SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification Metric (English)
Instrument Cluster Bolt	2.5 N.m (22 lb in)

FUEL LEVEL SPECIFICATIONS

Approximate CNG Fuel Pressure (psi)	Alternate Fuel Tank Pressure Signal (Volts)
0	0.50
50	0.55
100	0.60
150	0.65
200	0.70
250	0.75
300	0.80
350	0.84
400	0.89
450	0.94
500	0.99
550	1.04
600	1.09
650	1.14
700	1.19
750	1.24
800	1.29
850	1.34
900	1.39
950	1.44
1000	1.48
1050	1.53
1100	1.58
1150	1.63

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Approximate CNG Fuel Pressure (psi)	Alternate Fuel Tank Pressure Signal (Volts)
1200	1.68
1250	1.73
1300	1.78
1350	1.83
1400	1.88
1450	1.93
1500	1.98
1550	2.03
1600	2.08
1650	2.13
1700	2.17
1750	2.22
1800	2.27
1850	2.32
1900	2.37
1950	2.42
2000	2.47
2050	2.52
2100	2.57
2150	2.62
2200	2.67
2250	2.72
2300	2.77
2350	2.81
2400	2.86
2450	2.91
2500	2.96
2550	3.01
2600	3.06
2650	3.11
2700	3.16
2750	3.21
2800	3.26
2850	3.31
2900	3.36
2950	3.41
3000	3.45
3050	3.50
3100	3.55
3150	3.60
3200	3.65
3250	3.70
3300	3.75

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Approximate CNG Fuel Pressure (psi)	Alternate Fuel Tank Pressure Signal (Volts)
3350	3.80
3400	3.85
3450	3.90
3500	3.95
3550	4.00
3600	4.05
3650	4.10
3700	4.14
3750	4.19
3800	4.24
3850	4.29
3900	4.34
3950	4.39
4000	4.44

SCHEMATIC WIRING DIAGRAMS

INSTRUMENT CLUSTER WIRING SCHEMATICS

Power, Ground and Serial Data

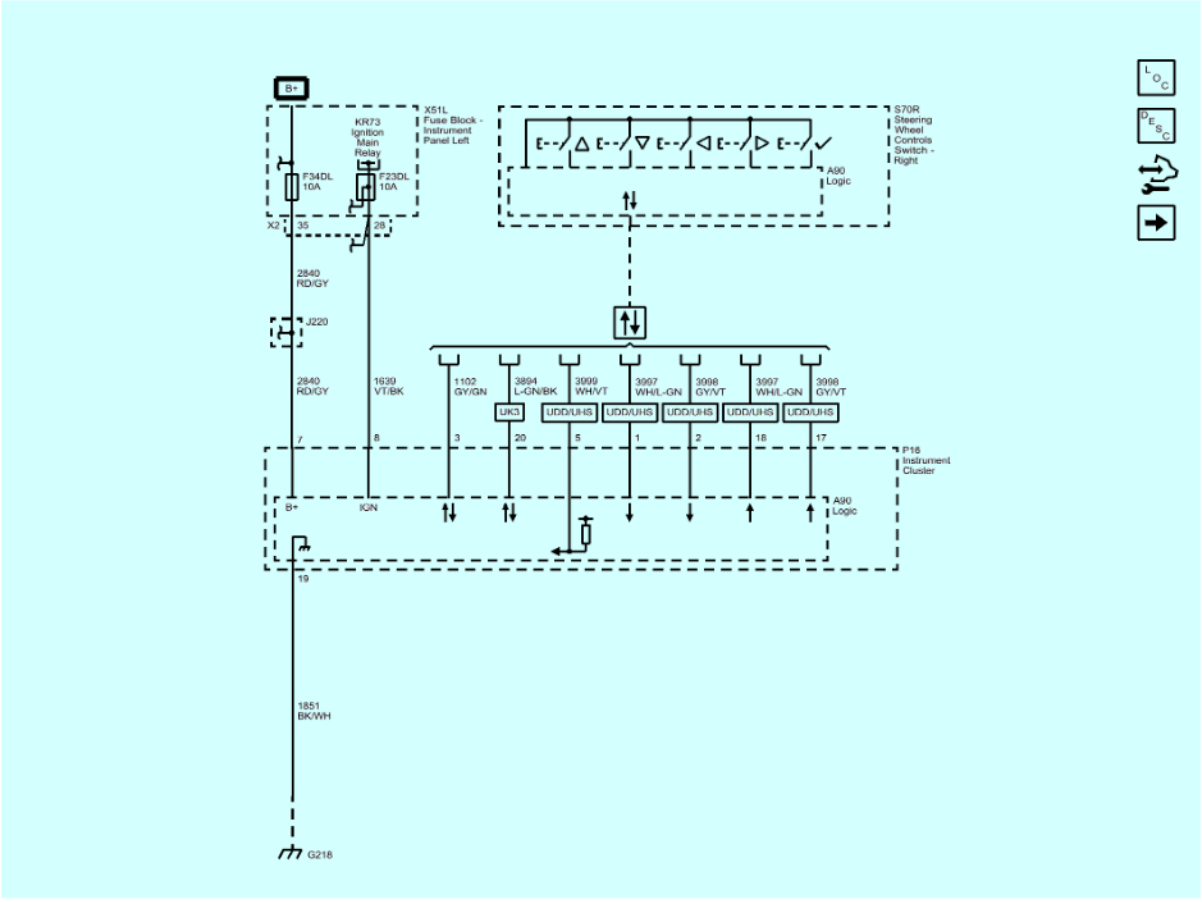


Fig. 1: Power, Ground and Serial Data
Courtesy of GENERAL MOTORS COMPANY

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Gages (1500)

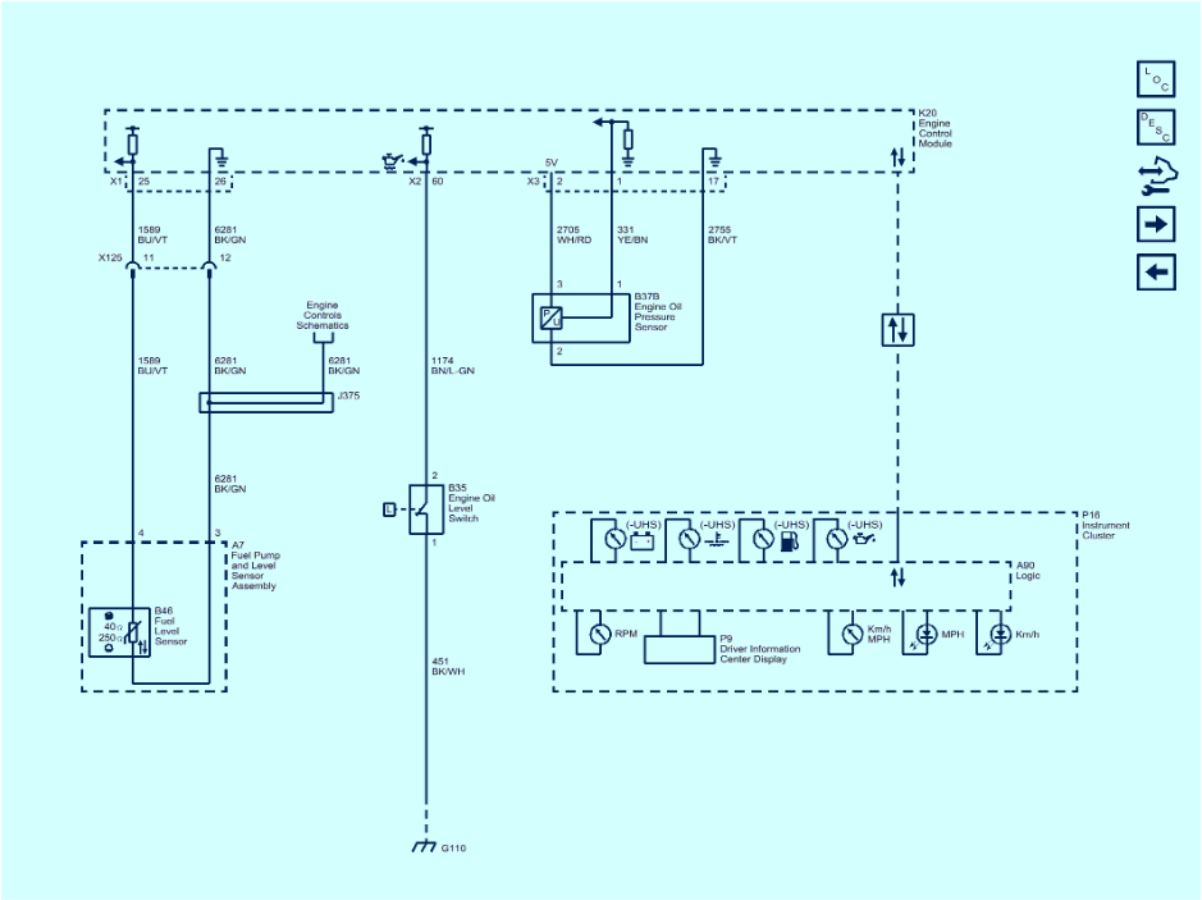


Fig. 2: Gages (LV3, L83, L86, L8B)
Courtesy of GENERAL MOTORS COMPANY

Gages (L96 or LC8)

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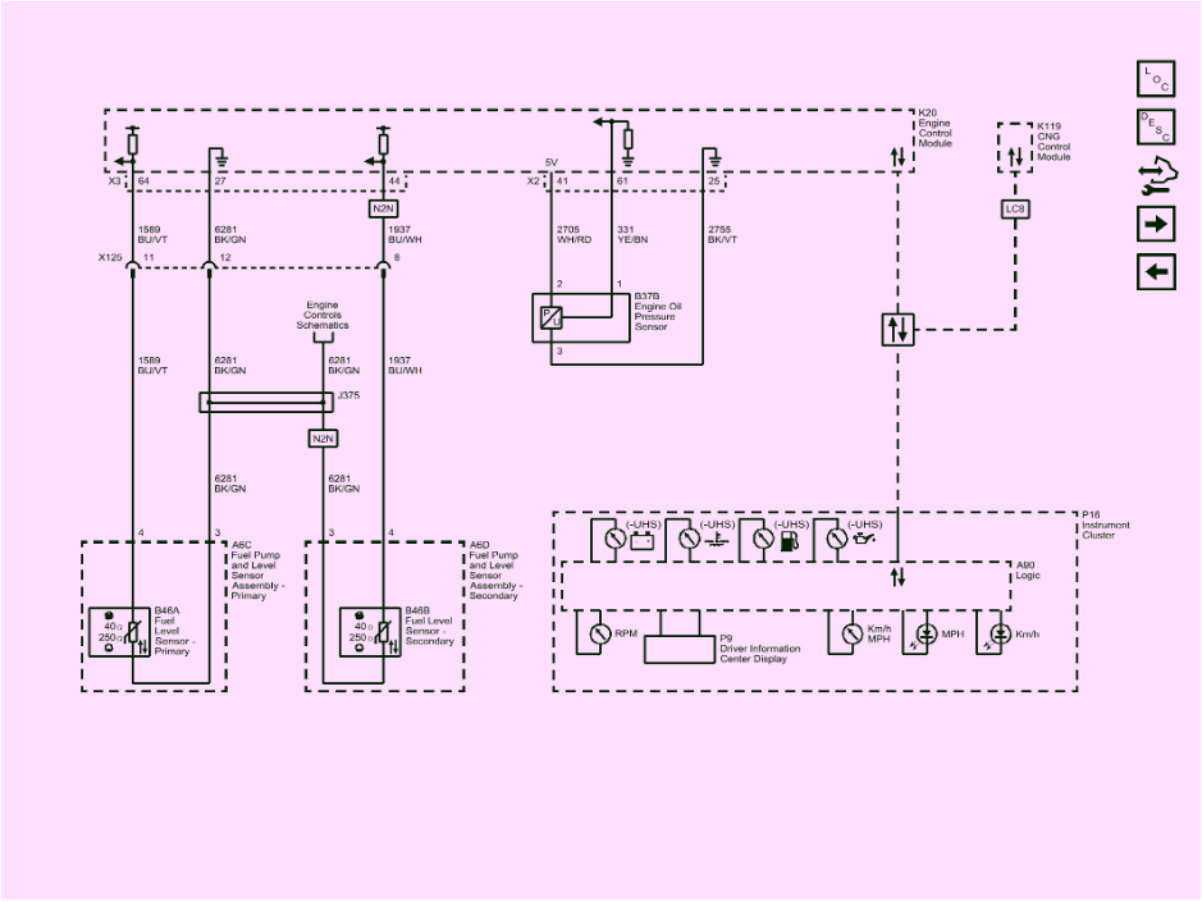


Fig. 3: Gages (L96 or LC8)
Courtesy of GENERAL MOTORS COMPANY

Gages (L5P)

