

Indicators and Signals

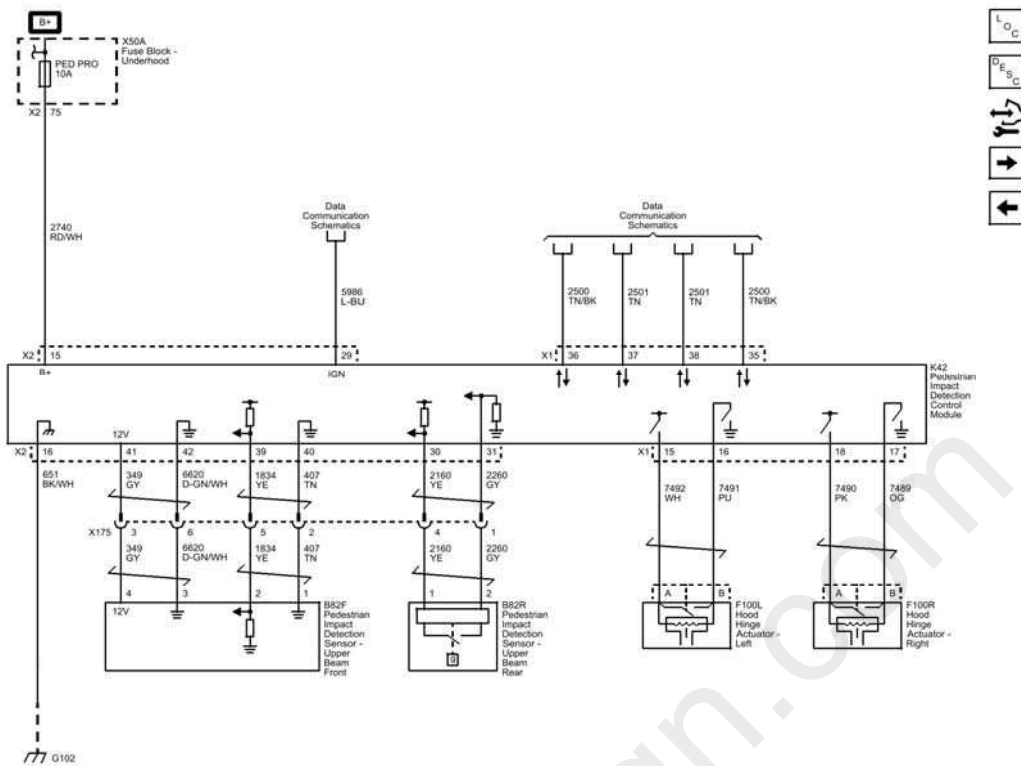


Fig. 2: Indicators and Signals

Courtesy of GENERAL MOTORS COMPANY

HEAD-UP DISPLAY WIRING SCHEMATICS

Head-Up Display (UV6)

Audible Warning System

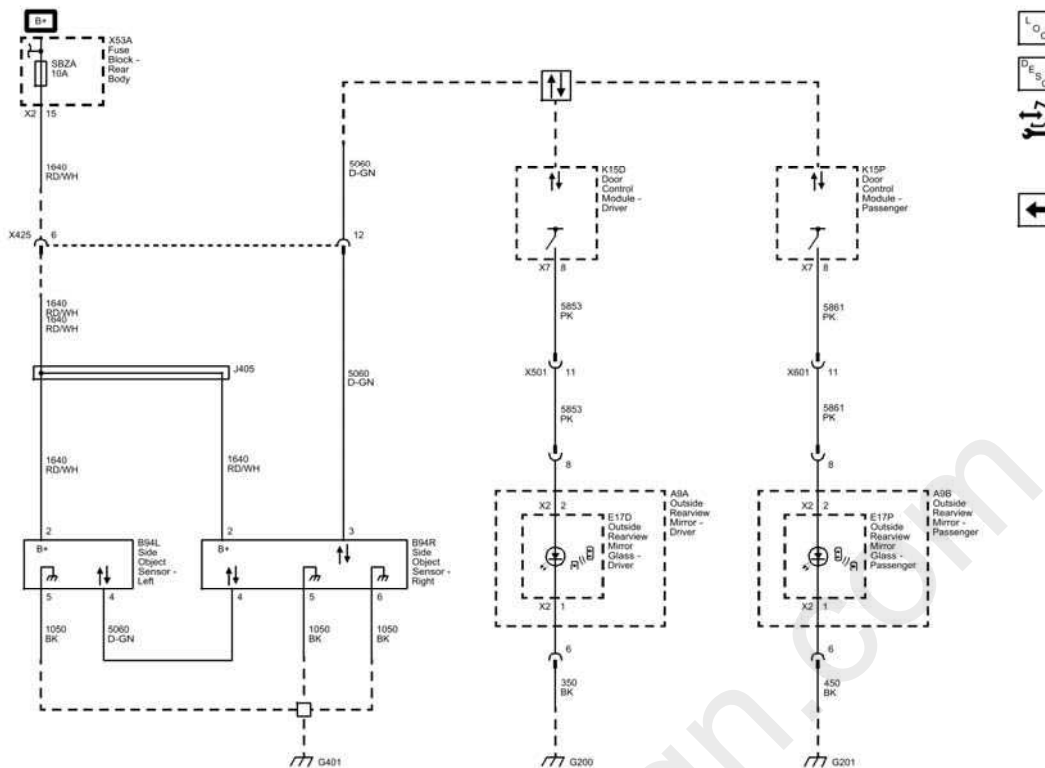


Fig. 4: Audible Warning System

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
DTC B0158	DTC B0158 02 Ambient Air Temperature Sensor Circuit Short to Ground DTC B0158 05 Ambient Air Temperature Sensor Circuit High Voltage/Open
DTC B0550	DTC B0550 32 Odometer Circuit General Memory Malfunction
DTC B071F	DTC B071F 39 Transmission Range Indicator Internal Malfunction
DTC B124F	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
DTC B361A	DTC B361A 39 Head-Up Display Module Internal Malfunction DTC B361A 4B Head-Up Display Module Calibration Not Learned

<u>DTC B361B</u>	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
<u>DTC P0461-P0464, P2066, P2067, or P2068</u>	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
<u>DTC P0521, P0522, or P0523</u>	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

DTC B0158: 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.

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 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	-	-

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 and displays the temperature.

Conditions for Running the DTC

The system voltage is between 9-16 V.

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).

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).

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - SEDAN

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

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.

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

Refer to Circuit/System Testing.

