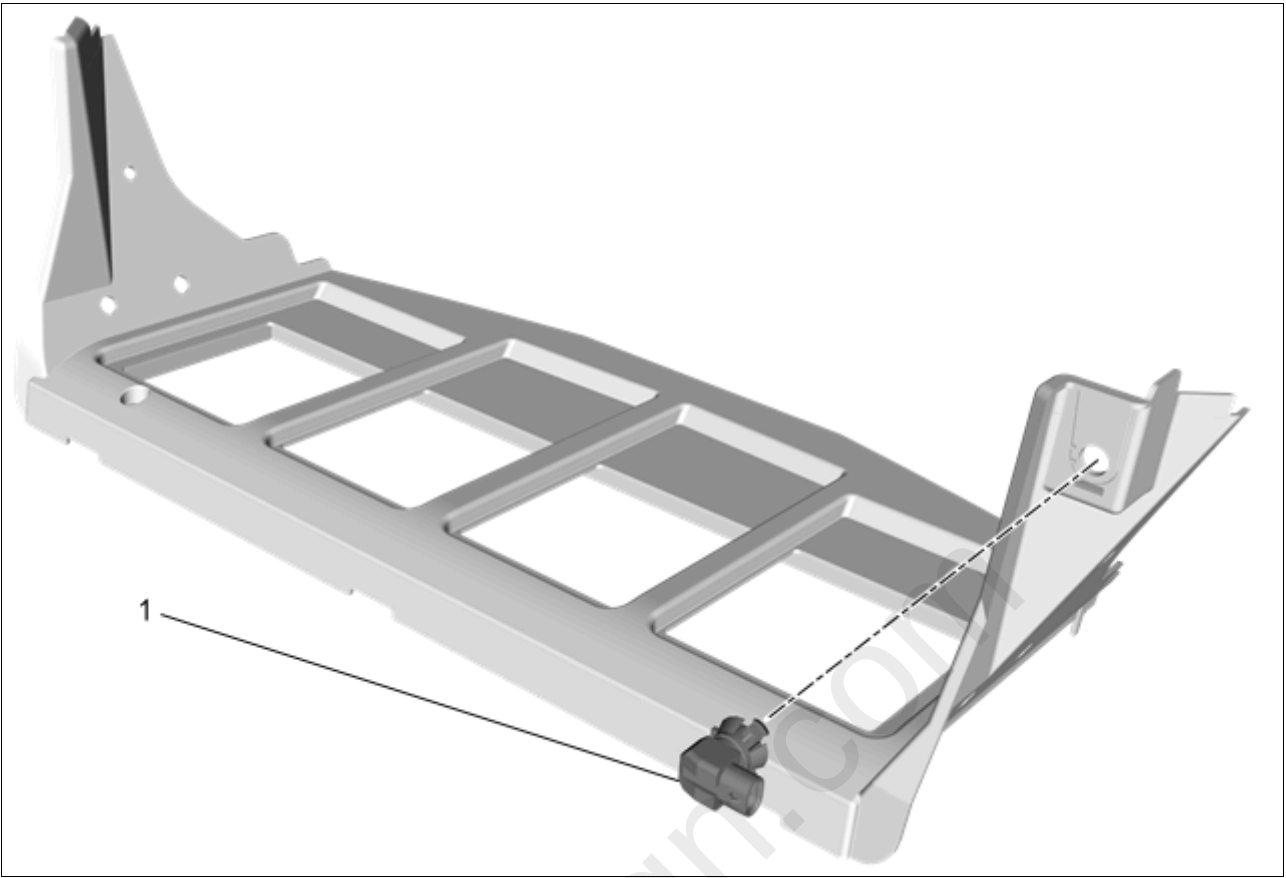
DIAGNOSTIC INFORMATION AND PROCEDURES > TACHOMETER INACCURATE OR INOPERATIVE > REPAIR INSTRUCTIONS

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for control module replacement, programming, and setup

REPAIR INSTRUCTIONS > AMBIENT AIR TEMPERATURE SENSOR REPLACEMENT (LT1)

Fig 1: Ambient Air Temperature Sensor (LT1)