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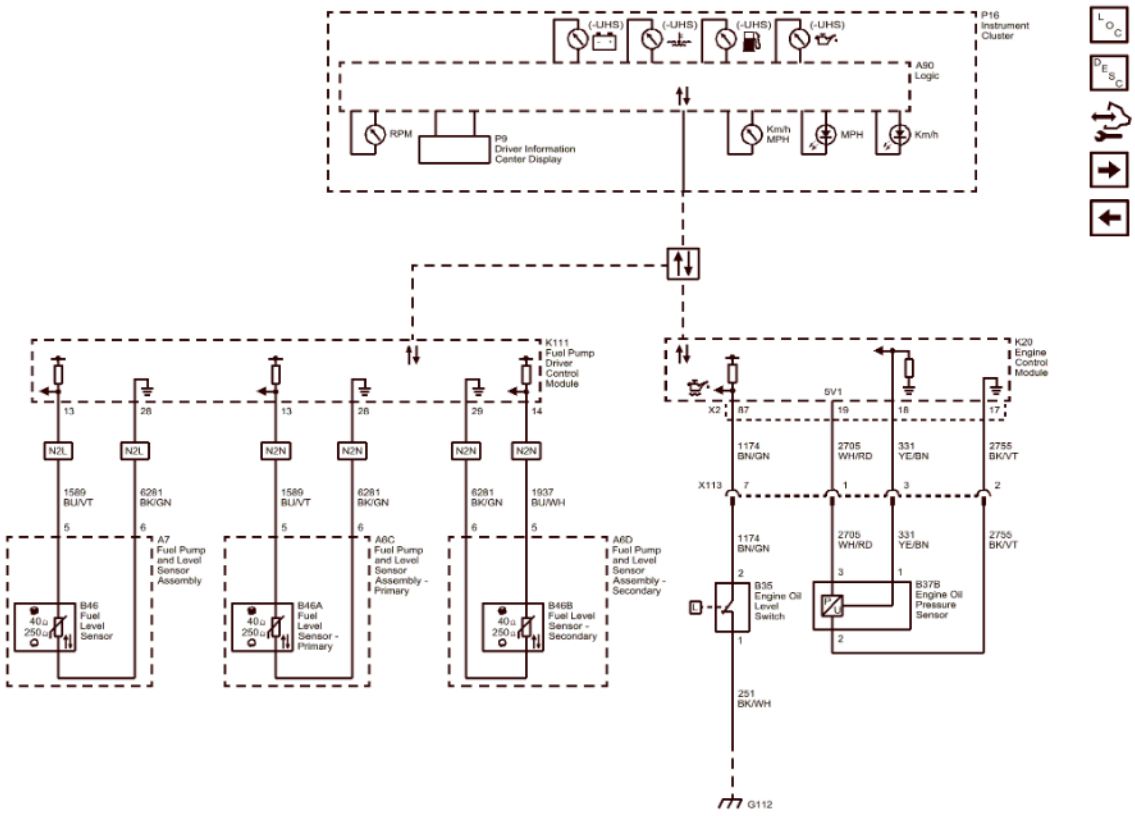


Fig. 4: Gages (L5P)
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Indicators and Ambient Temperature

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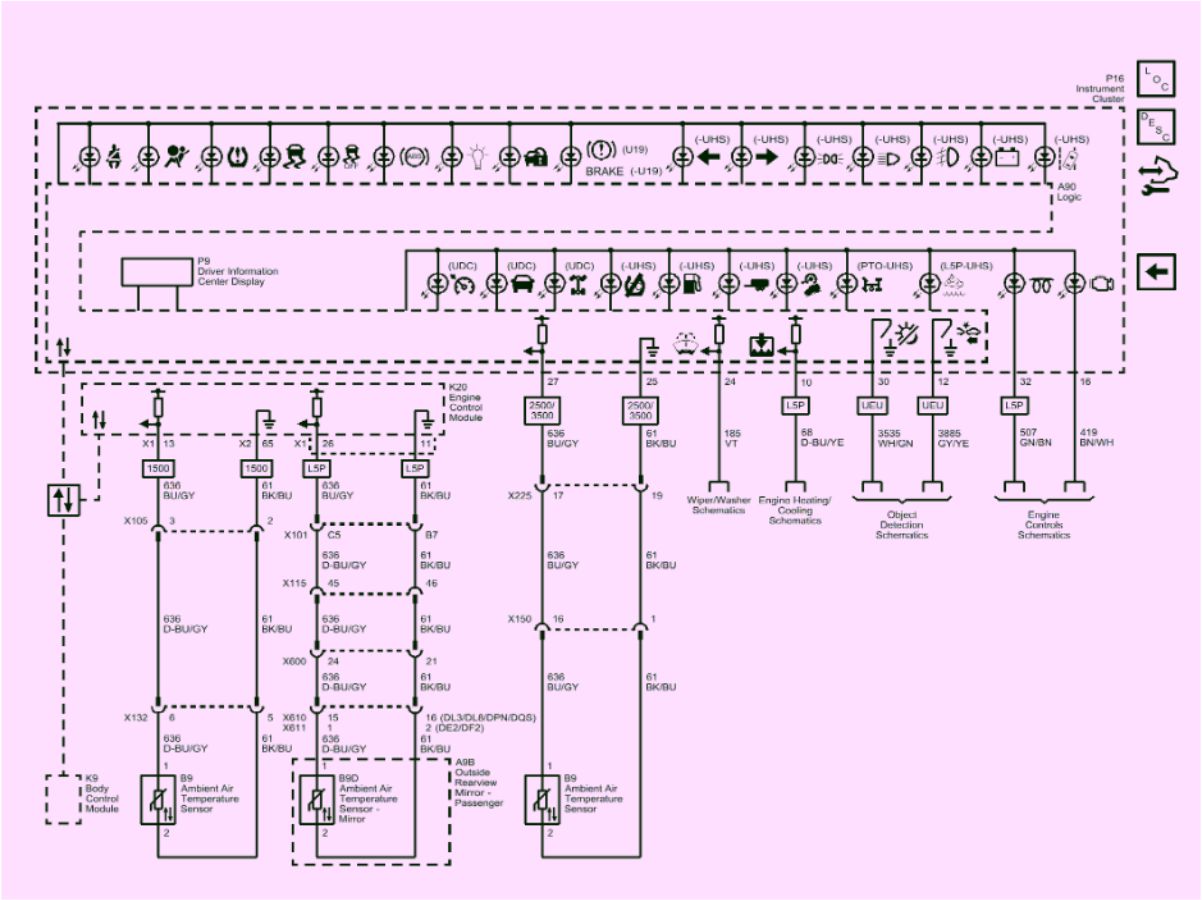


Fig. 5: Indicators and Ambient Temperature
Courtesy of GENERAL MOTORS COMPANY

AUDIBLE WARNINGS WIRING SCHEMATICS

Audible Warnings

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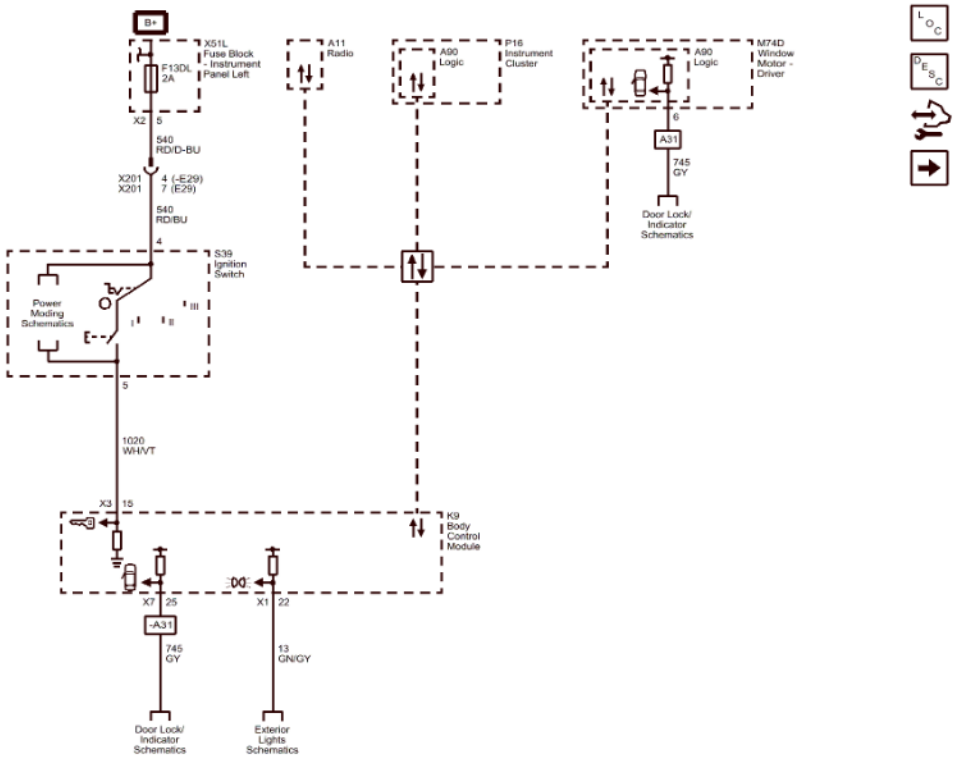


Fig. 6: Audible Warnings
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Backup Alarm (8S3)

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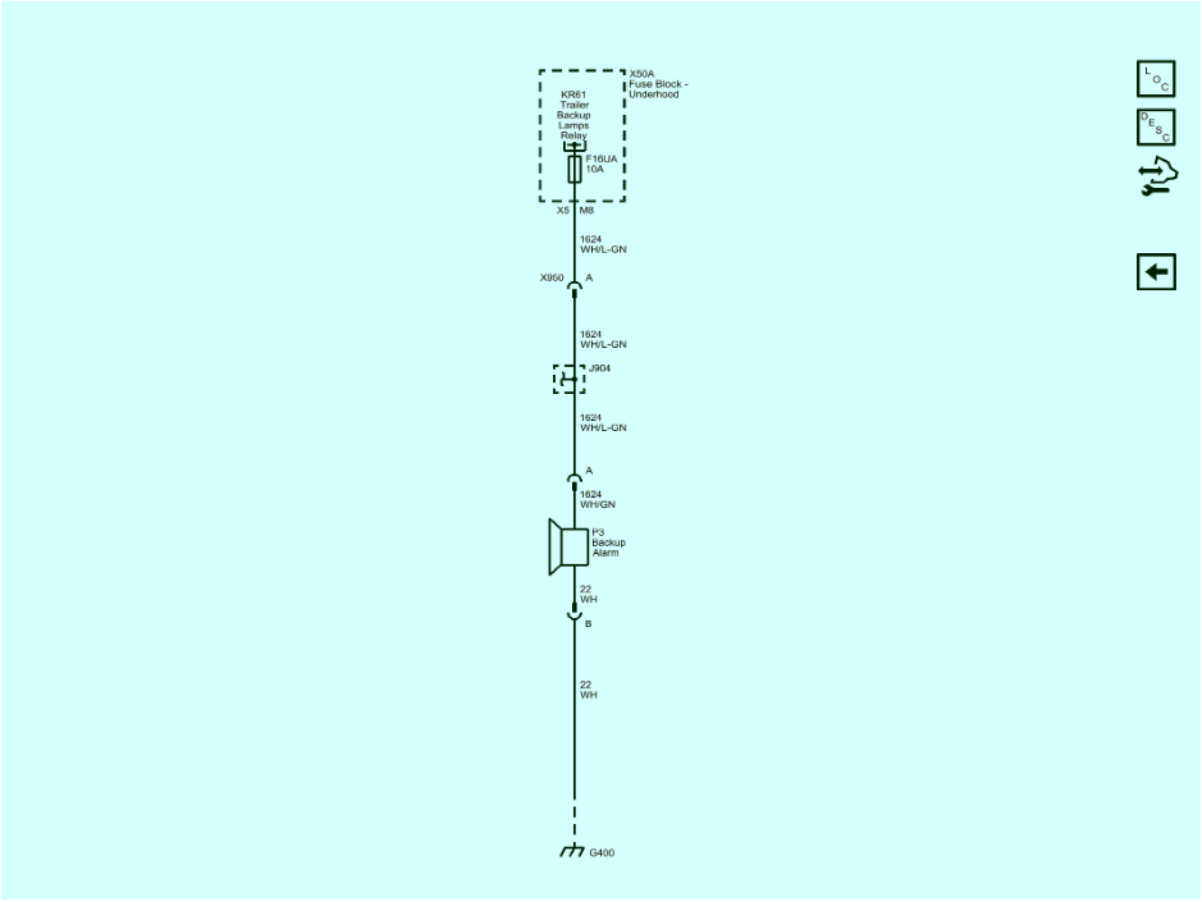


Fig. 7: Backup Alarm (8S3)
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

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

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Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B0158 02	1 or B0158 05	B0158 05	1
Low Reference	-	B0158 05	-	-
1. Outside Air Temperature Display Malfunction				

Circuit/System Description

The B9 Ambient Air Temperature Sensor is located behind the grille. 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 88Â°C (190Â°F) .

B0158 05

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

Action Taken When the DTC Sets

The instrument cluster uses a default air temperature value for further calculations. The instrument cluster will display -Â°C (-Â°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

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

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- **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

NOTE: **For vehicles with RPO AVF, ensure that the Body Control Module and Instrument Cluster have been programmed with the latest calibrations before proceeding with Circuit/System Verification and Circuit/System Testing.**

1. Ignition ON.

   NOTE: **The scan tool Instrument Cluster Ambient Air Temperature parameter is a buffered value when the measured temperature is increasing. Performing the Ambient Air Temperature Instant Update with the scan tool may be necessary to force the Ambient Air Temperature parameter to update to the current measured temperature.**

2. Verify the scan tool Instrument Cluster Ambient Air Temperature parameter is between -40Â°C (-40Â°F) and +88Â°C (+190Â°F) and changes with air temperature changes.
   - **If not between -40Â°C (-40Â°F) and +88Â°C (+190Â°F) or changes with air temperature changes**

     Refer to Circuit/System Testing.

   - **If between -40Â°C (-40Â°F) and +88Â°C (+190Â°F) and changes with air temperature changes**
3. All OK.

Circuit/System Testing

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

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B9 Ambient Air Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal B (or 2) and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF, disconnect the harness connector at the P16 Instrument Cluster.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the P16 Instrument Cluster.
   - **If less than 10 Ω**

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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 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, 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.