- **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 displayed is within five degrees of actual ambient air temperature.

- **If not within five degrees of actual ambient air temperature**

Refer to Circuit/System Testing.

- **If within five degrees of actual ambient air temperature**

5. All OK.

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 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal B and ground.

- **If 10 ohms or greater**

1. Ignition OFF, disconnect the harness connector at the P16 Instrument Cluster.
2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the P16 Instrument Cluster.

- **If less than 10 ohms**

3. Ignition ON.
4. Verify the scan tool Ambient Air Temperature parameter is greater than 98%.
 - **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 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the P16 Instrument Cluster.

- **If greater than 98%**

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

6. Verify the scan tool Ambient Air Temperature parameter is less than 8%.
 - **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.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Ignition OFF
 4. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the P16 Instrument Cluster.
 - **If less than 8%**
 - 7. Test or replace the B9 Ambient Air Temperature Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Ambient Air Temperature Sensor Replacement**
- **Control Module References** for Instrument Cluster replacement, programming and setup

DTC B0550: ODOMETER CIRCUIT GENERAL MEMORY

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.

DTC Descriptor

DTC B0550 32

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.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

The body control module has detected an internal memory malfunction.

Action Taken When the DTC Sets

The DTC is stored in the body control module memory.

Conditions for Clearing the DTC

The body control module no longer detects a malfunction.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - SEDAN

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

Circuit/System Verification

1. Ignition ON.
2. Verify DTC B0550 is not set.
 - **If the DTC is set**
 1. Program the K9 Body Control Module.
 2. Verify the DTC is not set.

- If the DTC is set, replace the K9 Body Control Module.
- If the DTC is not set

3. All OK.

- **If the DTC is not set**

3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

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

DTC B071F: TRANSMISSION RANGE INDICATOR

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.

DTC Descriptor

DTC B071F 39

Transmission Range 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.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

No action is taken

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - SEDAN

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

Circuit/System Verification

1. Ignition ON.
2. Verify DTC B071F 39 is not set.
 - **If the DTC is set**

Replace the P2 Transmission Shift Lever Position Indicator.

- **If the DTC is not set**
3. All OK.

Repair Instructions

Automatic Transmission Control Indicator Replacement

Perform the **Diagnostic Repair Verification** after completing the repair.

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.

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

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.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

The instrument cluster no longer detects a malfunction.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - SEDAN

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

Circuit/System Verification

1. Ignition ON.
2. Verify DTC B124F is not set.
 - **If the DTC is set**
 1. Program the P16 Instrument Cluster.
 2. Verify the DTC is not set.
 - If the DTC is set, replace the P16 Instrument Cluster.
 - If the DTC is not set
 - 3. All OK.
 - **If the DTC is not set**
3. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for instrument cluster replacement, programming and setup

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.

DTC Descriptor

DTC B361A 39

Head-Up Display Module Internal Malfunction

DTC B361A 4B

Head-Up Display Module Calibration Not Learned

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.

Conditions for Running the DTC

Ignition ON.

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.

Action Taken When the DTC Sets

Head-up display function is disabled.

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

Head-Up Display Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - SEDAN

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

Circuit/System Verification

1. Ignition ON.
2. Verify DTC B361A 4B is not set.
 - **If DTC B361A 4B is set**
 1. Program the P16 Instrument Cluster.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the P29 Head-Up Display.
 - If the DTC does not set
 - 3. All OK.
3. Verify DTC B361A 39 is not set.
 - **If DTC B361A 39 is set**

Replace the P29 Head-Up Display.

 - **If DTC B361A 39 is not set**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for the head-up display replacement, programming, and setup

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.

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 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	-	-

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.

Conditions for Running the DTC

The ignition is ON.

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

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

Head-Up Display Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - SEDAN

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

Circuit/System Verification

1. Ignition ON.
2. While holding each switch listed below, verify the scan tool Heads Up Display Switch State parameter is

as follows:

- DIM + Switch - HUD Dimming Up/Down Pressed
- DIM - Switch - HUD Dimming Up/Down Pressed
- UP Switch - HUD Movement
- DOWN Switch- HUD Movement
- PAGE Switch- HUD Page Switch
- **If the scan tool parameter does not equal the expected result with the switch in the appropriate state**

Refer to Circuit/System Testing.

- **If the scan tool parameter equals the expected result with the switch in the appropriate state**

3. All OK.

Circuit/System Testing

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 ohms between the low reference circuit terminal 3 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the P29 Head-Up Display.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the P29 Head-Up Display.
 - **If less than 10 ohms**
3. Test for less than 1 V between the signal circuit terminal 4 and ground.
 - **If 1 V or greater**
 1. Ignition OFF, disconnect the harness connector at the P29 Head-Up Display.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage in the circuit.
 - If less than 1 V, replace the P29 Head-Up Display.
 - **If less than 1 V**
4. Ignition ON.
5. Test for B+ between the signal circuit terminal 4 and ground.
 - **If less than B+**
 1. Ignition OFF, disconnect the harness connector at the P29 Head-Up Display.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the signal circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.
- If less than 2 ohms, replace the P29 Head-Up Display.

○ **If B+**

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

Component Testing

1. Ignition OFF, disconnect the harness connector at the S27 Head-Up Display Switch.
2. Test for 3.4K - 4.2K ohms between the signal terminal 4 and the low reference terminal 3.

○ **If not between 3.4K - 4.2K ohms**

Replace the S27 Head-Up Display Switch.

○ **If between 3.4K - 4.2K ohms**

3. Test for 87 - 107 ohms between the signal terminal 4 and the low reference terminal 3 with the DIM + Switch pressed.

○ **If not between 87 - 107 ohms**

Replace the S27 Head-Up Display switch.

○ **If between 87 - 107 ohms**

4. Test for 291 - 356 ohms between the signal terminal 4 and the low reference terminal 3 with the DIM - Switch pressed.

○ **If not between 291 - 356 ohms**

Replace the S27 Head-Up Display switch.

○ **If between 291 - 356 ohms**

5. Test for 575 - 704 ohms between the signal terminal 4 and the low reference terminal 3 with the UP Switch pressed.

○ **If not between 575 - 704 ohms**

Replace the S27 Head-Up Display Switch.

○ **If between 575 - 704 ohms**

6. Test for 1K - 1.2K ohms between the signal terminal 4 and the low reference terminal 3 with the DOWN Switch pressed.

○ **If not between 1K - 1.2K ohms**

Replace the S27 Head-Up Display Switch.