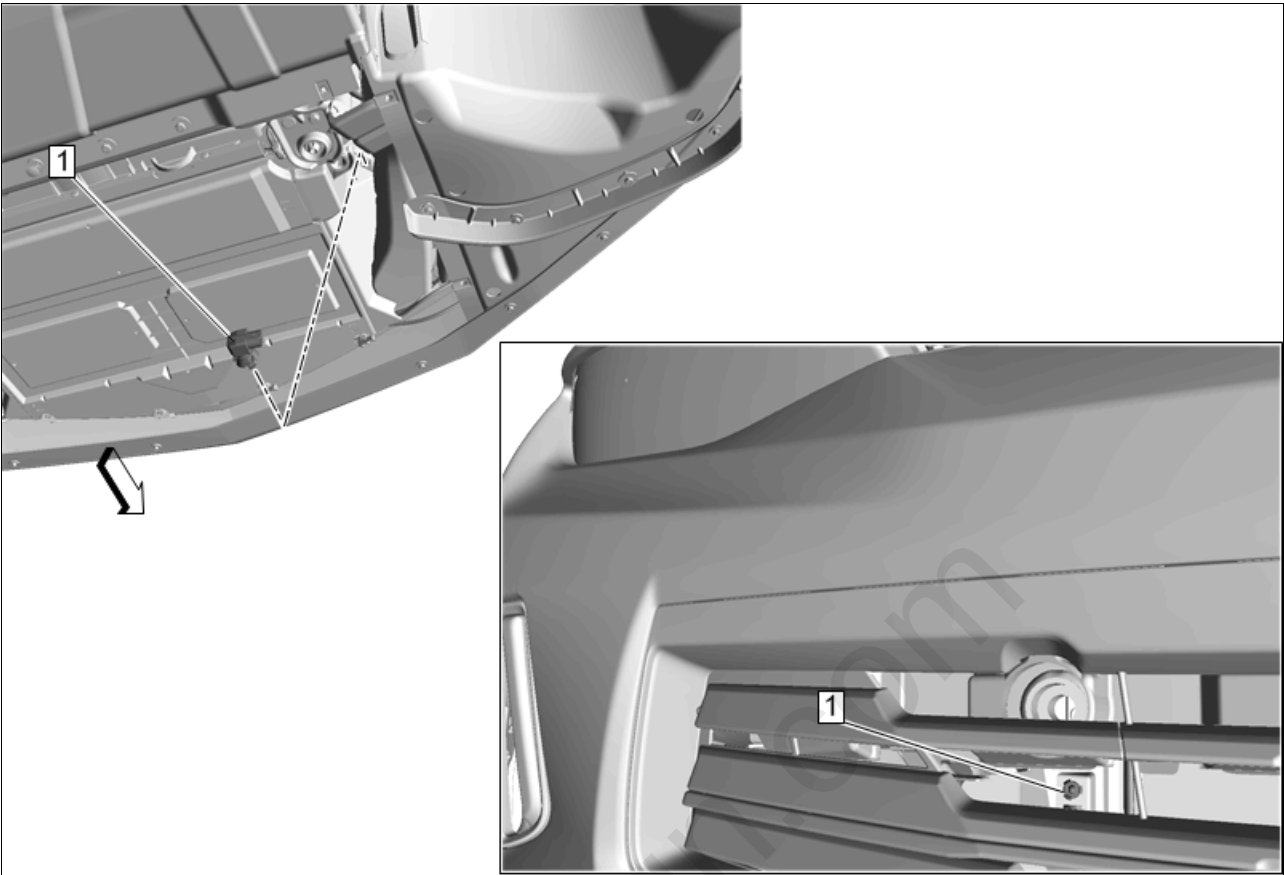


Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Radiator Air Lower Baffle Replacement (LT1)	
1	Ambient Air Temperature Sensor Procedure Squeeze the ambient air temperature sensor tabs, to release the sensor.

REPAIR INSTRUCTIONS > AMBIENT AIR TEMPERATURE SENSOR REPLACEMENT (LGX LTG)

Fig 1: Ambient Air Temperature Sensor (LGX LTG)