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

DTC B0550: ODOMETER

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure:**Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis:**Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here:**Diagnostic Procedure Instructions**

DTC Descriptor

DTC B0550

Odometer Circuit

- Symptom Byte: 32 - General Memory Malfunction

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Circuit/System Description

For an overview of the component/system, refer to:**Instrument Cluster Description and Operation**

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode

Conditions for Setting the DTC

K9 Body Control Module=Internal Malfunction

Actions Taken When the DTC Sets

Odometer = "- - -"

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC B0550 is not set.
    - **If the DTC is set**
    1. Perform all necessary programming and setup procedures for the control module:K9 Body Control Module
    2. Verify the DTC does not set.
        - If the DTC sets - Replace the component:K9 Body Control Module
        - If the DTC is not set
    3. All OK.
    - **If the DTC is not set**
3. All OK.

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Repair Instructions

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

For control module replacement, programming, and setup refer to: **Control Module References**

DTC B0931: COMPASS

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure:**Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis:**Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here:**Diagnostic Procedure Instructions**

DTC Descriptor

Compass Circuit

- Symptom Byte: 39 - Internal Malfunction

Circuit/System Description

The compass module uses low-field magnetic sensing to sense vehicle directional and heading information.

For an overview of the component/system, refer to:**Instrument Cluster Description and Operation**

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode

Conditions for Setting the DTC

K9 Body Control ModuleDetected K18 Compass Module=Internal Malfunction

Actions Taken When the DTC Sets

P17 Info Display Module or P16 Instrument Cluster Displays "- - -"

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC B0931 is not set.
   - **If the DTC is set**

     Replace the component: K18 Compass Module

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

Repair Instructions

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

Displays and Gauges Component Replacement Reference

DTC B124F: UNIVERSAL SERIAL BUS (USB) PROGRAMMING

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure:**Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis:**Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here:**Diagnostic Procedure Instructions**

DTC Descriptor

Universal Serial Bus (USB) Programming

- Symptom Byte:41 - Not Programmed
- Symptom Byte:42 - Configuration Not Programmed
- Symptom Byte:44 - Security Access Not Activated
- Symptom Byte:4A - Programming Checksum Error

Circuit/System Description

The control module P16 performs software checks to validate a programming event has completed successfully.No external circuit diagnosis is involved.

Conditions for Running the DTC

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Ignition - On / Vehicle - In Service Mode

Conditions for Setting the DTC

P16 Instrument Cluster=Programming Malfunction

Actions Taken When the DTC Sets

- DTCs Stored
- Some functions will not work.

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC B124F is not set.
    - **If the DTC is set**
    1. Perform all necessary programming and setup procedures for the control module:P16 Instrument Cluster
    2. Verify the DTC does not set.
        - If the DTC sets - Replace the component: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: **Diagnostic Repair Verification**

For control module replacement, programming, and setup refer to: **Control Module References**

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DTC P0070: AMBIENT AIR TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0070

Ambient Air Temperature Sensor Circuit

Symptom Byte Information: Symptom Byte List

Circuit/System Description

Circuit	Description
Signal circuit	The sensor resistance varies with temperature.
Components • B9 Ambient Air Temperature Sensor • P16 Instrument Cluster	
The input voltage varies depending on the temperature of the sensor.	

Conditions for Running the DTC

Ignition On

Conditions for Setting the DTC

The internal fault detection is handled inside the control module. No external circuit diagnosis is involved.

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category=Type B DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category=Type B DTC

Diagnostic Aids

DTC P0070 is set in case the battery was disconnected or the control module was re-programmed.

Reference Information

Schematic Reference

Instrument Cluster Schematics

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Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC B0158 is not set.
    - **If DTC B0158 is set**

      Refer to:**Diagnostic Trouble Code (DTC) List - Vehicle**

    - **If the DTC is not set**
3. Verify DTC P0070 is not set.
    - **If the DTC is not set**

      All OK.

    - **If DTC B0070 is set**
4. Clear DTC B0070
5. Verify the DTC does not set.
    - **If the DTC is not set**

      All OK.

    - **If DTC P0070 is set**
6. Ignition/Vehicle - Off - For greater than 3 h

   Verify the following parameters are within 15Â°C (59Â°F) of each other:

    - IAT Sensor 1
    - Ambient Air Temperature

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- **If not in the specified range**

  Replace the component:B9 Ambient Air Temperature Sensor

- **If in the specified range**

7. Verify DTC P0070 is not set.
   - **If the DTC is not set**

     All OK.

   - **If DTC P0070 is set**
8. Perform all necessary programming and setup procedures for the control module:P16 Instrument Cluster
9. Verify DTC P0070 is not set.
   - **If the DTC is not set**

     All OK.

   - **If DTC P0070 is set**
10. Perform all necessary programming and setup procedures for the control module:K9 Body Control Module
11. Verify DTC P0070 is not set.
    - **If the DTC is not set**

      All OK.

    - **If DTC P0070 is set**
12. Perform all necessary programming and setup procedures for the control module:K20 Engine Control Module
13. Verify DTC P0070 is not set.
    - **If the DTC is not set**

      All OK.

    - **If DTC P0070 is set**
14. Replace the control module: K20 Engine Control Module

Repair Instructions

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

- For control module replacement, programming, and setup refer to: **Control Module References**

DTC P0071-P0074: AMBIENT AIR TEMPERATURE SENSOR (1500 SERIES)

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.

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DTC Descriptors

DTC P0071

Ambient Air Temperature Sensor Performance

DTC P0072

Ambient Air Temperature Sensor Circuit Low Voltage

DTC P0073

Ambient Air Temperature Sensor Circuit High Voltage

DTC P0074

Ambient Air Temperature Sensor Circuit Intermittent

Diagnostic Fault Information

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

Circuit/System Description

The B9 Ambient Air Temperature Sensor is located behind the grille. The engine control module monitors the ambient air temperature sensor with a low reference circuit and signal circuit. The engine control module 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 engine control module converts the voltage value to a temperature value and sends the value to the P17 Info Display Module via serial data. The P17 Info Display Module displays the temperature.

Conditions for Running the DTC

- The ignition is ON
- The 12 V battery voltage is greater than or equal to 10.2 V.

Conditions for Setting the DTC

P0071

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

P0072

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

P0073

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

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P0074

The ECM detects an unrealistic signal variance.

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool ECM Ambient Air Temperature parameter is between -40Â°C (-40Â°F) and +88Â°C (+190Â°F) and changes with air temperature changes.
    - **If not between -40Â°C (-40Â°F) and +88Â°C (+190Â°F) or changes with air temperature changes**

      Refer to Circuit/System Testing.

    - **If between -40Â°C (-40Â°F) and +88Â°C (+190Â°F) and changes with air temperature changes**
3. All OK.

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Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B9 Ambient Air Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal B (or 2) and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If less than 10 Ω**
3. Ignition ON.
4. Verify the ECM scan tool Ambient Air Temperature parameter reads colder than -30Â°F (-34Â°C).
    - **If -30Â°F (-34Â°C) or warmer**
    1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
    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 K20 Engine Control Module.
    - **If colder than -30Â°F (-34Â°C)**
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 reads warmer than 180Â°F (82Â°C)
    - **If 180Â°F (82Â°C) or colder**
    1. Ignition OFF, disconnect the X1 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 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If warmer than 180Â°F (82Â°C)**
7. Test or replace the B9 Ambient Air Temperature Sensor.

Repair Instructions

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

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

DTC P0071-P0074: AMBIENT AIR TEMPERATURE SENSOR (2500/3500 SERIES)

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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 P0071

Ambient Air Temperature Sensor Performance

DTC P0072

Ambient Air Temperature Sensor Circuit Low Voltage

DTC P0073

Ambient Air Temperature Sensor Circuit High Voltage

DTC P0074

Ambient Air Temperature Sensor Circuit Intermittent

Diagnostic Fault Information

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

Circuit/System Description

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

Conditions for Running the DTC

- The ignition is ON
- The 12 V battery voltage is greater than or equal to 10.2 V.

Conditions for Setting the DTC

P0071

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

P0072

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

P0073

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

P0074

The ECM detects an unrealistic signal variance.

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

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

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

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

  Refer to Circuit/System Testing.

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

3. All OK.

Circuit/System Testing

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

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B9D Ambient Air Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K20 Engine Control Module.
   - **If less than 10 Ω**
3. Ignition ON.
4. Verify the scan tool Ambient Air Temperature parameter is less than-39Â°C (-38Â°F).
   - **If -39Â°C (-38Â°F) or greater**
   1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module.
   2. Test for infinite resistance between the signal circuit terminal 1 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 less than -39Â°C (-38Â°F)**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2.
6. Verify the scan tool Ambient Air Temperature parameter is greater than 88Â°C (190Â°F).
   - **If 88Â°C (190Â°F) or less**
   1. Ignition OFF, remove the jumper wire and disconnect the X3 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 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.

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- If less than 2 Ω, replace the K20 Engine Control Module.
- **If less than 88Â°C (190Â°F)**

7. Test or replace the B9D Mirror Ambient Air Temperature Sensor.

Repair Instructions

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

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

DTC P0461-P0464: FUEL LEVEL SENSOR (GASOLINE ENGINE WITHOUT N2N)

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 Performance

DTC P0462

Fuel Level Sensor Circuit Low Voltage

DTC P0463

Fuel Level Sensor Circuit High Voltage

DTC P0464

Fuel Level Sensor Circuit Intermittent

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fuel Level Sensor 1 Signal	P0462	P0463	P0463	P0461
Low Reference	-	1	P0463, P0464	P0461
1. Fuel Gauge Malfunction				

Circuit/System Description

The fuel level sensor changes resistance based on fuel level. The engine control module (ECM) monitors the signal circuit of the fuel level sensor in order to determine the fuel level. When the fuel tank is full, the resistance of the fuel level sensor is low and the ECM senses a low signal voltage on the signal circuit of the fuel level sensor. When the fuel tank is empty, the resistance of the fuel level sensor is high and the ECM senses a high signal voltage. The ECM uses the signal circuit of the fuel level sensor in order to calculate the

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percentage of remaining fuel in the tank. The ECM sends the fuel level percentage via High Speed CAN-Bus to the body control module (BCM). The BCM then sends the fuel level percentage via Low Speed CAN-Bus to the instrument cluster in order to control the fuel gauge.

Conditions for Running the DTC

- Ignition ON/Vehicle in Service Mode
- Battery voltage is between 11-32 V

Conditions for Setting the DTC

P0461

- 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

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

P0463

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

P0464

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

Action Taken When the DTC Sets

P0461, P0462, and P0463

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

P0464

- P0464 is a Type A DTC

Conditions for Clearing the DTC

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

Reference Information

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Instrument Cluster Schematics

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Instrument Cluster Description and Operation

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Without UHS or UDV

1. Ignition ON/Vehicle in Service Mode.
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 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 Circuit/System Testing

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

With UHS or UDV

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1. Ignition ON/Vehicle in Service Mode.
2. Verify the scan tool Fuel Level Sensor 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 Circuit/System Testing

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

Circuit/System Testing

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

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the A7 Fuel Pump and Level Sensor assembly. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Verify the scan tool Fuel Level Sensor parameter is greater than 4.8 V.
    - **If 4.8 V or less**
    1. Ignition OFF/Vehicle 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 parameter is less than 0.2 V.
    - **If 0.2 V or greater**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Ignition OFF/Vehicle OFF
    4. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.

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- **If less than 0.2 V**

7. Test or replace the fuel level sensor

Component Testing

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

      Replace the fuel level sensor.

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

Repair Instructions

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

- **Displays and Gauges Component Replacement Reference**
- **Control Module References** for engine control module or instrument cluster replacement, programming, and setup

DTC P0461-P0464: FUEL LEVEL SENSOR (DIESEL ENGINE (L5P) WITHOUT N2N)

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 Performance

DTC P0462

Fuel Level Sensor Circuit Low Voltage

DTC P0463

Fuel Level Sensor Circuit High Voltage

DTC P0464

Fuel Level Sensor Circuit Intermittent

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Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fuel Level Sensor 1 Signal	P0462	P0463	P0463	P0461
Low Reference	-	1	P0463, P0464	P0461
1. Fuel Gauge Malfunction				

Circuit/System Description

The fuel level sensor changes resistance based on fuel level. The Fuel Pump Driver Control Module monitors the signal circuit of the fuel level sensor and sends the signal information to the Engine Control Module (ECM). The ECM uses this value in order to determine the fuel level. When the fuel tank is full, the resistance of the fuel level sensor is low and the ECM senses a low signal voltage on the signal circuit of the fuel level sensor. When the fuel tank is empty, the resistance of the fuel level sensor is high and the ECM senses a high signal voltage. The ECM uses the signal circuit of the fuel level sensor in order to calculate the percentage of remaining fuel in the tank. The Fuel Pump Driver Control Module sends the fuel level percentage via High Speed CAN-Bus to the body control module (BCM). The BCM then sends the fuel level percentage via Low Speed CAN-Bus to the instrument cluster in order to control the fuel gauge.

Conditions for Running the DTC

- Ignition ON/Vehicle in Service Mode
- Battery voltage is between 11-32 V

Conditions for Setting the DTC

P0461

- 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

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

P0463

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

P0464

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

Action Taken When the DTC Sets

P0461, P0462, and P0463

- P0461, P0462, and P0463 are Type B DTCs

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- The fuel gauge defaults to empty
- The low fuel indicator illuminates

P0464

- P0464 is a Type A DTC

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

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Description and Operation

Instrument Cluster Description and Operation

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- **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/Vehicle in Service Mode.
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**

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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 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 Circuit/System Testing

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

With UHS or UDV

1. Ignition ON/Vehicle in Service Mode.
2. Verify the scan tool Fuel Level Sensor 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 Circuit/System Testing

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

Circuit/System Testing

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

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the A7 Fuel Pump and Level Sensor assembly. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 6 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Verify the scan tool Fuel Level Sensor parameter is greater than 4.8 V.
    - **If 4.8 V or less**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the signal circuit terminal 5 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K20 Engine Control Module.