○ **If between 1K - 1.2K ohms**

7. Test for 1.7K - 2.1K ohms between the signal terminal 4 and the low reference terminal 3 with the PAGE Switch pressed.

- If not between 1.7K - 2.1K ohms

Replace the S27 Head-Up Display Switch.

- If between 1.7K - 2.1K ohms

8. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for head-up display replacement, programming, and setup

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.

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 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				

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.

Conditions for Running the DTC

- The engine is running
- The system voltage is between 11-16 V

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%.
- The above conditions must be met for 30 seconds.
- DTC P0464 runs and fails 2 out of 3 test cycles.

Action Taken When the DTC Sets

- P0461, P0462, P0463, P0464, P2066, P2067 and P2068 are Type B DTCs
- The fuel gauge defaults to empty
- The low fuel indicator illuminates

Conditions for Clearing the DTC

- P0461, P0462, P0463, P0464, P2066, P2067 and P2068 are Type B DTCs
- 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.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - SEDAN

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **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

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.
 - **If the fuel level gauge does not sweep**

Replace the P16 Instrument Cluster
 - **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.
 - **If the low fuel level indicator does not turn ON and OFF**

Replace the P16 Instrument Cluster
 - **If the low fuel level indicator turns ON and OFF**
4. Verify the scan tool Fuel Level Sensor Left Tank parameter is between 0.5-3.5 V and varies with fuel level.
 - **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
 - **If between 0.5-3.5 V and varies with fuel level**
5. Verify the scan tool Fuel Level Sensor Right Tank parameter is between 0.5-3.5 V and varies with fuel level.
 - **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
 - **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 scan tool Fuel Level Sensor Left Tank parameter is between 0.5-3.5 V and varies with fuel level.
 - **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

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

- **If between 0.5-3.5 V and varies with fuel level**
- 4. All OK.

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 ohms between the low reference circuit terminal 3 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify the scan tool Fuel Level Sensor Left Tank parameter is greater than 4.8 V.
 - **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.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **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 scan tool Fuel Level Sensor Left Tank parameter is less than 0.2 V.
 - **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.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Ignition OFF

4. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **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 ohms between the low reference circuit terminal 3 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify the scan tool Fuel Level Sensor Right Tank parameter is greater than 4.8 V.
 - **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.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **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 scan tool Fuel Level Sensor Right Tank parameter is less than 0.2 V.
 - **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.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Ignition OFF
 4. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If less than 0.2 V**
7. Test or replace the B46B Fuel Level Sensor - Secondary.

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 ohms and a maximum value of 245-255 ohms without any spikes or dropouts.
 - **If minimum resistance is not 37-43 ohms, maximum resistance is not 245-255 ohms, or if there are any spikes or dropouts**

Replace the appropriate Fuel Level Sensor.

- **If minimum resistance is 37-43 ohms, maximum resistance is 245-255 ohms, and if there are no spikes or dropouts**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Fuel Level Sensor Replacement**
- **Control Module References** for Engine Control Module or Instrument Cluster replacement, programming, and setup

DTC P0521, P0522, OR P0523: 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.

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 Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0522	P0522	P0523	P0521
Signal	P0522	P0522	P0523	P0521
Low Reference	-	P0523	-	P0521

Circuit/System Description

The engine oil pressure sensor is a 3-wire sensor comprising of a signal circuit, low reference circuit and the 5 V reference circuit. The engine control module (ECM) supplies 5 V to the sensor via the 5 V reference circuit and provides ground via the low reference circuit. The ECM monitors the signal circuit to determine the sensor voltage is within the normal operating range of approximately 1-4 V. When the engine oil pressure is high, the sensor voltage is high and the ECM senses a high signal voltage. When the engine oil pressure is low, the sensor voltage is low and the ECM senses a low signal voltage. The ECM sends the engine oil pressure information via serial data to the body control module (BCM). The BCM then sends the engine oil pressure information to the Instrument Panel via serial data.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

P0521

- The engine oil pressure is out of its working range.
- The ECM does not detect a change in the engine oil pressure.
- The engine oil pressure is outside of a calculated working range determined by engine speed and temperature.
- One of the above conditions are present for greater than 4 seconds.

P0522

- The ECM detects a short to ground in the engine oil pressure signal circuit.
- The above condition is present for greater than 10 seconds.

P0523

- The ECM detects a short to voltage or an open circuit in the engine oil pressure signal circuit.
- The above condition is present for greater than 10 seconds.

Action Taken When the DTC Sets

The instrument cluster illuminates the service vehicle soon indicator and the oil pressure low indicator.

Conditions for Clearing the DTC

The DTC becomes history when the conditions for setting the DTC are no longer present.

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.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - SEDAN

Description and Operation

- **Instrument Cluster Description and Operation**
- **Indicator/Warning Message Description and Operation**
- **Driver Information Center (DIC) 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

Circuit/System Verification

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.
 - **If the engine oil pressure Indicator does not turn on and off.**

Replace the P16 Instrument Cluster.

- **If the engine oil pressure Indicator turns on and off**
- 3. Verify the scan tool Engine Oil Pressure parameter is Low.
 - **If not Low**

Refer to Circuit/System Testing.

- **If Low**
- 4. Engine running.
- 5. Verify the scan tool Engine Oil Pressure parameter is OK.
 - **If not OK**

Refer to Circuit/System Testing.

- **If OK**
- 6. All OK.

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 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal 1 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If less than 10 ohms**
3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 2 and ground.
 - **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.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
 3. Test for less than 2 ohms in the 5 V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **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.

- If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8-5.2 V**
5. Verify the scan tool Engine Oil Pressure parameter is less than 1 V.
 - **If 1 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 terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If less than 1 V**
 6. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the 5 V reference circuit terminal 2.
 7. Verify the scan tool Engine Oil Pressure parameter is greater than 4.8 V.
 - **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 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If greater than 4.8 V**
 8. Test or replace the B37B Engine Oil Pressure Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Engine Oil Pressure Sensor and/or Switch Replacement (LFX) , Engine Oil Pressure Sensor and/or Switch Replacement (LF3)**
- **Control Module References** for Instrument Cluster or Engine Control Module replacement, programming and setup

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:

- **Instrument Cluster Description and Operation**
- **Indicator/Warning Message Description and Operation**
- **Driver Information Center (DIC) Description and Operation**
- **Audible Warnings Description and Operation**
- **Head-Up Display Description and Operation**

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.