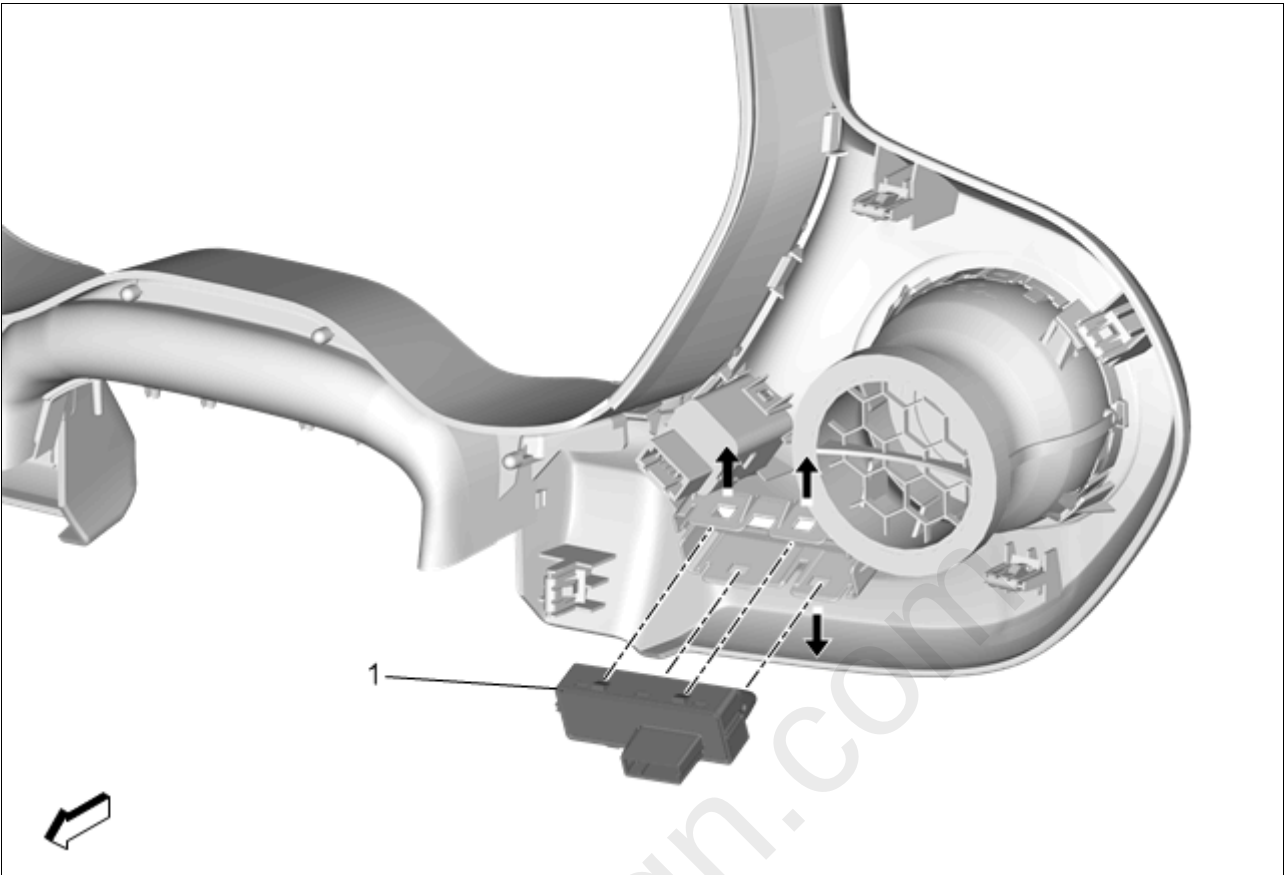


Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Compartment Air Deflector Replacement (Convertible - LGX, LTG) Front Compartment Air Deflector Replacement (Coupe - LGX, LTG)	
1	Ambient Air Temperature Sensor Procedure 1. Squeeze the ambient air temperature sensor tabs, to release the sensor from the radiator air lower baffle. 2. Disconnect the electrical connector.

REPAIR INSTRUCTIONS > HEAD UP DISPLAY SWITCH REPLACEMENT

Fig 1: Head Up Display Switch

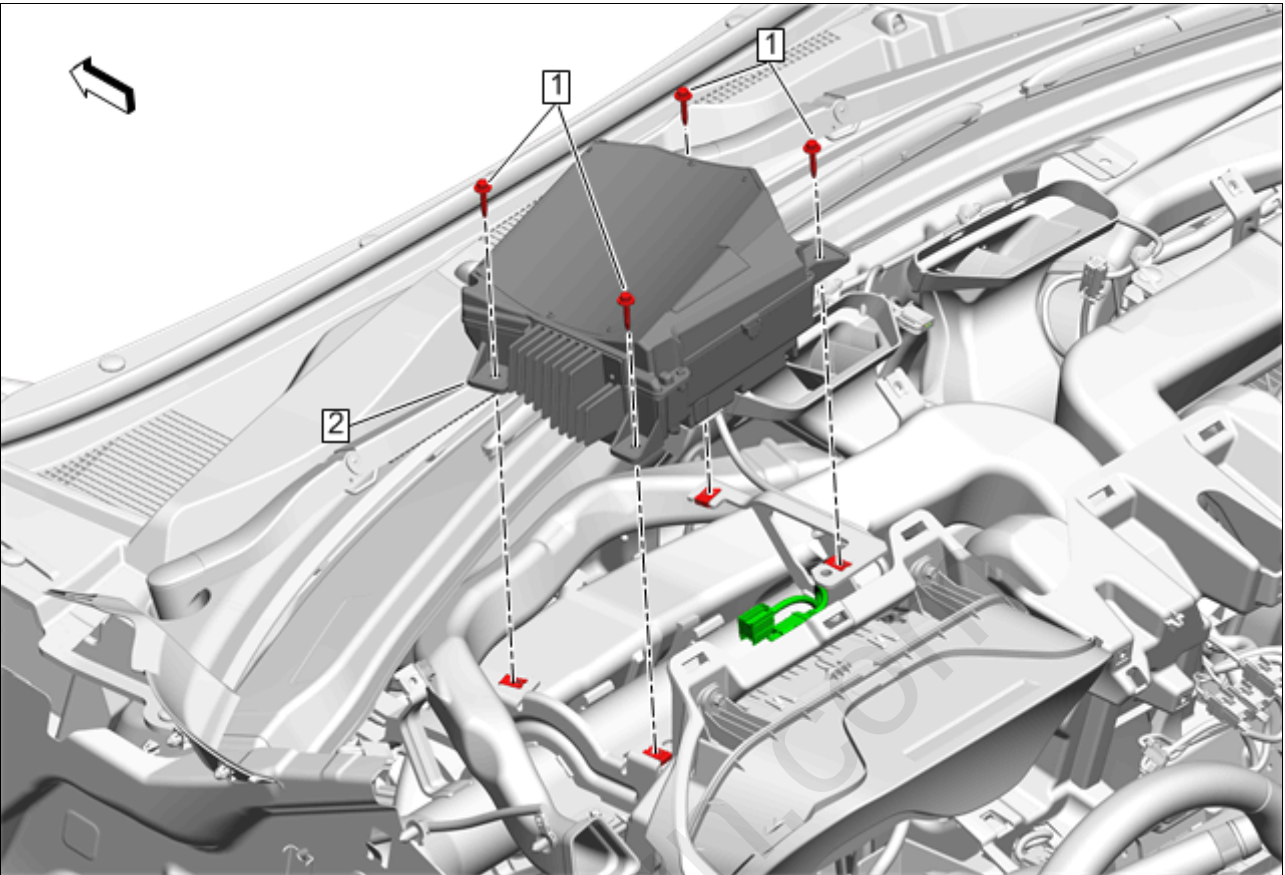


Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Instrument Panel Cluster Trim Plate Replacement	
1	Head-Up Display Switch Procedure Release the tabs and remove the switch.