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- **If greater than 4.8 V**

5. Install a 3 A fused jumper wire between the signal circuit terminal 5 and the low reference circuit terminal 6.
6. Verify the scan tool Fuel Level Sensor parameter is less than 0.2 V.
    - **If 0.2 V or greater**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Ignition OFF/Vehicle OFF
    4. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If less than 0.2 V**
7. Test or replace the fuel level sensor

Component Testing

1. Ignition OFF/Vehicle OFF, remove the fuel level sender.
2. Sweep the fuel level sensor through its full range of motion while measuring resistance between the signal terminal 5 and the low reference terminal 6.
3. Test for a minimum resistance value of 37-43 Ω and a maximum value of 245-255 Ω without any spikes or dropouts.
    - **If minimum resistance is not 37-43 Ω, maximum resistance is not 245-255 Ω, or if there are any spikes or dropouts**

      Replace the fuel level sensor.

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

Repair Instructions

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

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

DTC P0461-P0464, P2066, P2067, OR P2068: FUEL LEVEL SENSOR (GASOLINE ENGINE WITH N2N)

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.

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- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0461

Fuel Level Sensor Performance

DTC P0462

Fuel Level Sensor Circuit Low Voltage

DTC P0463

Fuel Level Sensor Circuit High Voltage

DTC P0464

Fuel Level Sensor 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 Signal	P0462	P0463	P0463	P0461
Fuel Level Sensor 2 Signal	P2067	P2068	P2068	P2066
Low Reference	-	1	P0463, P0464, P2068	P0461, P2066
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 the primary fuel level sensor and the secondary fuel level sensor in order to determine the fuel level. When the fuel tank is full, the resistances of both fuel level sensors are low and the ECM senses a low signal voltage on both the signal circuits of the primary fuel level sensor and the secondary fuel level sensor. When the fuel tank is empty, the resistances of the fuel level sensors are high and the ECM senses a high signal voltage. The ECM uses the signal circuits of the primary fuel level sensor and the secondary fuel level sensor in order to calculate the percentage of remaining fuel in the tank. The ECM sends the fuel level percentage via the serial data circuit to the instrument cluster in order to control the fuel gauge.

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Conditions for Running the DTC

- Ignition ON
- 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% for a duration lasting less than 30 seconds.
- DTC P0464 runs and fails 2 out of 3 test cycles.

Action Taken When the DTC Sets

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

P0464

- P0464 is a Type A DTC

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

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- **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 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 Rear 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**
5. Verify the scan tool Fuel Level Sensor 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**
6. All OK.

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With UHS or UDV

1. Ignition ON.
2. Verify the scan tool Fuel Level Sensor Rear 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**
3. Verify the scan tool Fuel Level Sensor 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**
4. All OK.

Circuit/System Testing

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

Primary Fuel Level Sensor Malfunction

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B46A Fuel Level Sensor- Primary. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Verify the scan tool Fuel Level Sensor parameter is greater than 4.8 V.
    - **If 4.8 V or less**
    1. Ignition OFF/Vehicle 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 parameter is less than 0.2 V.
    - **If 0.2 V or greater**

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

- **If less than 0.2 V**

7. Test or replace the B46A Fuel Level Sensor- Primary.

Secondary Fuel Level Sensor Malfunction

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B46B Fuel Level Sensor - Secondary. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If less than 10 Ω**
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 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.

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- If less than 2 Ω, 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/Vehicle OFF, remove the fuel level sender.
2. Sweep the fuel level sensor through its full range of motion while measuring resistance between the signal terminal 4 and the low reference terminal 3.
3. Test for a minimum resistance value of 37-43 Ω and a maximum value of 245-255 Ω without any spikes or dropouts.
   - **If minimum resistance is not 37-43 Ω, maximum resistance is not 245-255 Ω, or if there are any spikes or dropouts**

     Replace the fuel level sensor.

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

Repair Instructions

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

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

DTC P0461-P0464, P2066, P2067, OR P2068: FUEL LEVEL SENSOR (DIESEL ENGINE WITH N2N)

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 Performance

DTC P0462

Fuel Level Sensor Circuit Low Voltage

DTC P0463

Fuel Level Sensor Circuit High Voltage

DTC P0464

Fuel Level Sensor Circuit Intermittent

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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 Signal	P0462	P0463	P0463	P0461
Fuel Level Sensor 2 Signal	P2067	P2068	P2068	P2066
Low Reference	-	1	P0463, P0464, P2068	P0461, P2066
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 Fuel Pump Driver Control Module monitors the signal circuits of the primary fuel level sensor and the secondary fuel level sensor and sends the signal information to the Engine Control Module (ECM). The ECM uses this value to in order to determine the fuel level. When the fuel tank is full, the resistances of both fuel level sensors are low and the ECM senses a low signal voltage on both the signal circuits of the primary fuel level sensor and the secondary fuel level sensor. When the fuel tank is empty, the resistances of the fuel level sensors are high and the ECM senses a high signal voltage. The ECM uses the signal circuits of the primary fuel level sensor and the secondary fuel level sensor in order to calculate the percentage of remaining fuel in the tank. The ECM sends the fuel level percentage via the serial data circuit to the instrument cluster in order to control the fuel gauge.

Conditions for Running the DTC

- Ignition ON
- 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.

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P0463 or P2068

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

P0464

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

Action Taken When the DTC Sets

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

P0464

- P0464 is a Type A DTC

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

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Control Module References for scan tool information

Circuit/System Verification

Without 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 Rear 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**
5. Verify the scan tool Fuel Level Sensor 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**
6. All OK.

With UHS or UDV

1. Ignition ON.
2. Verify the scan tool Fuel Level Sensor Rear 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**
3. Verify the scan tool Fuel Level Sensor 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

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

4. All OK.

Circuit/System Testing

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

Primary Fuel Level Sensor Malfunction

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B46A Fuel Level Sensor- Primary. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 6 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K111 Fuel Pump Driver Control Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K111 Fuel Pump Driver Control Module.
   - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Verify the scan tool Fuel Level Sensor parameter is greater than 4.8 V.
   - **If 4.8 V or less**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K111 Fuel Pump Driver Control Module.
   2. Test for infinite resistance between the signal circuit terminal 5 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K111 Fuel Pump Driver Control Module.
   - **If greater than 4.8 V**
5. Install a 3 A fused jumper wire between the signal circuit terminal 5 and the low reference circuit terminal 6.
6. Verify the scan tool Fuel Level Sensor parameter is less than 0.2 V.
   - **If 0.2 V or greater**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K111 Fuel Pump Driver 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/Vehicle OFF
   4. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K111 Fuel Pump Driver Control Module.
   - **If less than 0.2 V**
7. Test or replace the B46A Fuel Level Sensor- Primary.

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8. Engine running, verify the condition no longer exists.
    - **If condition is still present**

      Replace the K111 Fuel Pump Driver Control Module.

    - **If condition is not present**
9. All OK.

Secondary Fuel Level Sensor Malfunction

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B46B Fuel Level Sensor - Secondary. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 6 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF, disconnect the harness connector at the K111 Fuel Pump Driver Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K111 Fuel Pump Driver Control Module.
    - **If less than 10 Ω**
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 K111 Fuel Pump Driver Control Module.
    2. Test for infinite resistance between the signal circuit terminal 5 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K111 Fuel Pump Driver Control Module.
    - **If greater than 4.8 V**
5. Install a 3 A fused jumper wire between the signal circuit terminal 5 and the low reference circuit terminal 6.
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 K111 Fuel Pump Driver 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 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K111 Fuel Pump Driver Control Module.
    - **If less than 0.2 V**
7. Test or replace the B46B Fuel Level Sensor - Secondary.
8. Engine running, verify the condition no longer exists.

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- **If condition is still present**

  Replace the K111 Fuel Pump Driver Control Module.

- **If condition is not present**

9. All OK.

Component Testing

1. Ignition OFF/Vehicle OFF, remove the fuel level sender.
2. Sweep the fuel level sensor through its full range of motion while measuring resistance between the signal terminal 5 and the low reference terminal 6.
3. Test for a minimum resistance value of 37-43 Ω and a maximum value of 245-255 Ω without any spikes or dropouts.
   - **If minimum resistance is not 37-43 Ω, maximum resistance is not 245-255 Ω, or if there are any spikes or dropouts**

     Replace the fuel level sensor.

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

Repair Instructions

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

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

DTC P0521, P0522, OR P0523: ENGINE OIL PRESSURE SENSOR (1500 SERIES)

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

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Diagnostic Fault Information

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

Circuit/System Description

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

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

P0521

- The ECM detects that measured oil pressure is at least 47 kPa (6.8 psi) less than or 50 kPa (7.3 psi) higher than the predicted oil pressure.
- The engine oil pressure is outside of a calculated working range determined by engine speed and temperature.
- One of the above conditions are present for greater than 4 s.

P0522

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

P0523

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

Action Taken When the DTC Sets

- The ECM records the operating conditions at the time the diagnostics test fails. The ECM displays this information in the Failure Records on the scan tool.

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- The instrument cluster illuminates the engine oil pressure indicator.

Conditions for Clearing the DTC

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

Diagnostic 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

Description and Operation

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

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify the scan tool Engine Oil Pressure Sensor parameter is 0 psi (0 kPa).
   - **If not 0 psi (0 kPa)**

     Refer to Circuit/System Testing.

   - **If 0 psi (0 kPa)**
3. Engine running.
4. Verify actual engine oil pressure is within specified range. Refer to Oil Pressure Diagnosis and Testing in **Displays and Gauges Component Replacement Reference**.

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5. Verify the scan tool Engine Oil Pressure parameter is within specified range.
    - **If not within specified range**

      Refer to Circuit/System Testing.

    - **If within specified range**
6. Verify the engine oil pressure displayed on the P16 Instrument Cluster is within specified range.
    - **If not within specified range**

      Test or replace the P16 Instrument Cluster.

    - **If within specified range**
7. All OK.

Circuit/System Testing

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

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B37B Engine Oil Pressure Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 3 and ground.
    - **If less than 4.8 V**
    1. Ignition OFF/Vehicle 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 Ω in the 5 V reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If greater than 5.2 V**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the 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.

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- **If between 4.8-5.2 V**

5. Verify the scan tool Engine Oil Pressure parameter is less than 14 kPa (2 psi).
    - **If 14 kPa (2 psi) or above**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit terminal 1 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 below 14 kPa (2 psi)**
6. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the 5 V reference circuit terminal 3.
7. Engine running.
8. Verify the scan tool Engine Oil Pressure parameter is greater than 800kPa (116psi).
    - **If 800kPa (116psi) or less**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the signal circuit terminal 1 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If greater than 800kPa (116psi)**
9. Test or replace the B37B Engine Oil Pressure Sensor.

Repair Instructions

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

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

DTC P0521, P0522, OR P0523: ENGINE OIL PRESSURE SENSOR (2500 OR 3500 SERIES)

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

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Engine Oil Pressure Sensor Circuit Low Voltage.

DTC P0523

Engine Oil Pressure Sensor Circuit High Voltage

Diagnostic Fault Information

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

Circuit/System Description

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

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

P0521

- The ECM detects that measured oil pressure is at least 47 kPa (6.8 psi) less than or 50 kPa (7.3 psi) higher than the predicted oil pressure.
- The engine oil pressure is outside of a calculated working range determined by engine speed and temperature.
- One of the above conditions are present for greater than 4 s.

P0522

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

P0523

- The ECM detects that the engine oil pressure sensor signal circuit is greater than 4.8 V.

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- The above condition is present for greater than 10 s.

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

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

Diagnostic 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

Description and Operation

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

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify the scan tool Engine Oil Pressure Sensor parameter is 0 psi (0 kPa).
    - **If not 0 psi (0 kPa)**

      Refer to Circuit/System Testing.

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- **If 0 psi (0 kPa)**

3. Engine running.
4. Verify actual engine oil pressure is within specified range. Refer to Oil Pressure Diagnosis and Testing in **Displays and Gauges Component Replacement Reference**.
5. Verify the scan tool Engine Oil Pressure parameter is within specified range.
   - **If not within specified range**

     Refer to Circuit/System Testing.

   - **If within specified range**
6. Verify the engine oil pressure displayed on the P16 Instrument Cluster is within specified range.
   - **If not within specified range**

     Test or replace the P16 Instrument Cluster.

   - **If within specified range**
7. All OK.

Circuit/System Testing

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

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B37B Engine Oil Pressure Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K20 Engine Control Module.
   - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
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/Vehicle 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 Ω in the 5 V reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K20 Engine Control Module.
   - **If greater than 5.2 V**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

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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 14 kPa (2 psi).
    - **If 14 kPa (2 psi) or above**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit terminal 1 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 below 14 kPa (2 psi)**
6. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the 5 V reference circuit terminal 2.
7. Engine running.
8. Verify the scan tool Engine Oil Pressure parameter is greater than 800kPa (116psi).
    - **If 800kPa (116psi) or less**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the signal circuit terminal 1 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If greater than 800kPa (116psi)**
9. Test or replace the B37B Engine Oil Pressure Sensor.

Repair Instructions

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

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

DTC P1100: FUEL LEVEL SENSOR 2 SIGNAL MESSAGE COUNTER

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure:**Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis:**Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here:**Diagnostic Procedure Instructions**

DTC Descriptor

Fuel Level Sensor 2 Signal Message Counter Incorrect

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Circuit/System Description

The signal circuit is connected to the following control module:K111 Fuel Pump Driver Control Module

The control module communicates with the engine control module via serial data.