Intermittent

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

Symptom List

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

- **Fuel Gauge Malfunction**
- **Engine Oil Pressure Indicator Malfunction**
- **Head-Up Display Malfunction**
- **Outside Air Temperature Display Malfunction**

ENGINE OIL PRESSURE 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.

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 Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0522	P0522	P0523	P0521
Signal	P0522	P0522	P0523	P0521
Low Reference	-	P0523	-	P0521

Circuit/System Description

The engine oil pressure sensor is a 3-wire sensor comprising of a signal circuit, low reference circuit and the 5 V reference circuit. The engine control module (ECM) supplies 5 V to the sensor via the 5 V reference circuit and provides ground via the low reference circuit. The ECM monitors the signal circuit to determine the sensor voltage is within the normal operating range of approximately 1-4 V. When the engine oil pressure is high, the sensor voltage is high and the ECM senses a high signal voltage. When the engine oil pressure is low, the sensor voltage is low and the ECM senses a low signal voltage. The ECM sends the engine oil pressure information via serial data to the body control module (BCM). The BCM then sends the engine oil pressure information to the Instrument Panel via serial data.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

P0521

- The engine oil pressure is out of its working range.
- The ECM does not detect a change in the engine oil pressure.
- The engine oil pressure is outside of a calculated working range determined by engine speed and temperature.
- One of the above conditions are present for greater than 4 seconds.

P0522

- The ECM detects a short to ground in the engine oil pressure signal circuit.
- The above condition is present for greater than 10 seconds.

P0523

- The ECM detects a short to voltage or an open circuit in the engine oil pressure signal circuit.
- The above condition is present for greater than 10 seconds.

Action Taken When the DTC Sets

The instrument cluster illuminates the service vehicle soon indicator and the oil pressure low indicator.

Conditions for Clearing the DTC

The DTC becomes history when the conditions for setting the DTC are no longer present.

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.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - SEDAN

Description and Operation

- **Instrument Cluster Description and Operation**
- **Indicator/Warning Message Description and Operation**
- **Driver Information Center (DIC) 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

Circuit/System Verification

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.

- **If the engine oil pressure Indicator does not turn on and off.**

Replace the P16 Instrument Cluster.

- **If the engine oil pressure Indicator turns on and off**

3. Verify the scan tool Engine Oil Pressure parameter is Low.

- **If not Low**

Refer to Circuit/System Testing.

- **If Low**

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

- **If not OK**

Refer to Circuit/System Testing.

- **If OK**

6. All OK.

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 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal 1 and ground.

- **If 10 ohms or greater**

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

- **If less than 10 ohms**

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

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

- If infinite resistance.
- 3. Test for less than 2 ohms in the 5 V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **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.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8-5.2 V**
- 5. Verify the scan tool Engine Oil Pressure parameter is less than 1 V.
 - **If 1 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 terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If less than 1 V**
- 6. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the 5 V reference circuit terminal 2.
- 7. Verify the scan tool Engine Oil Pressure parameter is greater than 4.8 V.
 - **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 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
- 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If greater than 4.8 V**
- 8. Test or replace the B37B Engine Oil Pressure Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Engine Oil Pressure Sensor and/or Switch Replacement (LFX) , Engine Oil Pressure Sensor and/or Switch Replacement (LF3)**
- **Control Module References** for Instrument Cluster or Engine Control Module replacement, programming and setup

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.

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 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				

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.

Conditions for Running the DTC

- The engine is running
- The system voltage is between 11-16 V

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%.
- The above conditions must be met for 30 seconds.
- DTC P0464 runs and fails 2 out of 3 test cycles.

Action Taken When the DTC Sets

- P0461, P0462, P0463, P0464, P2066, P2067 and P2068 are Type B DTCs
- The fuel gauge defaults to empty

- The low fuel indicator illuminates

Conditions for Clearing the DTC

- P0461, P0462, P0463, P0464, P2066, P2067 and P2068 are Type B DTCs
- 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.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - SEDAN

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **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

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.
 - **If the fuel level gauge does not sweep**

Replace the P16 Instrument Cluster

- **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.

- **If the low fuel level indicator does not turn ON and OFF**

Replace the P16 Instrument Cluster

- **If the low fuel level indicator turns ON and OFF**

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

- **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

- **If between 0.5-3.5 V and varies with fuel level**

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

- **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

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

- **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

- **If between 0.5-3.5 V and varies with fuel level**

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

- **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

- **If between 0.5-3.5 V and varies with fuel level**

4. All OK.

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 ohms between the low reference circuit terminal 3 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify the scan tool Fuel Level Sensor Left Tank parameter is greater than 4.8 V.
 - **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.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **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 scan tool Fuel Level Sensor Left Tank parameter is less than 0.2 V.
 - **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.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 - 3. Ignition OFF
 - 4. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **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 ohms between the low reference circuit terminal 3 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If less than 10 ohms**
3. Ignition ON.
4. Verify the scan tool Fuel Level Sensor Right Tank parameter is greater than 4.8 V.
 - **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.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **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 scan tool Fuel Level Sensor Right Tank parameter is less than 0.2 V.
 - **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.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Ignition OFF
 4. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If less than 0.2 V**
7. Test or replace the B46B Fuel Level Sensor - Secondary.

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 ohms and a maximum value of 245-255 ohms without any spikes or dropouts.
 - **If minimum resistance is not 37-43 ohms, maximum resistance is not 245-255 ohms, or if there are any spikes or dropouts**

Replace the appropriate Fuel Level Sensor.

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

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Fuel Level Sensor Replacement**
- **Control Module References** for Engine Control Module or Instrument Cluster replacement, programming, and setup

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 Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1518 00	U1518 00	-	-
Serial Data	U1518 00	U1518 00	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. Image is not displayed on head-up display				

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.

Reference Information

Schematic Reference

Head-Up Display Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX - SEDAN

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

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.
 - **If the test pattern is not displayed**
 1. Replace the video cable between the P29 Head-Up Display and the P16 Instrument Cluster.
 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.
 - If the test pattern is not displayed, replace the P16 Instrument Cluster.
 - If the test pattern is displayed
3. All OK.
 - **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:

- DIM + Switch - HUD Dimming Up/Down Pressed
- DIM - Switch - HUD Dimming Up/Down Pressed
- UP Switch - HUD Movement
- DOWN Switch - HUD Movement
- PAGE Switch - HUD Page Switch
- **If the scan tool parameter does not equal the expected result with the switch in the appropriate state**

Refer to Circuit/System Testing.