REPAIR INSTRUCTIONS > HEAD-UP DISPLAY REPLACEMENT

Fig 1: Head-Up Display



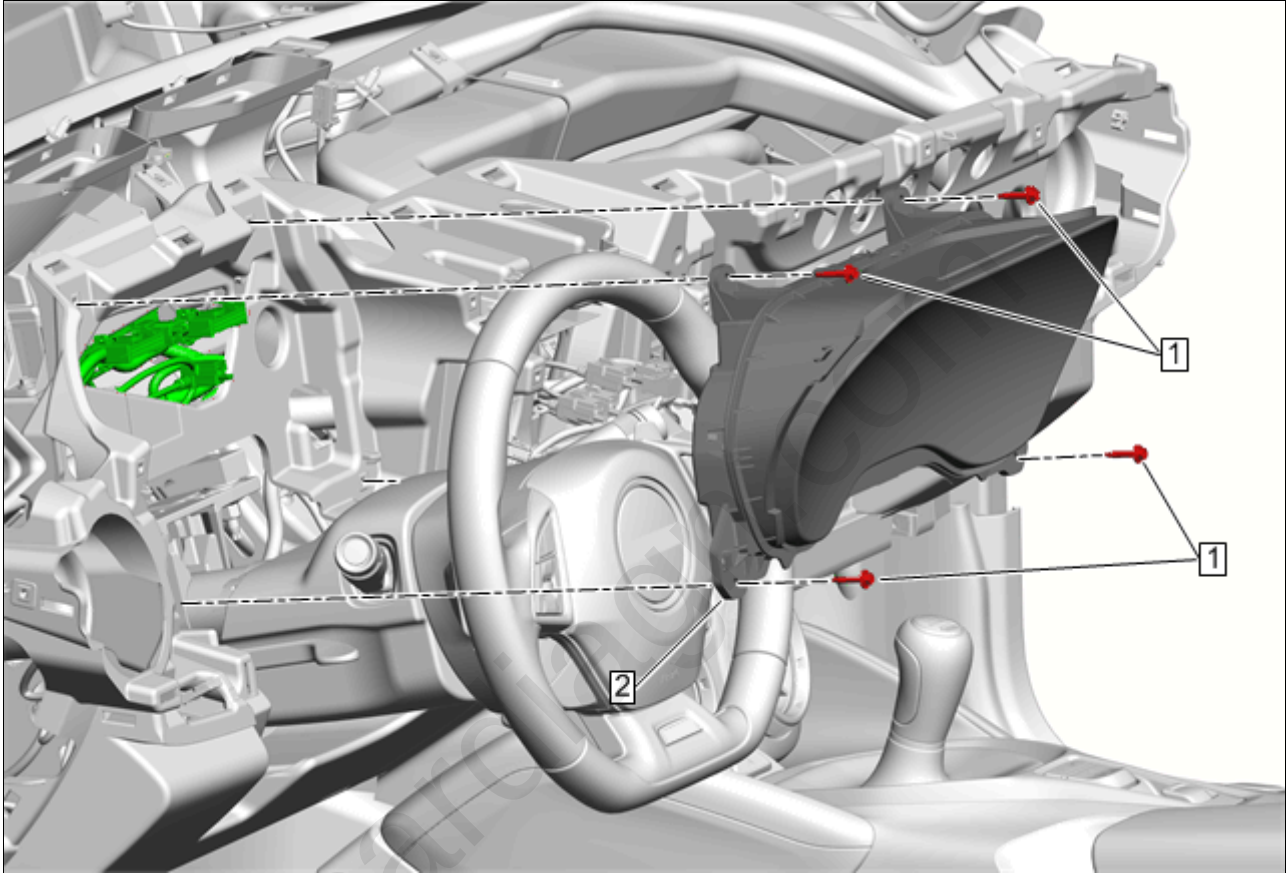
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Windshield Replacement 2. Instrument Panel Upper Trim Panel Cover Replacement	
1	Head-Up Display Bolt (Qty: 4) <i>CAUTION:</i> <i>Refer to Fastener Caution .</i> Tighten 2.5 N.m (22 lb in)
2	Head-Up Display Procedure

1. Disconnect the electrical connectors.
2. Control Module References for programming and set up procedures, if required.

REPAIR INSTRUCTIONS > INSTRUMENT CLUSTER REPLACEMENT

Fig 1: Instrument Cluster



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Callout	Component Name
Preliminary Procedure Instrument Panel Upper Trim Panel Cover Replacement	
1	Instrument Cluster Bolt (Qty: 4) CAUTION: Refer to Fastener Caution .
	Tighten

	2.3 N.m (20 lb in)
2	Instrument Cluster Procedure 1. Disconnect the electrical connectors. 2. Control Module References for programming and set up information, if required.

DESCRIPTION AND OPERATION > AUDIBLE WARNINGS DESCRIPTION AND OPERATION

The audible warnings alert the driver of a system concern or a critical vehicle condition. If equipped with an serial data communicating audio amplifier, the audio amplifier generates the audible warnings through the speakers. If not equipped with an audio amplifier, the radio generates the audible warnings through the speakers. The radio or audio amplifier receives audible warning requests via serial data. If the radio or audio amplifier receives multiple audible warning requests, the warning with the highest priority sounds first. Different audible warnings may sound with a different frequency or a different chime pattern, depending on the system or module making the request. The chime volume may be selectable through vehicle personalization.

DESCRIPTION AND OPERATION > AUDIBLE WARNINGS DESCRIPTION AND OPERATION > AUDIBLE WARNINGS OR CHIMES

The following is a list of common audible warnings or chimes. For additional chimes or complete system description, refer to the appropriate system's Description and Operation or the vehicle owner's manual.