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode

Conditions for Setting the DTC

K20 Engine Control Module=K111 Fuel Pump Driver Control ModuleMessage Counter Incorrect

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category=Type B DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category=Type B DTC

Reference Information

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify no other DTCs are set.
    - **If other DTCs are set**

      Refer to:**Diagnostic Trouble Code (DTC) List - Vehicle**

    - **If no other DTCs are set**
3. Replace the component:K111 Fuel Pump Driver Control Module
4. Verify the DTC does not set.
    - **If the DTC is set**

      Replace the component:K20 Engine Control Module

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- **If the DTC is not set**

5. All OK.

Repair Instructions

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

For control module replacement, programming, and setup refer to: **Control Module References**

DTC P1200: FUEL LEVEL SENSOR 1 SIGNAL MESSAGE COUNTER

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure:**Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis:**Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here:**Diagnostic Procedure Instructions**

DTC Descriptor

Fuel Level Sensor 1 Signal Message Counter Incorrect

Circuit/System Description

The signal circuit is connected to the following control module:K111 Fuel Pump Driver Control Module

The control module communicates with the engine control module via serial data.

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode

Conditions for Setting the DTC

K20 Engine Control Module=K111 Fuel Pump Driver Control ModuleMessage Counter Incorrect

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category=Type B DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category=Type B DTC

Reference Information

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

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

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify no other DTCs are set.
    - **If other DTCs are set**

      Refer to:**Diagnostic Trouble Code (DTC) List - Vehicle**

    - **If no other DTCs are set**
3. Replace the component:K111 Fuel Pump Driver Control Module
4. Verify the DTC does not set.
    - **If the DTC is set**

      Replace the component:K20 Engine Control Module

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

Repair Instructions

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

For control module replacement, programming, and setup refer to: **Control Module References**

DTC P1434: FUEL LEVEL SENSOR 1 REFERENCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure:**Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis:**Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here:**Diagnostic Procedure Instructions**

DTC Descriptor

Fuel Level Sensor 1 Reference Feedback Performance

Circuit/System Description

The signal circuit is connected to the following control module:K111 Fuel Pump Driver Control Module

The control module communicates with the engine control module via serial data.

Conditions for Running the DTC

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Ignition - On / Vehicle - In Service Mode

Ignition Voltage =Greater than 11 V

Conditions for Setting the DTC

Invalid Data Received From Fuel Pump Control Module

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category=Type B DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category=Type B DTC

Reference Information

Schematic Reference

Data Communication Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify no other DTCs are set.
    - **If other DTCs are set**

      Refer to:**Diagnostic Trouble Code (DTC) List - Vehicle**

    - **If no other DTCs are set**
3. Replace the component:K111 Fuel Pump Driver Control Module
4. Verify the DTC does not set.
    - **If the DTC is set**

      Replace the component:K20 Engine Control Module

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- **If the DTC is not set**

5. All OK.

Repair Instructions

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

For control module replacement, programming, and setup refer to: **Control Module References**

DTC P143E: FUEL LEVEL SENSOR 2 REFERENCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure:**Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis:**Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here:**Diagnostic Procedure Instructions**

DTC Descriptor

Fuel Level Sensor 2 Reference Feedback Performance

Circuit/System Description

The signal circuit is connected to the following control module:K111 Fuel Pump Driver Control Module

The control module communicates with the engine control module via serial data.

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode

Ignition Voltage =Greater than 11 V

Conditions for Setting the DTC

Invalid Data Received From Fuel Pump Control Module

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category=Type B DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category=Type B DTC

Reference Information

Schematic Reference

Data Communication Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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Electrical Information Reference

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

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify no other DTCs are set.
    - **If other DTCs are set**

      Refer to:**Diagnostic Trouble Code (DTC) List - Vehicle**

    - **If no other DTCs are set**
3. Replace the component:K111 Fuel Pump Driver Control Module
4. Verify the DTC does not set.
    - **If the DTC is set**

      Replace the component:K20 Engine Control Module

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

Repair Instructions

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

For control module replacement, programming, and setup refer to: **Control Module References**

DTC P250A: LOW ENGINE OIL LEVEL MESSAGE LAMP (WITH DIESEL ENGINE)

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
Engine Oil Level Sensor Signal	2	1	-
Engine Oil Level Sensor Ground	-	1	-

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

Typical Scan Tool Data

Engine Oil Level Switch

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

Circuit/System Description

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

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

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

Reference Information

Schematic Reference

- **Engine Mechanical Schematics**
- **Instrument Cluster Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

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

Electrical Information Reference

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- **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. Verify proper engine oil level.
    - **If not at proper level**

      Add oil as necessary.

    - **If at proper level**
2. Ignition ON, verify the scan tool Engine Oil Level parameter reads OK.
    - **If not OK**

      Refer to Circuit/System Testing.

    - **If OK**
3. All OK.

Circuit/System Testing

NOTE: Verify proper engine oil level before continuing with diagnosis.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B35 Engine Oil Level Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal B and ground.
    - **If 5 Ω or greater**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 5 Ω**
3. Ignition ON.
4. Verify the scan tool Engine Oil Level Switch parameter reads Low.
    - **If the Engine Oil Level Switch parameter reads OK**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the signal circuit terminal A 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 the Engine Oil Level Switch parameter reads Low**

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

5. Install a 3A fused jumper wire between the signal circuit terminal A and the ground circuit terminal B.
6. Verify the scan tool Engine Oil Level Switch parameter reads OK.
   - **If the Engine Oil Level Switch parameter reads Low**
   1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance on the circuit.
      - If less than 2 Ω, replace the K20 Engine Control Module.
   - **If the Engine Oil Level Switch parameter reads OK**
7. Test or replace the B35 Engine Oil Level Switch.

Repair Instructions

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

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

DTC P250A: ENGINE OIL LEVEL SWITCH (1500 SERIES WITH GASOLINE ENGINE)

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 P250A

Engine Oil Level Switch Circuit

Diagnostic Fault Information

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

Typical Scan Tool Data

Engine Oil Level Switch

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

Circuit/System Description

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

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

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

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

Engine Oil Level Low message activated.

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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Description and Operation

Indicator/Warning Message Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Verify proper engine oil level.
    - **If not at proper level**

      Add oil as necessary.

    - **If at proper level**
2. Ignition ON, verify the scan tool Engine Oil Level parameter reads OK.
    - **If not OK**

      Refer to Circuit/System Testing.

    - **If OK**
3. All OK.

Circuit/System Testing

NOTE: **Verify proper engine oil level before continuing with diagnosis.**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B35 Engine Oil Level Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 1 and ground.
    - **If 5 Ω or greater**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 5 Ω**
3. Ignition ON.
4. Verify the scan tool Engine Oil Level Switch parameter reads Low.
    - **If the Engine Oil Level Switch parameter reads OK**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

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2. Test for infinite resistance between the signal circuit terminal 2 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 the Engine Oil Level Switch parameter reads Low**

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

5. Install a 3A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 1.
6. Verify the scan tool Engine Oil Level Switch parameter reads OK.
    - **If the Engine Oil Level Switch parameter reads Low**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance on the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If the Engine Oil Level Switch parameter reads OK**
7. Test or replace the B35 Engine Oil Level Switch.

Repair Instructions

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

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

DISPLAYS AND GAUGES COMPONENT REPLACEMENT REFERENCE

Component	Repair Instruction
B9 Ambient Air Temperature Sensor	**Ambient Air Temperature Sensor Replacement (GMC 1500)Ambient Air Temperature Sensor Replacement (Chev 1500)Ambient Air Temperature Sensor Replacement (Chev 2500 3500)Ambient Air Temperature Sensor Replacement (GMC 2500 3500)Ambient Air Temperature Sensor Replacement (LP5 AVF)Ambient Air Temperature Sensor Replacement (TL1 GAT With Active Shutter GMC)**
B9D Ambient Air Temperature Sensor	{diesel engine} **Ambient Air Temperature Sensor Replacement (GMC 1500)Ambient Air Temperature Sensor Replacement (Chev 1500)Ambient Air Temperature Sensor Replacement (Chev 2500 3500)Ambient Air Temperature Sensor Replacement (GMC 2500**

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Component	Repair Instruction
	3500)Ambient Air Temperature Sensor Replacement (LP5 AVF)Ambient Air Temperature Sensor Replacement (TL1 GAT With Active Shutter GMC)
B35 Engine Oil Level Switch	{4.3L engine} Engine Oil Level Indicator Switch Replacement {5.3L L83 L8B or 6.2L L86} Engine Oil Level Indicator Switch Replacement (L83)
B37B Engine Oil Pressure Sensor	{4.3L engine} Engine Oil Pressure Sensor Replacement {5.3L or 6.2L engine} Engine Oil Pressure Sensor Replacement {6.0L engine} Engine Oil Pressure Sensor and/or Switch Replacement
B46 Fuel Level Sensor	{4.3L engine} Fuel Level Sensor Replacement (Regular Cab w/26 Gal Tank) Fuel Level Sensor Replacement (Extended Cab w/26 Gal Tank) Fuel Level Sensor Replacement (Regular Cab w/34 Gal Tank) {5.3L or 6.2L engine} Fuel Level Sensor Replacement (Regular Cab w/26 Gal Tank) Fuel Level Sensor Replacement (Extended Cab w/26 Gal Tank) Fuel Level Sensor Replacement (Regular Cab w/34 Gal Tank) {6.0L engine} Fuel Level Sensor Replacement (15 Reg Cab With 26 gal Tank) Fuel Level Sensor Replacement (15 Ext/Crew Cab With 26 gal Tank) Fuel Level Sensor Replacement (15 Reg/Ext/Crew Cab w/34 gal Tank) Fuel Level Sensor Replacement (25/35 Series)
S39 Ignition Switch	Ignition and Start Switch Replacement
Oil Pressure Diagnosis and Testing	{4.3L engine} Oil Pressure Diagnosis and Testing {5.3L or 6.2L engine} Oil Pressure Diagnosis and Testing {6.0L engine} Oil Pressure Diagnosis and Testing

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

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- **Audible Warnings 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 (Gasoline with Single Fuel Tank)Fuel Gauge Malfunction (Gasoline with Dual Fuel Tanks (N2N))Fuel Gauge Malfunction (Diesel with Dual Fuel Tanks (N2N))Fuel Gauge Malfunction (Diesel with Single Fuel Tank)**
- **Engine Oil Pressure Gauge Inaccurate or Inoperative (1500 series)Engine Oil Pressure Gauge Inaccurate or Inoperative (2500 or 3500 series)**
- **Outside Air Temperature Display Malfunction (2500/3500 series with Gasoline Engine)Outside Air Temperature Display Malfunction (1500 series)Outside Air Temperature Display Malfunction (2500/3500 series with L5P Diesel Engine)**

BACKUP ALARM MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure:**Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis:**Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here:**Diagnostic Procedure Instructions**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	2	2	1	-
Ground	-	2	2	1
1. Backup Alarm always on 2. Backup Alarm inoperative				

Circuit/System Description

Circuit	Description
Control	The output circuit is switched to 12 V to activate the component.

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Circuit	Description
Ground	Chassis Ground

When the transmission is placed in Reverse, the Body Control Module (BCM) activates the KR61 Trailer Backup Lamps Relay which supplies 12V to the reverse lamps and the Backup Alarm simultaneously..

Reference Information

Schematic Reference

Audible Warnings Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Audible Warnings Description and Operation

Electrical Information Reference

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

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Perform the scan tool control function:Backup Lamps - On and Off

   Verify the component turns On and Off:P9 Backup Alarm

   - **If the component does not turn On and Off** Refer to: Circuit/System Testing
   - **If the component turns On and Off**
3. All OK.

Circuit/System Testing

NOTE: **It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.**

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector:P3 Backup Alarm
3. Test for less than 10 ohms between the test points:Ground circuit terminal B & Ground
   - **If 10 ohms or greater**
   1. Disconnect the ground connection: G400
   2. Test for less than 2 ohms between the test points:Ground circuit terminal B & G400
      - If 2 ohms or greater - Repair the open/high resistance in the circuit.

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- If less than 2 ohms - Repair the open/high resistance in the ground connection.

- **If less than 10 ohms**

4. Connect a test lamp between the test points:Control circuit terminal A & Ground circuit terminal B
5. Ignition - On / Vehicle - In Service Mode
6. Perform the scan tool control function:Backup Lamps- On and Off

   Verify the test lamp turns On and Off.

   - **If the test lamp is always Off**

   1. Ignition/Vehicle - Off & Remove - Test lamp
   2. Disconnect the electrical connector:K50A Underhood Fuse Block X5
   3. Test for infinite resistance between the test points:Control circuit terminal A @Component harness & Ground
      - If less than infinite resistance - Repair the short to ground on the circuit.
      - If infinite resistance
   4. Test for less than 2 ohms between the test points:Control circuit terminal A @Component harness & Terminal M8 @K50A Underhood Fuse Block X5
      - If 2 ohms or greater - Repair the open/high resistance in the circuit.
      - If less than 2 ohms - Replace the component:K50A Underhood Fuse Block

   - **If the test lamp is always On**

   1. Ignition/Vehicle - Off & Remove - Test lamp
   2. Disconnect the electrical connector:K50A Underhood Fuse Block X5
   3. Ignition - On / Vehicle - In Service Mode
   4. Test for less than 1 V between the test points:Control circuit terminal A @Component harness & Ground
      - If 1 V or greater - Repair the short to voltage on the circuit.
      - If less than 1 V - Replace the component:K50A Underhood Fuse Block

   - **If the test lamp turns On and Off**

7. Test or replace the component:P3 Backup Alarm

Repair Instructions

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

- For control module replacement, programming, and setup refer to:**Control Module References**

CHIME MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis:**Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

Circuit/System Description

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A11 Radio- Chime - Warning

The serial data circuits are used to exchange information between the control modules.