- **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:

- DIM + Switch - Head-up display brightness increases
- DIM - Switch - Head-up display brightness decreases
- UP Switch - Head-up display image moves up
- DOWN Switch - Head-up display image moves down
- PAGE Switch - Head-up display image changes pages
- **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.

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

5. All OK.

Circuit/System Testing

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 minutes for all vehicle systems to power down.
2. Test for less than 10 ohms between the low reference circuit terminal 3 and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the P29 Head-Up Display.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the P29 Head-Up Display.
 - **If less than 10 ohms**
3. Ignition ON.
4. Test for 4.8-5.2 V between the signal circuit terminal 4 and ground.

- **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.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the P29 Head-Up Display.

- **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.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the P29 Head-Up Display.

- **If between 4.8-5.2 V**

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

Component Testing

1. Ignition OFF, disconnect the harness connector at the S27 Head-Up Display Switch.
2. Test for 3.4K - 4.2K ohms between the signal terminal 4 and the low reference terminal 3.
 - **If not between 3.4K - 4.2K ohms**

Replace the S27 Head-Up Display Switch.

- **If between 3.4K - 4.2K ohms**

3. Test for 87 - 107 ohms between the signal terminal 4 and the low reference terminal 3 with the Dim + switch pressed.
 - **If not between 87 - 107 ohms**

Replace the S27 Head-Up Display Switch.

- **If between 87 - 107 ohms**

4. Test for 291 - 356 ohms between the signal terminal 4 and the low reference terminal 3 with the Dim - switch pressed.
 - **If not between 291 - 356 ohms**

Replace the S27 Head-Up Display Switch.

- **If between 291 - 356 ohms**

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

- **If not between 575 - 704 ohms**

Replace the S27 Head-Up Display Switch.

- **If between 575 - 704 ohms**

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

- **If not between 1K - 1.2K ohms**

Replace the S27 Head-Up Display Switch.

- **If between 1K - 1.2K ohms**

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

- **If not between 1.7K - 2.1K ohms**

Replace the S27 Head-Up Display Switch.

- **If between 1.7K - 2.1K ohms**

8. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Head-Up Display Replacement**
- **Control Module References** for Instrument Cluster replacement, programming, and setup

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.

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 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	-	-

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 and displays the temperature.

Conditions for Running the DTC

The system voltage is between 9-16 V.

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).

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.

Conditions for Clearing the DTC

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

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

Refer to Circuit/System Testing.

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

Refer to Circuit/System Testing.

- **If within five degrees of actual ambient air temperature**
5. All OK.

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 ohms between the low reference circuit terminal B (or 2) and ground.
 - **If 10 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the P16 Instrument Cluster.
 2. Test for less than 2 ohms in the low reference circuit end to end.

- If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the P16 Instrument Cluster.
- **If less than 10 ohms**
- 3. Ignition ON.
- 4. Verify the scan tool Ambient Air Temperature parameter is greater than 98%.
 - **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.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the P16 Instrument Cluster.
 - **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%.
 - **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.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Ignition OFF
 4. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the P16 Instrument Cluster.
 - **If less than 8%**
- 7. Test or replace the B9 Ambient Air Temperature Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Ambient Air Temperature Sensor Replacement**
- **Control Module References** for instrument cluster replacement, programming and setup

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.

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 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.

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify no DTC is set.

- **If any DTC is set**

Diagnose DTCs first. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no DTCs are set**

2. Ignition ON.
3. Verify the speedometer sweeps from low to high position when performing the Speedometer Sweep Test with the scan tool.

- **If speedometer does not sweep**

Replace the P16 Instrument Cluster.

- **If speedometer sweeps properly**

4. Verify the speedometer gauge value matches the scan tool Vehicle Speed parameter while driving the vehicle.

- **If the values do not match**

Replace the P16 Instrument Cluster.

- **If the speedometer value matches the scan tool parameter**

5. Verify the odometer display and the displayed distance counts up while driving the vehicle.

- **If the odometer displays only "----" (dashes)**

Refer to Circuit/System Testing.

- **If the odometer display does not count up**

Replace the P16 Instrument Cluster.

- **If speedometer sweeps and displays the correct value, and the odometer display counts up**

6. All OK.

Circuit/System Testing

NOTE: 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.

Perform circuit/system verification first.

Correcting VIN mismatch: Instrument Cluster is Showing "----" (Dashes), odometer is still unlocked

1. Verify the scan tool Odometer Status parameter is Unlocked.

- **If the reading is Locked**

Refer to correcting VIN mismatch - odometer locked.

- **If the reading is Unlocked**

2. Verify the scan tool BCM VIN parameter matches the vehicle's VIN placard.

- **If the VIN does not match**

Reprogram the BCM, then proceed to Step 3.

- **If the VIN matches**

3. Verify the scan tool Instrument Cluster VIN parameter matches the vehicle's VIN placard.

- **If the VIN does not match**

Reprogram the instrument cluster. Then proceed with step 4.

- **If the VIN matches**

4. Ignition ON.
5. Verify the instrument cluster is displaying the correct value.
 - **If the instrument cluster is still displaying "----" (dashes)**

Replace the P16 Instrument Cluster.

6. All OK.

Correcting VIN mismatch: Instrument Cluster is Showing "----" (Dashes), odometer is locked

1. Verify the scan tool Odometer Status parameter is Locked.

- **If the reading is Unlocked**

Refer to Correcting VIN mismatch - odometer unlocked.

- **If the reading is Locked**

2. Verify the scan tool Instrument Cluster VIN parameter matches the vehicle's VIN placard.

- **If the VIN does not match**

Reprogram the Instrument Cluster. Then proceed with step 3.

- **If the VIN matches**

3. Perform the BCM setup procedure in SPS.
4. Ignition ON.
5. Verify the instrument cluster is displaying the correct value.
 - **If the instrument cluster is still displaying "----" (dashes)**

Replace the P16 Instrument Cluster.

- **If instrument cluster is displaying the correct value**

6. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for instrument cluster, BCM or ECM replacement, programming, and setup.

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.

Circuit/System Description

The Engine Control Module creates the engine speed signal by pulsing the engine speed signal circuit to ground at a rate of 2 pulses per engine revolution. The Instrument Cluster converts the 2 pulses per engine revolution signal to a tachometer position indicating the engine speed. The engine speed is sent to the Instrument Cluster over a discreet 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.