- **Driver Seat Belt Reminder** - If the vehicle is started and the seat belt is unbuckled, the BCM requests the radio or audio amplifier sound a chime to indicated that the belt is unbuckled. This is accompanied by a flashing driver seat belt indicator on the instrument cluster. If the belt remains unbuckled, the chime cycle may continue multiple times if the vehicle is driven and the indicator will remain on solid.
- **Passenger Seat Belt Reminder** - If the passenger presence system determines that their is an occupant in the passenger seat and the vehicle is started with the passenger seat belt unbuckled, the BCM requests the radio or audio amplifier sound a chime to indicated that the belt is unbuckled. This is accompanied by a flashing passenger seat belt indicator. If the belt remains unbuckled, the chime cycle may continue multiple times if the vehicle is driven and the indicator will remain on solid. If an object is placed on the passenger seat, the passenger presence system may interpret this as a passenger occupying the seat. Because the passenger seat belt is unbuckled, the passenger seat belt reminder chime will sound. To correct this, remove the object from the passenger seat.
- **Exterior Lamps On Warning** - If the exterior lamps are left on after the ignition is turned off and the driver door is opened, the BCM will request the radio or audio amplifier sound a chime as an indicator that the exterior lamps are on.
- **Electric Parking Brake (if equipped)** - If the electric parking brake switch is pressed while the

vehicle is in motion, the parking brake control module will request the radio or audio amplifier sound a chime. To release the parking brake, the brake pedal must be pressed when the electric parking brake switch is pressed. If the brake pedal is not pressed, the parking brake control module will request the radio or audio amplifier sound a chime. A message will also appear on the driver information center.

- Delayed Locking - If the keyless entry transmitter is not in the vehicle and the door lock switch is pressed with the driver door open, the BCM will request the radio or audio amplifier sound a chime three times to indicate that the vehicle has entered a delayed locking state. The doors will automatically lock five seconds after the last door is closed.
- Object Detection - The object detection system sends various chime requests to the radio or audio amplifier during normal operation.

DESCRIPTION AND OPERATION > AUDIBLE WARNINGS DESCRIPTION AND OPERATION > ADDITIONAL WARNINGS

The following warnings have an associated instrument cluster indicator or driver information center message:

- Turn Signal Indicators - The radio or audio amplifier activates the audible warning as requested by the BCM.
- Vehicle Overspeed Message - The radio or audio amplifier activates the audible warning as requested by the BCM.
- Fuel Level Low Message - The radio or audio amplifier activates the audible warning as requested by the BCM.
- Oil Pressure Indicator - The radio or audio amplifier activates the audible warning as requested by the BCM.
- Tire Pressure Low Indicator - The radio or audio amplifier activates the audible warning as requested by the BCM.
- Antilock Brake Indicator - The radio or audio amplifier activates the audible warning as requested by the electronic brake control module.
- Engine Cooling System Messages - The radio or audio amplifier activates the audible warning as requested by the engine control module.
- Transmission Messages - The radio or audio amplifier activates the audible warning as requested by the transmission control module.

DESCRIPTION AND OPERATION > AUDIBLE WARNINGS DESCRIPTION AND OPERATION > BACKUP ALARM (WITH 8S3)

When transmission placed in reverse, the Body Control Module (BCM) activates the KR61 Trailer Backup Lamps Relay which supplies 12V to the reverse lamps and the Backup Alarm simultaneously.

DESCRIPTION AND OPERATION > DRIVER INFORMATION CENTER (DIC)

DESCRIPTION AND OPERATION

The driver information center is located in the lower middle portion of the instrument cluster, between the speedometer and the tachometer. The driver information center displays information about the vehicle and allows the operator to access applications. It also displays warning messages if a system problem is detected.

The driver information center is made up of three distinct display zones. In the middle is an interactive application display zone. The application display zone allows access to the info application, navigation application, audio application, phone application, or settings application. To the left is the application selection menu and to the right are interactive information display zones. The information display zone contains multiple pages that display traditional vehicle information.

Each of the displays zones can be selected and their associated pages scrolled through using the steering wheel mounted driver information display switch.

DESCRIPTION AND OPERATION > HEAD-UP DISPLAY DESCRIPTION AND OPERATION

The head-up display projects an image on the windshield that is viewed from the driver seat. Information that is relevant to what the drive is currently doing is displayed, as well as any safety-critical information as it is happening.

The components of the head-up display are:

- Head-Up Display
- Instrument Cluster
- Head-Up Display Switch

DESCRIPTION AND OPERATION > HEAD-UP DISPLAY DESCRIPTION AND OPERATION > HEAD-UP DISPLAY

The head-up display is a slave device to the instrument cluster. The head-up display is powered through ignition voltage and ground. It communicates directly with instrument cluster via serial data and only has limited self-diagnosis capacity. Head-up display DTCs are reported through the instrument cluster.

The head-up display projects a full color image onto the windshield and is only viewable from the driver seat. The image location and brightness is adjustable using the head-up display switch. The image information is received from the instrument cluster through a video cable.

DESCRIPTION AND OPERATION > HEAD-UP DISPLAY DESCRIPTION AND OPERATION > INSTRUMENT CLUSTER

The instrument cluster sends the image information to the head-up display via a discrete video cable. The image sent to the head-up display is closely related to the information currently being displayed on the instrument cluster or driver information center. For example, if an incoming phone call is displayed in the cluster, this information will be displayed on the head-up display. If a navigation alert is shown in the cluster, then a turn-by-turn alert will display on the head-up display. When the operator interacts with the instrument cluster using the steering wheel mounted driver information center switch, the head-up display also responds to the interaction. If the operator dismisses the navigation alert on the instrument cluster, it is also removed from the head-up display.