Audible notifications that would normally be sounded over the radio speakers are transmitted by the chime alarm control module in case no radio is installed.

For an overview of the component/system, refer to:**Audible Warnings Description and Operation**

Reference Information

Schematic Reference

Audible Warnings Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify the component activates:Radio SpeakerThe balance and fade controls can be used to help isolate an inoperative speaker or poor sound condition.
    - **If the component does not activate**

      Refer to: **Speaker Malfunction (UQ3/UQ5)** **Speaker Malfunction (UQG)** **Speaker Malfunction (UQA with Front Bench Seat)** **Speaker Malfunction (UQA with Front Bucket Seats)** .

    - **If all components operate**
3. B153D Seat Belt Buckle - Driver & B153P Seat Belt Buckle - Passenger- Buckled

   Verify the scan tool parameter:Driver Seat Belt Status & Passenger Seat Belt Status =Buckled

    - **If not the specified state**

      Refer to: **Seat Belt Indicator Malfunction - Driver** .

    - **If the specified state**
4. Headlamp Switch- Off
5. Verify the scan tool parameter:Headlamps On Switch =Inactive

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- **If not the specified state**

  Refer to: **Headlamps Malfunction**

- **If the specified state**

6. Park Lamps Switch - Off
7. Verify the scan tool parameter:Park Lamps Switch =Inactive
   - **If not the specified state**

     Refer to:**Park, License, and/or Tail Lamps Malfunction**

   - **If the specified state**
8. Turn Signal Switch - Off
9. Verify the scan tool parameter:Left Turn Signal Switch & Right Turn Signal Switch =Inactive
   - **If not the specified state**

     Refer to: **Park, License, and/or Tail Lamps Malfunction**

   - **If the specified state**
10. Park Brake - Off
11. Verify the scan tool parameter:Park Brake Switch =Inactive
    - **If not the specified state**

      Refer to:**Park Brake System Diagnosis**

    - **If the specified state**
12. Close the doors and verify that the luggage compartment is empty.
13. Verify the scan tool parameter:Driver Door Ajar Switch & Passenger Door Ajar Switch & Left Rear Door Ajar Switch & Right Rear Door Ajar Switch =Inactive
    - **If not the specified state**

      Refer to:**Door Ajar Indicator Malfunction**

    - **If the specified state**
14. All OK.

Repair Instructions

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

- For control module replacement, programming, and setup refer to: **Control Module References**

ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (1500 SERIES)

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.

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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	High Resistance	Open	Short to Voltage	Signal Performance
Engine Oil Pressure 5 V Reference	P0522	1	P0522	P0523	P0521
Engine Oil Pressure Sensor Signal	P0522	1	P0522	P0523	P0521
Low Reference	-	1	P0523	-	P0521
1. Engine Oil Pressure Gauge Inaccurate or Inoperative					

Circuit/System Description

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

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

P0521

- The ECM detects that measured oil pressure is at least 47 kPa (6.8 psi) less than or 50 kPa (7.3 psi) higher than the predicted oil pressure.
- The engine oil pressure is outside of a calculated working range determined by engine speed and temperature.
- One of the above conditions are present for greater than 4 s.

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P0522

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

P0523

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

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

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

Diagnostic 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

Description and Operation

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

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

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Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify the scan tool Engine Oil Pressure Sensor parameter is 0 psi (0 kPa).
   - **If not 0 psi (0 kPa)**

     Refer to Circuit/System Testing.

   - **If 0 psi (0 kPa)**
3. Engine running.
4. Verify actual engine oil pressure is within specified range. Refer to Oil Pressure Diagnosis and Testing in **Displays and Gauges Component Replacement Reference**.
5. Verify the scan tool Engine Oil Pressure parameter is within specified range.
   - **If not within specified range**

     Refer to Circuit/System Testing.

   - **If within specified range**
6. Verify the engine oil pressure displayed on the P16 Instrument Cluster is within specified range.
   - **If not within specified range**

     Test or replace the P16 Instrument Cluster.

   - **If within specified range**
7. All OK.

Circuit/System Testing

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

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B37B Engine Oil Pressure Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K20 Engine Control Module.
   - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 3 and ground.
   - **If less than 4.8 V**
   1. Ignition OFF/Vehicle 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.

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- If infinite resistance

3. Test for less than 2 Ω in the 5 V reference circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the K20 Engine Control Module.

- **If greater than 5.2 V**

1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the 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 14 kPa (2 psi).
    - **If 14 kPa (2 psi) or above**

    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit terminal 1 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 below 14 kPa (2 psi)**

6. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the 5 V reference circuit terminal 3.
7. Engine running.
8. Verify the scan tool Engine Oil Pressure parameter is greater than 800kPa (116psi).
    - **If 800kPa (116psi) or less**

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

    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.

    - **If greater than 800kPa (116psi)**

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

Repair Instructions

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

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

ENGINE OIL PRESSURE GAUGE INACCURATE OR INOPERATIVE (2500 OR 3500 SERIES)

Diagnostic Instructions

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- 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	High Resistance	Open	Short to Voltage	Signal Performance
Engine Oil Pressure 5 V Reference	P0522	1	P0522	P0523	P0521
Engine Oil Pressure Sensor Signal	P0522	1	P0522	P0523	P0521
Low Reference	-	1	P0523	-	P0521
1. Engine Oil Pressure Gauge Inaccurate or Inoperative					

Circuit/System Description

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

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

P0521

- The ECM detects that measured oil pressure is at least 47 kPa (6.8 psi) less than or 50 kPa (7.3 psi) higher than the predicted oil pressure.

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- 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 s.

P0522

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

P0523

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

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

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

Diagnostic 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

Description and Operation

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

Electrical Information Reference

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

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify the scan tool Engine Oil Pressure Sensor parameter is 0 psi (0 kPa).
   - **If not 0 psi (0 kPa)**

     Refer to Circuit/System Testing.

   - **If 0 psi (0 kPa)**
3. Engine running.
4. Verify actual engine oil pressure is within specified range. Refer to Oil Pressure Diagnosis and Testing in **Displays and Gauges Component Replacement Reference**.
5. Verify the scan tool Engine Oil Pressure parameter is within specified range.
   - **If not within specified range**

     Refer to Circuit/System Testing.

   - **If within specified range**
6. Verify the engine oil pressure displayed on the P16 Instrument Cluster is within specified range.
   - **If not within specified range**

     Test or replace the P16 Instrument Cluster.

   - **If within specified range**
7. All OK.

Circuit/System Testing

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

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B37B Engine Oil Pressure Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K20 Engine Control Module.
   - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 2 and ground.
   - **If less than 4.8 V**

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1. Ignition OFF/Vehicle 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 Ω in the 5 V reference circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the K20 Engine Control Module.

- **If greater than 5.2 V**

1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the 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 14 kPa (2 psi).
    - **If 14 kPa (2 psi) or above**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit terminal 1 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 below 14 kPa (2 psi)**
6. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the 5 V reference circuit terminal 2.
7. Engine running.
8. Verify the scan tool Engine Oil Pressure parameter is greater than 800kPa (116psi).
    - **If 800kPa (116psi) or less**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the signal circuit terminal 1 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If greater than 800kPa (116psi)**
9. Test or replace the B37B Engine Oil Pressure Sensor.

Repair Instructions

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

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

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ENGINE OIL PRESSURE INDICATOR MALFUNCTION (1500 SERIES)

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	High Resistance	Open	Short to Voltage	Signal Performance
Engine Oil Pressure 5 V Reference	P0522	1	P0522	P0523	P0521
Engine Oil Pressure Sensor Signal	P0522	1	P0522	P0523	P0521
Low Reference	-	1	P0523	-	P0521
1. Engine Oil Pressure Gauge Inaccurate or Inoperative					

Circuit/System Description

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

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

P0521

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- The ECM detects that measured oil pressure is at least 47 kPa (6.8 psi) less than or 50 kPa (7.3 psi) higher than the predicted oil pressure.
- The engine oil pressure is outside of a calculated working range determined by engine speed and temperature.
- One of the above conditions are present for greater than 4 s.

P0522

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

P0523

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

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

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

Diagnostic 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

Description and Operation

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

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

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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 Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify the scan tool Engine Oil Pressure Sensor parameter is 0 psi (0 kPa).
   - **If not 0 psi (0 kPa)**

     Refer to Circuit/System Testing.

   - **If 0 psi (0 kPa)**
3. Engine running.
4. Verify actual engine oil pressure is within specified range. Refer to Oil Pressure Diagnosis and Testing in **Displays and Gauges Component Replacement Reference**.
5. Verify the scan tool Engine Oil Pressure parameter is within specified range.
   - **If not within specified range**

     Refer to Circuit/System Testing.

   - **If within specified range**
6. Verify the engine oil pressure displayed on the P16 Instrument Cluster is within specified range.
   - **If not within specified range**

     Test or replace the P16 Instrument Cluster.

   - **If within specified range**
7. All OK.

Circuit/System Testing

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

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B37B Engine Oil Pressure Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K20 Engine Control Module.
   - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.

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4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 3 and ground.
    - **If less than 4.8 V**
    1. Ignition OFF/Vehicle 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 Ω in the 5 V reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If greater than 5.2 V**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the 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 14 kPa (2 psi).
    - **If 14 kPa (2 psi) or above**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit terminal 1 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 below 14 kPa (2 psi)**
6. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the 5 V reference circuit terminal 3.
7. Engine running.
8. Verify the scan tool Engine Oil Pressure parameter is greater than 800kPa (116psi).
    - **If 800kPa (116psi) or less**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the signal circuit terminal 1 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If greater than 800kPa (116psi)**
9. Test or replace the B37B Engine Oil Pressure Sensor.

Repair Instructions

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

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

ENGINE OIL PRESSURE INDICATOR MALFUNCTION (2500 OR 3500 SERIES)

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	High Resistance	Open	Short to Voltage	Signal Performance
Engine Oil Pressure 5 V Reference	P0522	1	P0522	P0523	P0521
Engine Oil Pressure Sensor Signal	P0522	1	P0522	P0523	P0521
Low Reference	-	1	P0523	-	P0521
1. Engine Oil Pressure Gauge Inaccurate or Inoperative					

Circuit/System Description

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

Conditions for Running the DTC

The engine is running.

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Conditions for Setting the DTC

P0521

- The ECM detects that measured oil pressure is at least 47 kPa (6.8 psi) less than or 50 kPa (7.3 psi) higher than the predicted oil pressure.
- The engine oil pressure is outside of a calculated working range determined by engine speed and temperature.
- One of the above conditions are present for greater than 4 s.

P0522

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

P0523

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

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

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

Diagnostic 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

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Description and Operation

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

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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/Vehicle in Service Mode.
2. Verify the scan tool Engine Oil Pressure Sensor parameter is 0 psi (0 kPa).
   - **If not 0 psi (0 kPa)**

     Refer to Circuit/System Testing.

   - **If 0 psi (0 kPa)**
3. Engine running.
4. Verify actual engine oil pressure is within specified range. Refer to Oil Pressure Diagnosis and Testing in **Displays and Gauges Component Replacement Reference**.
5. Verify the scan tool Engine Oil Pressure parameter is within specified range.
   - **If not within specified range**

     Refer to Circuit/System Testing.

   - **If within specified range**
6. Verify the engine oil pressure displayed on the P16 Instrument Cluster is within specified range.
   - **If not within specified range**

     Test or replace the P16 Instrument Cluster.

   - **If within specified range**
7. All OK.

Circuit/System Testing

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

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B37B Engine Oil Pressure Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.

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- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω, replace the K20 Engine Control Module.

- **If less than 10 Ω**

3. Ignition ON/Vehicle in Service Mode.
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/Vehicle 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 Ω in the 5 V reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K20 Engine Control Module.
   - **If greater than 5.2 V**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
   2. Test for less than 1 V between the 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 14 kPa (2 psi).
   - **If 14 kPa (2 psi) or above**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
   2. Test for less than 1 V between the signal circuit terminal 1 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 below 14 kPa (2 psi)**
6. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the 5 V reference circuit terminal 2.
7. Engine running.
8. Verify the scan tool Engine Oil Pressure parameter is greater than 800kPa (116psi).
   - **If 800kPa (116psi) or less**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
   2. Test for infinite resistance between the signal circuit terminal 1 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K20 Engine Control Module.
   - **If greater than 800kPa (116psi)**

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

Repair Instructions

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

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

FUEL GAUGE MALFUNCTION (GASOLINE WITH SINGLE FUEL TANK)

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 Performance

DTC P0462

Fuel Level Sensor Circuit Low Voltage

DTC P0463

Fuel Level Sensor Circuit High Voltage

DTC P0464

Fuel Level Sensor Circuit Intermittent

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fuel Level Sensor 1 Signal	P0462	P0463	P0463	P0461
Low Reference	-	1	P0463, P0464	P0461
1. Fuel Gauge Malfunction				

Circuit/System Description

The fuel level sensor changes resistance based on fuel level. The engine control module (ECM) monitors the signal circuit of the fuel level sensor in order to determine the fuel level. When the fuel tank is full, the resistance of the fuel level sensor is low and the ECM senses a low signal voltage on the signal circuit of the fuel level sensor. When the fuel tank is empty, the resistance of the fuel level sensor is high and the ECM senses a high signal voltage. The ECM uses the signal circuit of the fuel level sensor in order to calculate the percentage of remaining fuel in the tank. The ECM sends the fuel level percentage via High Speed CAN-Bus to the body control module (BCM). The BCM then sends the fuel level percentage via Low Speed CAN-Bus to the instrument cluster in order to control the fuel gauge.