Reference Information

Schematic Reference

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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

Circuit/System Testing

1. Ignition ON, 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.
 - **If tachometer does not sweep**
 Replace the P16 Instrument Cluster.
 - **If speedometer sweeps properly**
2. Engine running.
3. Verify that the tachometer value matches the scan tool Engine Speed parameter in the ECM Engine Data List with the scan tool.
 - **If the tachometer does not match the scan tool Engine Speed parameter**
 Replace the P16 Instrument Cluster.
 - **If the tachometer matches the scan tool Engine Speed parameter**
4. Ignition OFF, disconnect the X2 harness connector at the Engine Control Module. Ignition ON.
5. Test for 9-11 V between the engine speed signal circuit terminal 39 and ground.
 - **If less than 9 V**
 1. Ignition OFF, disconnect the harness connector at the P16 Instrument Cluster.
 2. Test for infinite resistance between the engine speed signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the engine speed signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the P16 Instrument Cluster.
 - **If greater than 11 V**
 1. Ignition OFF, disconnect the harness connector at the P16 Instrument Cluster, ignition ON.
 2. Test for less than 1 V between the engine speed signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the P16 Instrument Cluster.
 - **If between 9-11 V**
6. Replace the K20 Engine Control Module.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for the ECM and Instrument Cluster replacement, programming, and setup

REPAIR INSTRUCTIONS

AMBIENT AIR TEMPERATURE SENSOR REPLACEMENT

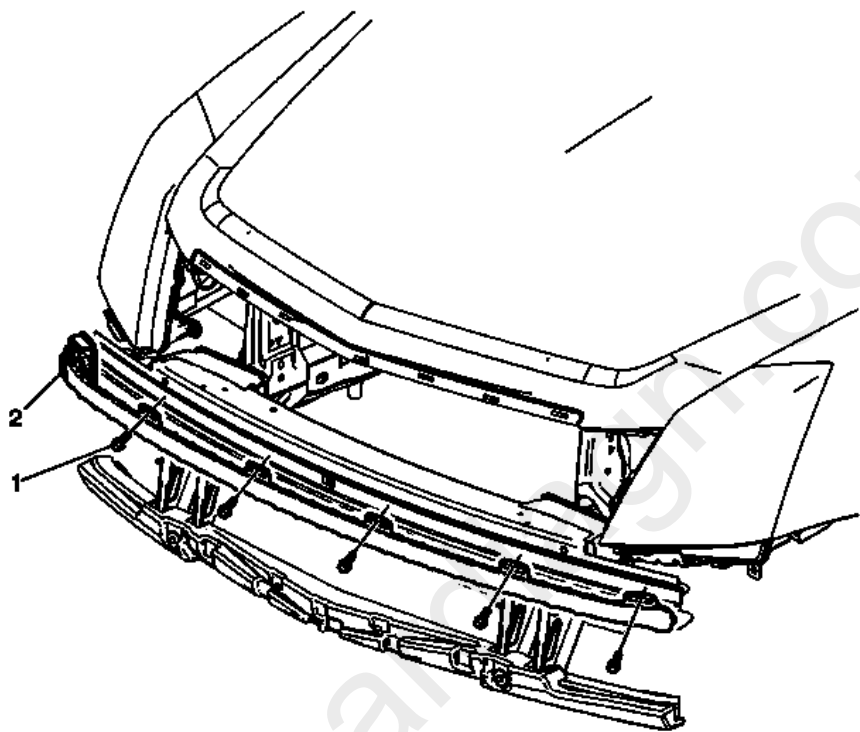


Fig. 5: Ambient Air Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

Ambient Air Temperature Sensor Replacement

Call out	Component Name
Preliminary Procedures	
1. Lift the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> .	
2. Remove the center front air deflector. Refer to <u>Front Bumper Fascia Air Deflector Replacement - Center</u> .	
3. Reposition the radiator air lower baffle, to gain access to the ambient air temperature sensor.	
1	Ambient Air Temperature Gauge Sensor Fastener
2	Ambient Air Temperature Gauge Sensor
Procedure	
Disconnect the ambient air temperature gauge sensor connector.	

HEAD UP DISPLAY SWITCH REPLACEMENT

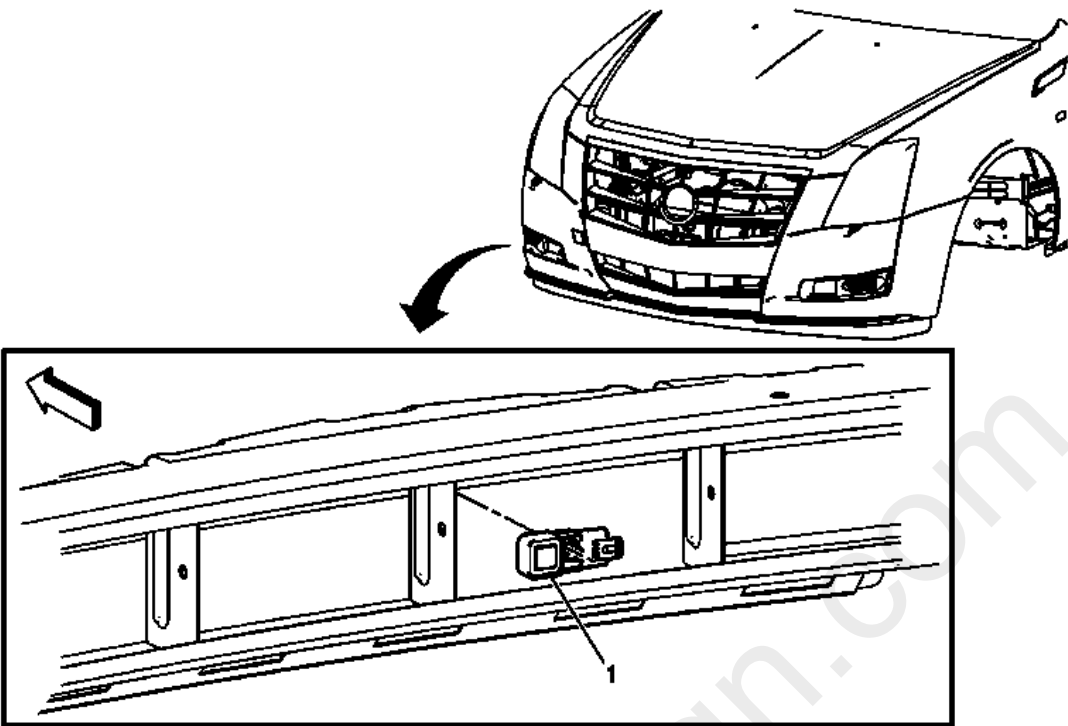


Fig. 6: Head Up Display Switch
Courtesy of GENERAL MOTORS COMPANY

Head Up Display Switch Replacement

Callout	Component Name
Preliminary Procedure Remove the instrument panel knee bolster. Refer to <u>Instrument Panel Knee Bolster Replacement</u> .	
1	Head Up Display Switch Procedure Release tabs on switch to remove from the bezel.