DESCRIPTION AND OPERATION > HEAD-UP DISPLAY DESCRIPTION AND OPERATION > HEAD-UP DISPLAY SWITCH

The head-up display switch is a multiplexed switch that controls the head-up display based on driver inputs. The head-up display provides the switch with a low reference and monitors a signal circuit. The head-up display switch is made up of a resistor ladder and three switches: Dim +/-, Up/Down, and Page. When a switch is pressed, the signal voltage is pulled low through the resistor ladder. When pressed, each of the switches will result in a different signal voltage seen by the head-up display, depending on the switch's location on the resistor ladder.

DESCRIPTION AND OPERATION > HEAD-UP DISPLAY DESCRIPTION AND OPERATION > HEAD-UP DISPLAY OPERATION

In normal operation, the operator may select from three different display configurations. These display configurations provide the operator with different information, with the vehicle speed being the primary item, along with the following standard indicators:

- Turn signal indicators
- High beam indicator
- Lane departure warning indicator (if equipped)
- Vehicle detected ahead indicator (if equipped)
- Adaptive cruise control on indicator (if equipped)

Standard/Speed Configuration

The head-up display projects only the vehicle speed. Additionally, the outside air temperature, compass, and time may also be displayed.

Audio Configuration

The head-up display will project the current audio information when listening to the audio system and the active phone information if the operator is on a phone call.

Navigation Configuration

The head-up display will project navigation information. If a current route is being followed, turn by turn instructions and arrows will be displayed. If no route is programmed, the compass heading is displayed.

Performance Configuration

The head-up display will project RPM and PRNDL information.

Adaptive Cruise Control Configuration (if equipped)

The head-up display will project the selected following distance when adaptive cruise control is active.

DESCRIPTION AND OPERATION > INDICATOR/WARNING MESSAGE DESCRIPTION AND OPERATION > INDICATOR LIGHT ON

Refer to the OWNER'S MANUAL for the descriptions and explanations of all indicator lights.

For diagnosis and repair information related to an indicator light refer to the System Diagnosis and the Description of Operation that the message relates to.

DESCRIPTION AND OPERATION > INDICATOR/WARNING MESSAGE DESCRIPTION AND OPERATION > MESSAGE DISPLAYED

Refer to the OWNER'S MANUAL for descriptions and explanations of all messages displayed.

For diagnosis and repair information related to a displayed message refer to the System Diagnosis and the Description of Operation that the message relates to.

DESCRIPTION AND OPERATION > INDICATOR/WARNING MESSAGE DESCRIPTION AND OPERATION > CHANGE TIMING BELT MESSAGE

The Instrument Cluster monitors the odometer mileage to determine when timing belt (if equipped) replacement may be necessary. After the vehicle has accumulated approximately 100, 000 miles (160, 000 kilometers), the Instrument Cluster may display the CHANGE TIMING BELT message. After the engine timing belt has been replaced, reset the CHANGE TIMING BELT message by locating and removing the fuses that supply power to the Instrument Cluster for two minutes.

DESCRIPTION AND OPERATION > INDICATOR/WARNING MESSAGE DESCRIPTION AND OPERATION > BRAKES OVERHEATED

The Electronic Brake Control Module monitors brake usage and compares it to an internal thermal model to determine if the brakes could become overheated. If the Electronic Brake Control Module determines the brakes pads have exceeded a desirable temperature based on the thermal model, it sends a serial data message to the Instrument Cluster to display the BRAKES OVERHEATED message. The message remains displayed until the estimated temperature returns to a desirable range.