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Conditions for Running the DTC

- Ignition ON/Vehicle in Service Mode
- Battery voltage is between 11-32 V

Conditions for Setting the DTC

P0461

- 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

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

P0463

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

P0464

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

Action Taken When the DTC Sets

P0461, P0462, and P0463

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

P0464

- P0464 is a Type A DTC

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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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**

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/Vehicle in Service Mode.
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 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 Circuit/System Testing

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

With UHS or UDV

1. Ignition ON/Vehicle in Service Mode.
2. Verify the scan tool Fuel Level Sensor parameter is between 0.5-3.5 V and varies with fuel level.

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

  Refer to Circuit/System Testing

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

3. All OK.

Circuit/System Testing

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

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the A7 Fuel Pump and Level Sensor assembly. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K20 Engine Control Module.
   - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Verify the scan tool Fuel Level Sensor parameter is greater than 4.8 V.
   - **If 4.8 V or less**
   1. Ignition OFF/Vehicle 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 parameter is less than 0.2 V.
   - **If 0.2 V or greater**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Ignition OFF/Vehicle OFF
   4. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K20 Engine Control Module.
   - **If less than 0.2 V**
7. Test or replace the fuel level sensor

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Component Testing

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

      Replace the fuel level sensor.

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

Repair Instructions

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

- **Displays and Gauges Component Replacement Reference**
- **Control Module References** for engine control module or instrument cluster replacement, programming, and setup

FUEL GAUGE MALFUNCTION (GASOLINE WITH DUAL FUEL TANKS (N2N))

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 Performance

DTC P0462

Fuel Level Sensor Circuit Low Voltage

DTC P0463

Fuel Level Sensor Circuit High Voltage

DTC P0464

Fuel Level Sensor Circuit Intermittent

DTC P2066

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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 Signal	P0462	P0463	P0463	P0461
Fuel Level Sensor 2 Signal	P2067	P2068	P2068	P2066
Low Reference	-	1	P0463, P0464, P2068	P0461, P2066
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 the primary fuel level sensor and the secondary fuel level sensor in order to determine the fuel level. When the fuel tank is full, the resistances of both fuel level sensors are low and the ECM senses a low signal voltage on both the signal circuits of the primary fuel level sensor and the secondary fuel level sensor. When the fuel tank is empty, the resistances of the fuel level sensors are high and the ECM senses a high signal voltage. The ECM uses the signal circuits of the primary fuel level sensor and the secondary fuel level sensor in order to calculate the percentage of remaining fuel in the tank. The ECM sends the fuel level percentage via the serial data circuit to the instrument cluster in order to control the fuel gauge.

Conditions for Running the DTC

- Ignition ON
- 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.

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- The above conditions must be met for 5 seconds.

P0464

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

Action Taken When the DTC Sets

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

P0464

- P0464 is a Type A DTC

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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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

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Without 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 Rear 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**
5. Verify the scan tool Fuel Level Sensor 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**
6. All OK.

With UHS or UDV

1. Ignition ON.
2. Verify the scan tool Fuel Level Sensor Rear 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**
3. Verify the scan tool Fuel Level Sensor 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**
4. All OK.

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Circuit/System Testing

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

Primary Fuel Level Sensor Malfunction

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B46A Fuel Level Sensor- Primary. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Verify the scan tool Fuel Level Sensor parameter is greater than 4.8 V.
    - **If 4.8 V or less**
    1. Ignition OFF/Vehicle 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 parameter is less than 0.2 V.
    - **If 0.2 V or greater**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Ignition OFF/Vehicle OFF
    4. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If less than 0.2 V**
7. Test or replace the B46A Fuel Level Sensor- Primary.

Secondary Fuel Level Sensor Malfunction

1. Ignition OFF/Vehicle 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.

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2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If less than 10 Ω**
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 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, 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/Vehicle OFF, remove the fuel level sender.
2. Sweep the fuel level sensor through its full range of motion while measuring resistance between the signal terminal 4 and the low reference terminal 3.
3. Test for a minimum resistance value of 37-43 Ω and a maximum value of 245-255 Ω without any spikes or dropouts.
    - **If minimum resistance is not 37-43 Ω, maximum resistance is not 245-255 Ω, or if there are any spikes or dropouts**

      Replace the fuel level sensor.

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

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4. All OK.

Repair Instructions

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

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

FUEL GAUGE MALFUNCTION (DIESEL WITH DUAL FUEL TANKS (N2N))

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 Performance

DTC P0462

Fuel Level Sensor Circuit Low Voltage

DTC P0463

Fuel Level Sensor Circuit High Voltage

DTC P0464

Fuel Level Sensor 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 Signal	P0462	P0463	P0463	P0461
Fuel Level Sensor 2 Signal	P2067	P2068	P2068	P2066

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Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Low Reference	-	1	P0463, P0464, P2068	P0461, P2066
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 Fuel Pump Driver Control Module monitors the signal circuits of the primary fuel level sensor and the secondary fuel level sensor and sends the signal information to the Engine Control Module (ECM). The ECM uses this value to in order to determine the fuel level. When the fuel tank is full, the resistances of both fuel level sensors are low and the ECM senses a low signal voltage on both the signal circuits of the primary fuel level sensor and the secondary fuel level sensor. When the fuel tank is empty, the resistances of the fuel level sensors are high and the ECM senses a high signal voltage. The ECM uses the signal circuits of the primary fuel level sensor and the secondary fuel level sensor in order to calculate the percentage of remaining fuel in the tank. The ECM sends the fuel level percentage via the serial data circuit to the instrument cluster in order to control the fuel gauge.

Conditions for Running the DTC

- Ignition ON
- 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% for a duration lasting less than 30 seconds.
- DTC P0464 runs and fails 2 out of 3 test cycles.

Action Taken When the DTC Sets

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

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P0464

- P0464 is a Type A DTC

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Without 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.

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- **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 Rear 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**
5. Verify the scan tool Fuel Level Sensor 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**
6. All OK.

With UHS or UDV

1. Ignition ON.
2. Verify the scan tool Fuel Level Sensor Rear 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**
3. Verify the scan tool Fuel Level Sensor 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**
4. All OK.

Circuit/System Testing

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

Primary Fuel Level Sensor Malfunction

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B46A Fuel Level Sensor- Primary. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 6 and ground.
   - **If 10 Ω or greater**
     1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K111 Fuel Pump Driver Control

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Module.

2. Test for less than 2 Ω in the low reference circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the K111 Fuel Pump Driver Control Module.

- **If less than 10 Ω**

3. Ignition ON/Vehicle in Service Mode.
4. Verify the scan tool Fuel Level Sensor parameter is greater than 4.8 V.
    - **If 4.8 V or less**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K111 Fuel Pump Driver Control Module.
    2. Test for infinite resistance between the signal circuit terminal 5 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K111 Fuel Pump Driver Control Module.
    - **If greater than 4.8 V**
5. Install a 3 A fused jumper wire between the signal circuit terminal 5 and the low reference circuit terminal 6.
6. Verify the scan tool Fuel Level Sensor parameter is less than 0.2 V.
    - **If 0.2 V or greater**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K111 Fuel Pump Driver 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/Vehicle OFF
    4. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K111 Fuel Pump Driver Control Module.
    - **If less than 0.2 V**
7. Test or replace the B46A Fuel Level Sensor- Primary.
8. Engine running, verify the condition no longer exists.
    - **If condition is still present**

      Replace the K111 Fuel Pump Driver Control Module.

    - **If condition is not present**
9. All OK.

Secondary Fuel Level Sensor Malfunction

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B46B Fuel Level Sensor - Secondary. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 6 and ground.
    - **If 10 Ω or greater**

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1. Ignition OFF, disconnect the harness connector at the K111 Fuel Pump Driver Control Module.
2. Test for less than 2 Ω in the low reference circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the K111 Fuel Pump Driver Control Module.

- **If less than 10 Ω**

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 K111 Fuel Pump Driver Control Module.
2. Test for infinite resistance between the signal circuit terminal 5 and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance, replace the K111 Fuel Pump Driver Control Module.

- **If greater than 4.8 V**

5. Install a 3 A fused jumper wire between the signal circuit terminal 5 and the low reference circuit terminal 6.
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 K111 Fuel Pump Driver 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 Ω in the signal circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the K111 Fuel Pump Driver Control Module.

- **If less than 0.2 V**

7. Test or replace the B46B Fuel Level Sensor - Secondary.
8. Engine running, verify the condition no longer exists.

- **If condition is still present**

  Replace the K111 Fuel Pump Driver Control Module.

- **If condition is not present**

9. All OK.

Component Testing

1. Ignition OFF/Vehicle OFF, remove the fuel level sender.
2. Sweep the fuel level sensor through its full range of motion while measuring resistance between the signal terminal 5 and the low reference terminal 6.
3. Test for a minimum resistance value of 37-43 Ω and a maximum value of 245-255 Ω without any spikes or dropouts.

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- **If minimum resistance is not 37-43 Ω, maximum resistance is not 245-255 Ω, or if there are any spikes or dropouts**

  Replace the fuel level sensor.

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

4. All OK.

Repair Instructions

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

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

FUEL GAUGE MALFUNCTION (DIESEL WITH SINGLE FUEL TANK)

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 Performance

DTC P0462

Fuel Level Sensor Circuit Low Voltage

DTC P0463

Fuel Level Sensor Circuit High Voltage

DTC P0464

Fuel Level Sensor Circuit Intermittent

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Fuel Level Sensor 1 Signal	P0462	P0463	P0463	P0461
Low Reference	-	1	P0463, P0464	P0461
1. Fuel Gauge Malfunction				

Circuit/System Description

The fuel level sensor changes resistance based on fuel level. The Fuel Pump Driver Control Module monitors

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the signal circuit of the fuel level sensor and sends the signal information to the Engine Control Module (ECM). The ECM uses this value in order to determine the fuel level. When the fuel tank is full, the resistance of the fuel level sensor is low and the ECM senses a low signal voltage on the signal circuit of the fuel level sensor. When the fuel tank is empty, the resistance of the fuel level sensor is high and the ECM senses a high signal voltage. The ECM uses the signal circuit of the fuel level sensor in order to calculate the percentage of remaining fuel in the tank. The Fuel Pump Driver Control Module sends the fuel level percentage via High Speed CAN-Bus to the body control module (BCM). The BCM then sends the fuel level percentage via Low Speed CAN-Bus to the instrument cluster in order to control the fuel gauge.

Conditions for Running the DTC

- Ignition ON/Vehicle in Service Mode
- Battery voltage is between 11-32 V

Conditions for Setting the DTC

P0461

- 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

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

P0463

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

P0464

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

Action Taken When the DTC Sets

P0461, P0462, and P0463

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

P0464

- P0464 is a Type A DTC

Conditions for Clearing the DTC

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

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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**

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/Vehicle in Service Mode.
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 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 Circuit/System Testing

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

5. All OK.

With UHS or UDV

1. Ignition ON/Vehicle in Service Mode.
2. Verify the scan tool Fuel Level Sensor 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 Circuit/System Testing

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

Circuit/System Testing

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

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the A7 Fuel Pump and Level Sensor assembly. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 6 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K20 Engine Control Module.
   - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Verify the scan tool Fuel Level Sensor parameter is greater than 4.8 V.
   - **If 4.8 V or less**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
   2. Test for infinite resistance between the signal circuit terminal 5 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 5 and the low reference circuit terminal 6.
6. Verify the scan tool Fuel Level Sensor parameter is less than 0.2 V.
   - **If 0.2 V or greater**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V

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3. Ignition OFF/Vehicle OFF
4. Test for less than 2 Ω in the signal circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the K20 Engine Control Module.
- **If less than 0.2 V**

7. Test or replace the fuel level sensor

Component Testing

1. Ignition OFF/Vehicle OFF, remove the fuel level sender.
2. Sweep the fuel level sensor through its full range of motion while measuring resistance between the signal terminal 5 and the low reference terminal 6.
3. Test for a minimum resistance value of 37-43 Ω and a maximum value of 245-255 Ω without any spikes or dropouts.
    - **If minimum resistance is not 37-43 Ω, maximum resistance is not 245-255 Ω, or if there are any spikes or dropouts**

      Replace the fuel level sensor.

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

Repair Instructions

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

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

ENGINE OIL LEVEL SENSOR DIAGNOSIS (WITH DIESEL ENGINE)

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
Engine Oil Level Sensor Signal	2	1	-
Engine Oil Level Sensor Ground	-	1	-
1. DIC message Engine Oil Level Low always ON 2. DIC message Engine Oil Level Low always OFF			

Typical Scan Tool Data

Engine Oil Level Switch

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

Circuit/System Description

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

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

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

Reference Information

Schematic Reference

- **Engine Mechanical Schematics**
- **Instrument Cluster Schematics**

Connector End View Reference

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Description and Operation

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

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

Scan Tool Reference

Control Module References for scan tool information.

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Circuit/System Verification

1. Verify proper engine oil level.
    - **If not at proper level**

      Add oil as necessary.

    - **If at proper level**
2. Ignition ON, verify the scan tool Engine Oil Level parameter reads OK.
    - **If not OK**

      Refer to Circuit/System Testing.

    - **If OK**
3. All OK.

Circuit/System Testing

NOTE: **Verify proper engine oil level before continuing with diagnosis.**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B35 Engine Oil Level Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal B and ground.
    - **If 5 Ω or greater**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 5 Ω**
3. Ignition ON.
4. Verify the scan tool Engine Oil Level Switch parameter reads Low.
    - **If the Engine Oil Level Switch parameter reads OK**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the signal circuit terminal A 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 the Engine Oil Level Switch parameter reads Low**

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

5. Install a 3A fused jumper wire between the signal circuit terminal A and the ground circuit terminal B.
6. Verify the scan tool Engine Oil Level Switch parameter reads OK.
    - **If the Engine Oil Level Switch parameter reads Low**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.