HEAD-UP DISPLAY REPLACEMENT

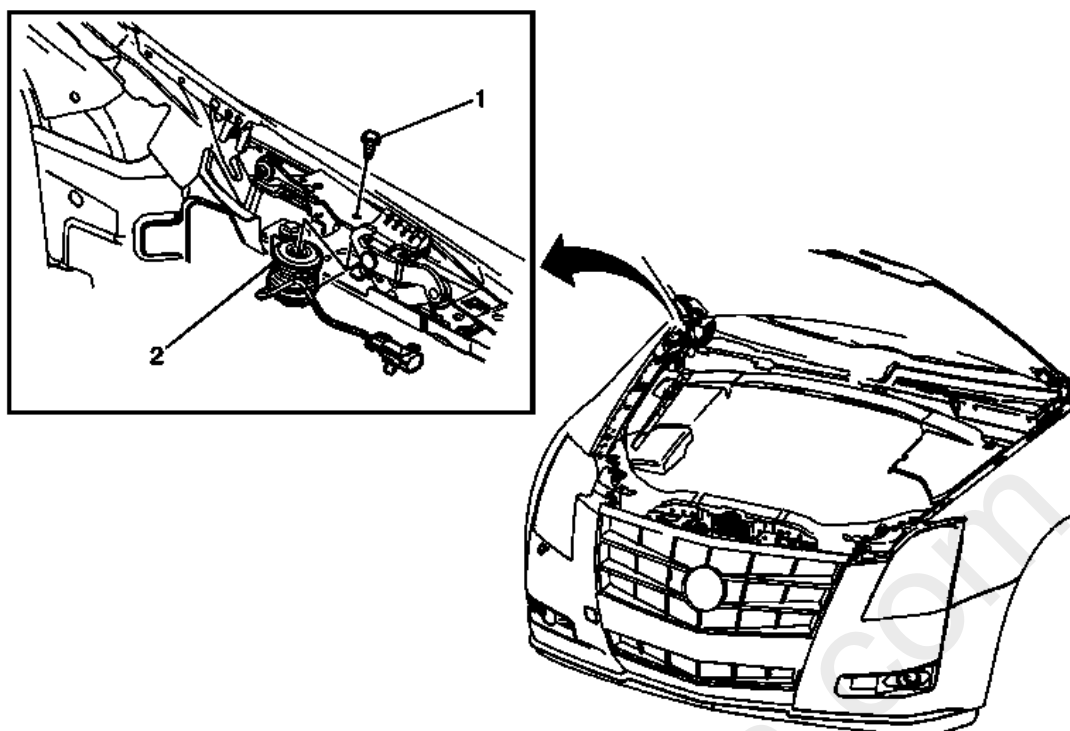


Fig. 7: Head-Up Display
 Courtesy of GENERAL MOTORS COMPANY

Head-Up Display Replacement

Callout	Component Name
Preliminary Procedure Remove the instrument panel center support bracket. Refer to <u>Instrument Panel Center Support Bracket Replacement</u> .	
1	Head-Up Display Bolt (Qty: 4) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2.5 (22 lb in)
2	Head-Up Display Procedure Disconnect the electrical connections.

INSTRUMENT CLUSTER REPLACEMENT

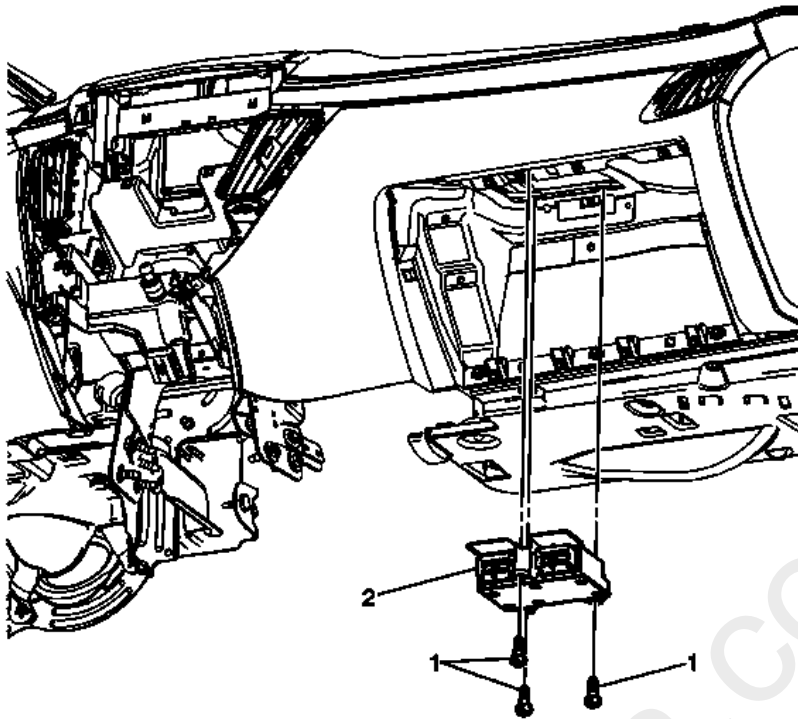


Fig. 8: Instrument Cluster
 Courtesy of GENERAL MOTORS COMPANY

Instrument Cluster Replacement

Callout	Component Name
Preliminary Procedure Remove the instrument panel cluster trim plate applique. Refer to <u>Instrument Panel Cluster Trim Plate Applique Replacement</u> .	
1	Instrument Cluster Bolt (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 2.5 (22 lb in)
2	Instrument Cluster Procedure 1. Disconnect the electrical connector. 2. Refer to <u>Control Module References</u> for programming and set up information.