DESCRIPTION AND OPERATION > INDICATOR/WARNING MESSAGE DESCRIPTION

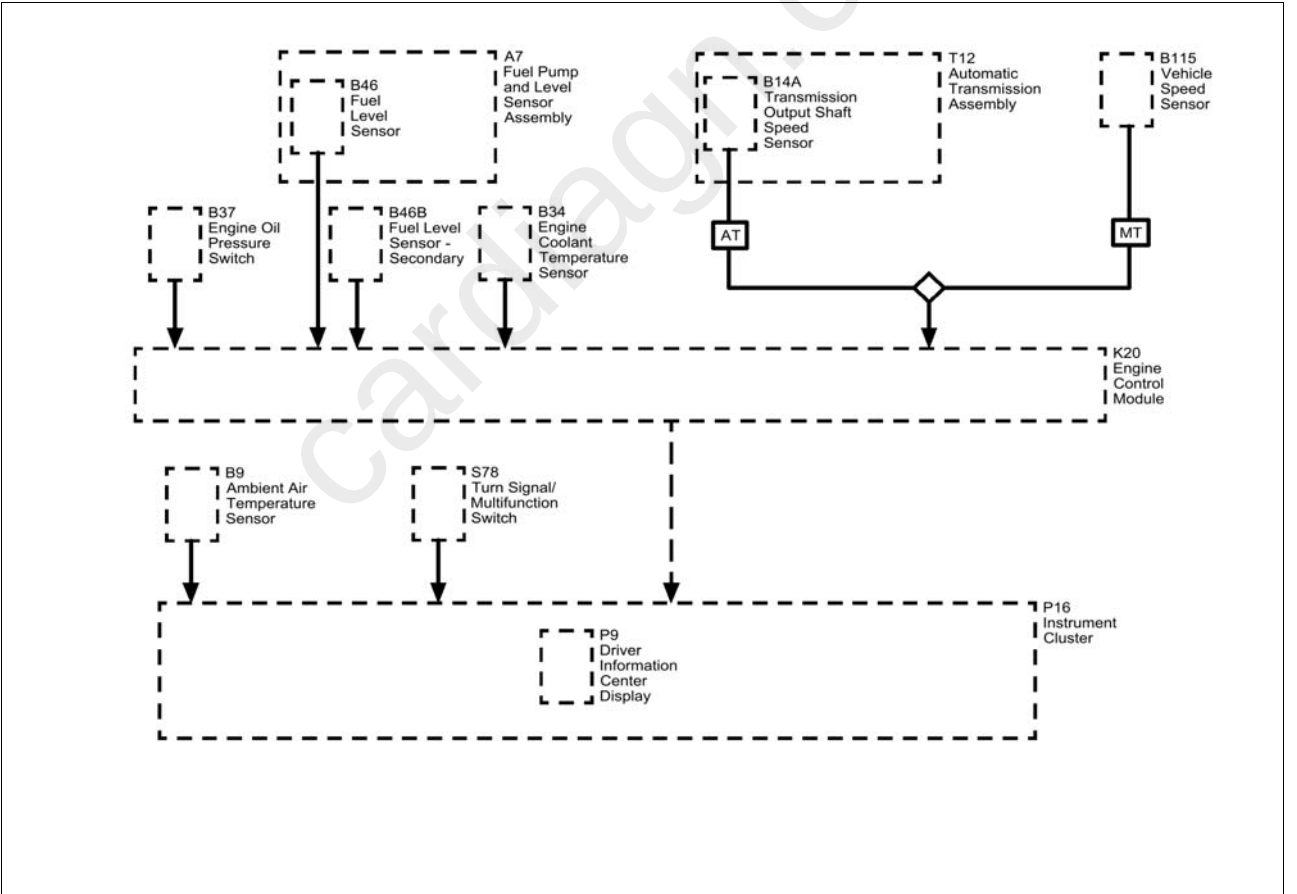
AND OPERATION > TRANSMISSION SHIFT LEVER POSITION INDICATOR

The Transmission Shift Lever Position Indicator (if equipped) is located on the center console and indicates the current transmission shift lever position. The Transmission Shift Lever Position Indicator receives power and ground and is controlled by the Body Control Module (BCM) via serial data. The Transmission Control Module determines transmission shift lever position based on signals from the Transmission Internal Mode Switch and sends the shift lever position information to the BCM via serial data.

DESCRIPTION AND OPERATION > INSTRUMENT CLUSTER DESCRIPTION AND OPERATION > INSTRUMENT CLUSTER

The instrument cluster is a multifunction module that provides the vehicle operator with information that is critical to vehicle operation, such as vehicle speed, engine RPM, and coolant temperature, using analog gauges. The instrument cluster also provides the operator with operational warnings and message through various indicators and the driver information center. The driver information center is a full color multifunction display that is located in the instrument cluster. The driver information center is also tightly integrated with the vehicle's infotainment system and is highly reconfigurable.

Fig 1: Displays and Gauges Block Diagram



Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
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AT	Automatic Transmission
MT	Manual Transmission
P16	P16 Instrument Cluster
P9	P9 Driver Information Center Display
S78	S78 Turn Signal/Multifunction Switch
B9	B9 Ambient Air Temperature Sensor
B14A	B14A Transmission Output Shaft Speed Sensor
T12	T12 Automatic Transmission Assembly
B115	B115 Vehicle Speed Sensor
K20	K20 Engine Control Module
B46	B46 Fuel Level Sensor
A7	A7 Fuel Pump and Level Sensor Assembly
B37	B37 Engine Oil Pressure Switch
B46B	B46B Fuel Level Sensor - Secondary
B34	B34 Engine Coolant Temperature Sensor

DESCRIPTION AND OPERATION > INSTRUMENT CLUSTER DESCRIPTION AND OPERATION > INDICATORS AND WARNING MESSAGES

Refer to Indicator/Warning Message Description and Operation .

DESCRIPTION AND OPERATION > INSTRUMENT CLUSTER DESCRIPTION AND OPERATION > ENGINE COOLANT TEMPERATURE GAUGE

The instrument cluster displays the engine coolant temperature as determined by the engine control module (ECM). The ECM sends the engine coolant temperature information via serial data to the body control module (BCM). The BCM then sends the information via a serial data to the instrument cluster to display the engine coolant temperature.

DESCRIPTION AND OPERATION > INSTRUMENT CLUSTER DESCRIPTION AND OPERATION > FUEL LEVEL GAUGE

The instrument cluster displays the fuel level based on the information from the ECM. The ECM converts the data from the fuel level sensors to a fuel level signal. The ECM sends the fuel level signal via serial data to the BCM. The BCM then sends the information via serial data to the instrument cluster to display the fuel level. If the fuel level falls under 11% the instrument cluster will illuminate the low fuel level indicator. The fuel gauge defaults to empty if:

- The ECM detects a malfunction in the fuel level sensor circuit.
- The BCM detects a loss of serial data communications with the ECM.
- The instrument cluster detects a loss of serial data communications with the BCM.

DESCRIPTION AND OPERATION > INSTRUMENT CLUSTER DESCRIPTION AND OPERATION > SPEEDOMETER

The instrument cluster displays the vehicle speed based on the information from the ECM. The ECM sends the vehicle speed information via serial data to the BCM. The BCM then sends the vehicle speed information via serial data to the instrument cluster to display the vehicle speed.