INSTRUMENT PANEL MULTIFUNCTION SWITCH REPLACEMENT

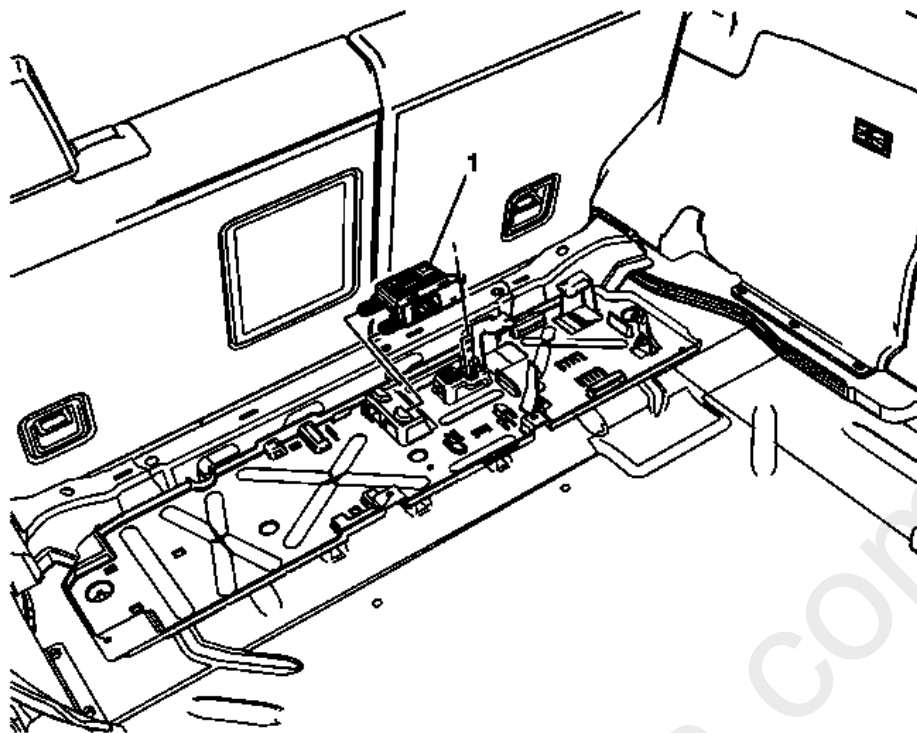


Fig. 9: Instrument Panel Multifunction Switch

Courtesy of GENERAL MOTORS COMPANY

Instrument Panel Multifunction Switch Replacement

Callout	Component Name
Preliminary Procedure Remove the instrument panel accessory bracket. Refer to <u>Instrument Panel Accessory Bracket Replacement</u> .	
1	Instrument Panel Multifunction Switch Procedure Using the appropriate tool, depress the tabs on switch to remove from the bracket.

DESCRIPTION AND OPERATION

AUDIBLE WARNINGS DESCRIPTION AND OPERATION

The audible warnings alert the driver of a system concern or a critical vehicle condition. The radio generates the audible warnings through the speakers. The radio receives audible warning requests via serial data. If the radio 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.

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 sound a chime to indicate 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 there is an occupant in the passenger seat and the vehicle is started with the passenger seat belt unbuckled, the BCM requests the radio sound a chime to indicate 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 sound a chime as an indicator that the exterior lamps are on.
- **Electric Parking Brake** - If the electric parking brake switch is pressed while the vehicle is in motion, the parking brake control module will request the radio 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 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 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 during normal operation.

Additional Warnings

The following warnings have an associated instrument cluster indicator or driver information center message:

- **Turn Signal Indicators** - The radio activates the audible warning as requested by the BCM.
- **Vehicle Overspeed Message** - The radio activates the audible warning as requested by the BCM.
- **Fuel Level Low Message** - The radio activates the audible warning as requested by the BCM.
- **Oil Pressure Indicator** - The radio activates the audible warning as requested by the BCM.
- **Tire Pressure Low Indicator** - The radio activates the audible warning as requested by the BCM.
- **Antilock Brake Indicator** - The radio activates the audible warning as requested by the electronic brake control module.
- **Engine Cooling System Messages** - The radio activates the audible warning as requested by the engine control module.
- **Transmission Messages** - The radio activates the audible warning as requested by the transmission control module.

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. The vehicle odometer and PRNDL are displayed at all times in the lower portion of each information display zone.

Each of the displays zones can be selected and their associated pages scrolled through using the steering wheel mounted driver information display switch.

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

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

Displays and Gauges Block Diagram

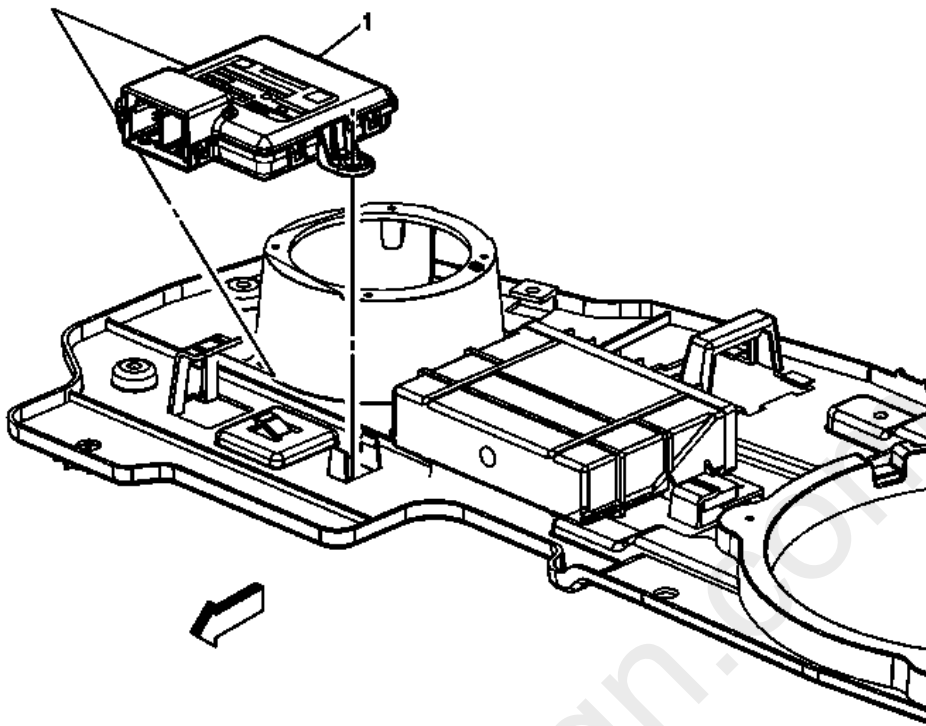


Fig. 10: Displays and Gauges Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
HW	Hard-Wired
HW	Hard-Wired
DA	Serial Data
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
HW	Hard-Wired
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

Indicators and Warning Messages

Refer to **Indicator/Warning Message 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.

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.

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.

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.

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.

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.

Driver Information Center Display

The driver information center is located In the lower middle of the instrument cluster. Its 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 displays 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**.