DESCRIPTION AND OPERATION > INSTRUMENT CLUSTER DESCRIPTION AND OPERATION > ODOMETER

The instrument cluster displays the vehicle odometer in the driver information center. The ECM send a distance rolling count message via serial data to the body control module (BCM). The BCM uses this information to calculate the vehicle odometer. This odometer value is then sent to the instrument cluster. The instrument cluster does not calculate the odometer.

The odometer value is stored in multiple modules. The instrument cluster is a secondary storage module for the odometer, while the BCM is the primary storage and accumulator.

In addition to storing the odometer value for the vehicle, the instrument cluster and the BCM store the VIN. Software checks are performed to ensure these modules, and their stored odometer information, can not be move or transferred between different vehicles.

DESCRIPTION AND OPERATION > INSTRUMENT CLUSTER DESCRIPTION AND OPERATION > TACHOMETER

The instrument cluster displays the engine speed based on the information from the ECM. The ECM converts the data from the crankshaft position sensor to an engine revolution signal. The ECM sends the engine speed information via a engine speed signal circuit to the instrument cluster to display the engine speed.

DESCRIPTION AND OPERATION > INSTRUMENT CLUSTER DESCRIPTION AND OPERATION > COMPASS

The vehicle compass information is gather through the compass module. The compass module determines vehicle direction and communicates this with the BCM through serial data. The BCM sends the compass information to the instrument cluster via serial data, where it is displayed.

DESCRIPTION AND OPERATION > INSTRUMENT CLUSTER DESCRIPTION AND OPERATION > OUTSIDE AIR TEMPERATURE

The outside air temperature (OAT) can be viewed on the Info Display Module. The Info Display Module shows the outside air temperature as a damped value. The time and rate of the temperature update is based on an algorithm in the instrument cluster. Factors such as last temperature reading, current temperature reading, length of time the vehicle was off, current vehicle speed, and the distance driven effect when the displayed temperature is updated. To get the vehicle to display the most accurate temperature faster, drive the vehicle. Constant moving traffic will update the display to the correct temperature more quickly than stop and go traffic.

The OAT uses a filter routine to minimize false updates due to engine heat or road heat.

Vehicle Outside

- Vehicle parked more than 2 hours: The OAT updates to the current sensor reading
- Vehicle parked less than 2 hours AND the new reading is LESS than the vehicle shutdown reading: The OAT updates to the current reading.
- Vehicle parked less than 2 hours AND the new reading is MORE than the vehicle shutdown reading: The vehicle will startup with the shutdown reading. As the vehicle is driven at speeds over 19 mph (30km/h) the filter counter starts to count up. When vehicle speed is under 19 mph (30km/h) the filter counter counts down. Once the counter reaches a predetermined maximum, the old OAT is updated to the current OAT reading.
- Example 1: Vehicle is OFF for 1 hour, OAT is 70 degrees F (21 degrees C). The ambient temperature has increased during the shut down to 74 degrees F (23 degrees C). The vehicle is started, OAT will still be displayed at 70 degrees F (21 degrees C), the driver drives at a stable speed over 19 mph (30km/h) for a minimum of 3 to 8 minutes with no stops, OAT display updates to current temp of 74 degrees F (23 degrees C).
- Example 2: Vehicle is shutoff for 1 hour, OAT is 70 degrees F (21 degrees C). The outside temperature has increased during the shut down to 74 degrees F (23 degrees C). The vehicle is started, OAT will still be clamped at 70 degrees F (21 degrees C). However, this time the driver is in heavy city traffic driving for 10 minutes of speeds below 19 mph (30km/h), then drives on the highway at speeds above 19 mph (30km/h) for a minimum of 2 to 6 minutes. The OAT display updates to the current temp of 74 degrees F (23 degrees C). This time it took longer to update because of all the stop and go driving below 19 mph (30km/h).

Since the OAT sensor is in the grille, the values must be filtered to prevent them from updating to false readings when there is engine heat or road heat.

Vehicle in Warm Garage

- If the vehicle is started in a garage that is warmer than the outside temperature, it may take some time to update to the new cooler ambient temperature. It may take up to 10 minutes to reach the new ambient temperature.
- Example 1: Vehicle is OFF for short time, or for overnight. Heated garage temp is 70 degrees F (21 degrees C). The outside temperature has decreased during the shut down to 60 degrees F (16 degrees C). The vehicle is started, OAT will register 70 degrees F (21 degrees C) (heated garage temperature). When driven outside the OAT will start to update lower to 60 degrees F (16 degrees C) as the sensor cools off, should take less than 8 minutes.

- Example 2: Same as above: Vehicle is OFF for short time, or for overnight. Heated garage temp is 70 degrees F (21 degrees C). The outside temperature has decreased during the shut down to 60 degrees F (16 degrees C). The vehicle is started, OAT will register 70 degrees F (21 degrees C) (heated garage temperature). However, this time, the driver does heavy city traffic driving for 10 minutes of speeds below 19 mph (30km/h), then gets on the highway at speeds above 19 mph (30km/h) for at least 2 minutes. When driven outside, the OAT will start to update lower to 60 degrees F (16 degrees C) as the sensor cools off. This should take less than 10 minutes to reach 60 degrees F (16 degrees C).

DESCRIPTION AND OPERATION > INSTRUMENT CLUSTER DESCRIPTION AND OPERATION > DRIVER INFORMATION CENTER DISPLAY

The driver information center is located in the lower middle of the instrument cluster. It is a multifunction full-color LCD intended to display additional information, such as an odometer or messages. The driver information center is divided into three display zones and is controlled using the steering wheel mounted driver information center select switch. For further information, refer to Driver Information Center (DIC) Description and Operation .