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

3. Test for less than 2 Ω in the signal circuit end to end.
   - If 2 Ω or greater, repair the open/high resistance on the circuit.
   - If less than 2 Ω, replace the K20 Engine Control Module.

- **If the Engine Oil Level Switch parameter reads OK**

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

Repair Instructions

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

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

ENGINE OIL LEVEL SENSOR DIAGNOSIS (1500 SERIES WITH GASOLINE ENGINE)

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 P250A

Engine Oil Level Switch Circuit

Diagnostic Fault Information

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

Typical Scan Tool Data

Engine Oil Level Switch

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

Circuit/System Description

The engine oil level sensor/switch is normally-closed with proper engine oil level. The switch opens when the

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

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

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

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

Engine Oil Level Low message activated.

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

- **Engine Mechanical Schematics**
- **Instrument Cluster Schematics**

Connector End View Reference

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

Electrical Information Reference

- **Circuit Testing**

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

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Verify proper engine oil level.
    - **If not at proper level**

      Add oil as necessary.

    - **If at proper level**
2. Ignition ON, verify the scan tool Engine Oil Level parameter reads OK.
    - **If not OK**

      Refer to Circuit/System Testing.

    - **If OK**
3. All OK.

Circuit/System Testing

NOTE: **Verify proper engine oil level before continuing with diagnosis.**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B35 Engine Oil Level Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 1 and ground.
    - **If 5 Ω or greater**
    1. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 5 Ω**
3. Ignition ON.
4. Verify the scan tool Engine Oil Level Switch parameter reads Low.
    - **If the Engine Oil Level Switch parameter reads OK**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the signal circuit terminal 2 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K20 Engine Control Module.
    - **If the Engine Oil Level Switch parameter reads Low**

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

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5. Install a 3A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 1.
6. Verify the scan tool Engine Oil Level Switch parameter reads OK.
    - **If the Engine Oil Level Switch parameter reads Low**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance on the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If the Engine Oil Level Switch parameter reads OK**
7. Test or replace the B35 Engine Oil Level Switch.

Repair Instructions

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

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

OUTSIDE AIR TEMPERATURE DISPLAY MALFUNCTION (2500/3500 SERIES WITH GASOLINE ENGINE)

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	1 or B0158 05	B0158 05	1
Low Reference	-	B0158 05	-	-
1. Outside Air Temperature Display Malfunction				

Circuit/System Description

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The B9 Ambient Air Temperature Sensor is located behind the grille. 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 88Â°C (190Â°F) .

B0158 05

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

Action Taken When the DTC Sets

The instrument cluster uses a default air temperature value for further calculations. The instrument cluster will display -Â°C (-Â°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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Instrument Cluster Description and Operation

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

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Circuit/System Verification

NOTE: **For vehicles with RPO AVF, ensure that the Body Control Module and Instrument Cluster have been programmed with the latest calibrations before proceeding with Circuit/System Verification and Circuit/System Testing.**

1. Ignition ON.

   NOTE: **The scan tool Instrument Cluster Ambient Air Temperature parameter is a buffered value when the measured temperature is increasing. Performing the Ambient Air Temperature Instant Update with the scan tool may be necessary to force the Ambient Air Temperature parameter to update to the current measured temperature.**

2. Verify the scan tool Instrument Cluster Ambient Air Temperature parameter is between -40Â°C (-40Â°F) and +88Â°C (+190Â°F) and changes with air temperature changes.
   - **If not between -40Â°C (-40Â°F) and +88Â°C (+190Â°F) or changes with air temperature changes**

     Refer to Circuit/System Testing.

   - **If between -40Â°C (-40Â°F) and +88Â°C (+190Â°F) and changes with air temperature changes**
3. All OK.

Circuit/System Testing

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

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B9 Ambient Air Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal B (or 2) and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF, disconnect the harness connector at the P16 Instrument Cluster.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the P16 Instrument Cluster.
   - **If less than 10 Ω**
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%**

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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 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, 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.

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

OUTSIDE AIR TEMPERATURE DISPLAY MALFUNCTION (1500 SERIES)

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 P0071

Ambient Air Temperature Sensor Performance

DTC P0072

Ambient Air Temperature Sensor Circuit Low Voltage

DTC P0073

Ambient Air Temperature Sensor Circuit High Voltage

DTC P0074

Ambient Air Temperature Sensor Circuit Intermittent

Diagnostic Fault Information

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

Circuit/System Description

The B9 Ambient Air Temperature Sensor is located behind the grille. The engine control module monitors the ambient air temperature sensor with a low reference circuit and signal circuit. The engine control module 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 engine control module converts the voltage value to a temperature value and sends the value to the P17 Info Display Module via serial data. The P17 Info Display Module displays the temperature.

Conditions for Running the DTC

- The ignition is ON
- The 12 V battery voltage is greater than or equal to 10.2 V.

Conditions for Setting the DTC

P0071

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

P0072

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

P0073

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

P0074

The ECM detects an unrealistic signal variance.

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

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Instrument Cluster Schematics

Connector End View Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool ECM Ambient Air Temperature parameter is between -40Â°C (-40Â°F) and +88Â°C (+190Â°F) and changes with air temperature changes.
   - **If not between -40Â°C (-40Â°F) and +88Â°C (+190Â°F) or changes with air temperature changes**

     Refer to Circuit/System Testing.

   - **If between -40Â°C (-40Â°F) and +88Â°C (+190Â°F) and changes with air temperature changes**
3. 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 Ω between the low reference circuit terminal B (or 2) and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K20 Engine Control Module.
   - **If less than 10 Ω**
3. Ignition ON.
4. Verify the ECM scan tool Ambient Air Temperature parameter reads colder than -30Â°F (-34Â°C).
   - **If -30Â°F (-34Â°C) or warmer**

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1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
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 K20 Engine Control Module.

- **If colder than -30Â°F (-34Â°C)**

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 reads warmer than 180Â°F (82Â°C)

- **If 180Â°F (82Â°C) or colder**

1. Ignition OFF, disconnect the X1 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 Ω in the signal circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the K20 Engine Control Module.

- **If warmer than 180Â°F (82Â°C)**

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

Repair Instructions

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

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

OUTSIDE AIR TEMPERATURE DISPLAY MALFUNCTION (2500/3500 SERIES WITH L5P DIESEL ENGINE)

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 P0071

Ambient Air Temperature Sensor Performance

DTC P0072

Ambient Air Temperature Sensor Circuit Low Voltage

DTC P0073

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Ambient Air Temperature Sensor Circuit High Voltage

DTC P0074

Ambient Air Temperature Sensor Circuit Intermittent

Diagnostic Fault Information

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

Circuit/System Description

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

Conditions for Running the DTC

- The ignition is ON
- The 12 V battery voltage is greater than or equal to 10.2 V.

Conditions for Setting the DTC

P0071

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

P0072

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

P0073

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

P0074

The ECM detects an unrealistic signal variance.

Action Taken When the DTC Sets

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

Conditions for Clearing the DTC

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

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool ECM Ambient Air Temperature parameter is between -40Â°C (-40Â°F) and +88Â°C (+190Â°F) and changes with air temperature changes.
   - **If not between -40Â°C (-40Â°F) and +88Â°C (+190Â°F) or changes with air temperature changes**

     Refer to Circuit/System Testing.

   - **If between -40Â°C (-40Â°F) and +88Â°C (+190Â°F) and changes with air temperature changes**
3. All OK.

Circuit/System Testing

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

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B9D Ambient Air Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.

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2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If less than 10 Ω**
3. Ignition ON.
4. Verify the scan tool Ambient Air Temperature parameter is less than-39Â°C (-38Â°F).
    - **If -39Â°C (-38Â°F) or greater**
    1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the signal circuit terminal 1 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 less than -39Â°C (-38Â°F)**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2.
6. Verify the scan tool Ambient Air Temperature parameter is greater than 88Â°C (190Â°F).
    - **If 88Â°C (190Â°F) or less**
    1. Ignition OFF, remove the jumper wire and disconnect the X3 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 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If less than 88Â°C (190Â°F)**
7. Test or replace the B9D Mirror Ambient Air Temperature Sensor.

Repair Instructions

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

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

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.

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- **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.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify no DTC is set.
    - **If any DTC is set**

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

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- **If no DTCs are set**

3. If applicable, verify the speedometer sweeps from low to high position when performing the Instrument Cluster Gauge Sweep with the scan tool.
   - **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:

- **Circuit/System Verification must be performed before proceeding with Circuit/System Testing.**
- **If there are multiple modules not original to the vehicle and they are used or incorrectly configured service parts, SPS may not be able to proper read or recover the vehicle odometer value. Follow government rules and documentation (including vehicle identification) regarding inaccurate/unknown odometer values.**

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

1. Ignition ON/Vehicle in Service Mode.
2. Verify the scan tool Odometer Status parameter is Unlocked.
   - **If the reading is Locked**

     Refer to correcting VIN mismatch - odometer locked.

   - **If the reading is Unlocked**
3. Verify the scan tool BCM VIN parameter matches the vehicle's VIN placard.
   - **If the VIN does not match**

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Reprogram the BCM, then proceed to Step 3.

- **If the VIN matches**

4. Verify the scan tool Instrument Cluster Vehicle Identification Number (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**
5. Verify the instrument cluster is displaying the correct value.
   - **If the instrument cluster is still displaying "----" (dashes)**

     Replace the P16 Instrument Cluster.

   - **If the instrument cluster is displaying the correct value**
6. All OK.

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

1. Ignition ON/Vehicle in Service Mode.
2. Verify the scan tool Odometer Status parameter is Locked.
   - **If the reading is Unlocked**

     Refer to Correcting VIN mismatch - odometer unlocked.

   - **If the reading is Locked**
3. Verify the scan tool Instrument Cluster Vehicle Identification Number (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**
4. Perform the BCM setup procedure in SPS.
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.

REPAIR INSTRUCTIONS

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AMBIENT AIR TEMPERATURE SENSOR REPLACEMENT (GMC 1500)

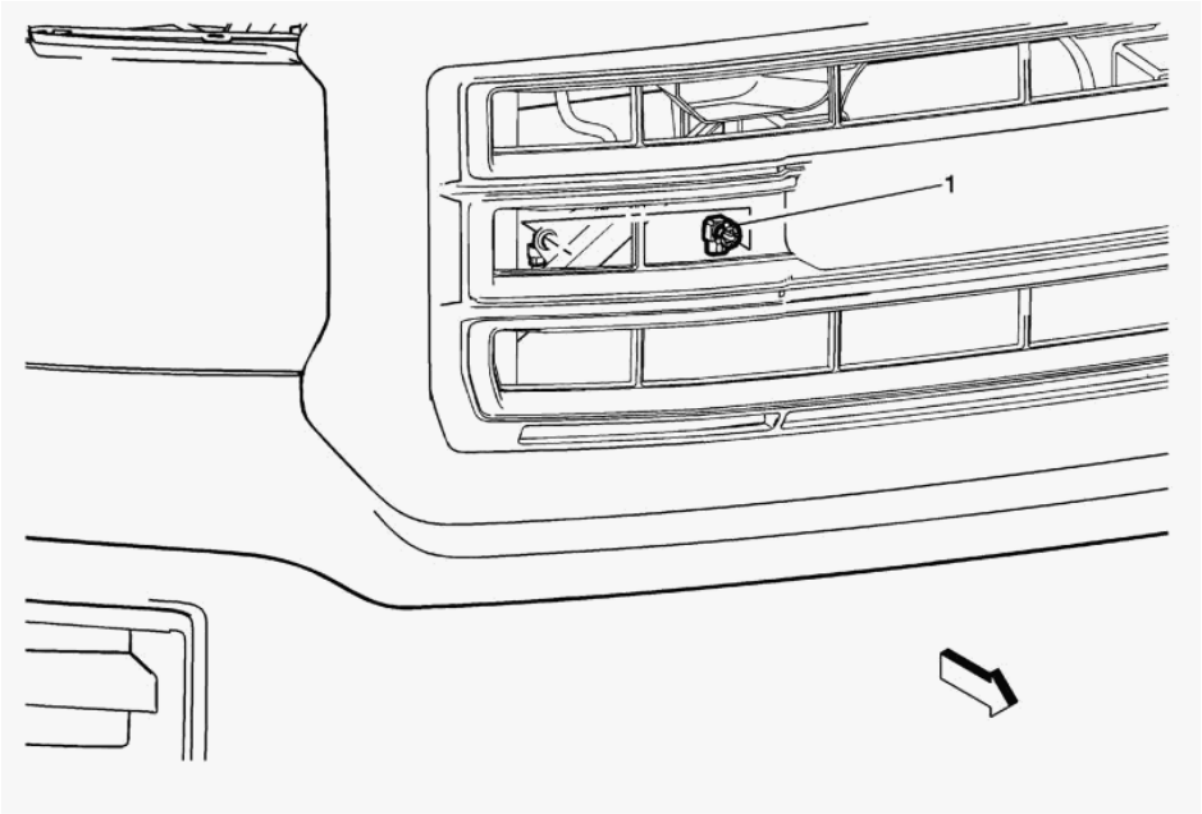


Fig. 8: Ambient Air Temperature Sensor (GMC 1500)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Ambient Air Temperature Sensor **Procedures** 1. Squeeze the tabs on the ambient temperature sensor, and push ambient temperature sensor back out of the ambient air temperature sensor bracket. 2. Maneuver ambient temperature sensor forward out away from the grille and disconnect the electrical connector.

AMBIENT AIR TEMPERATURE SENSOR REPLACEMENT (CHEV 1500)

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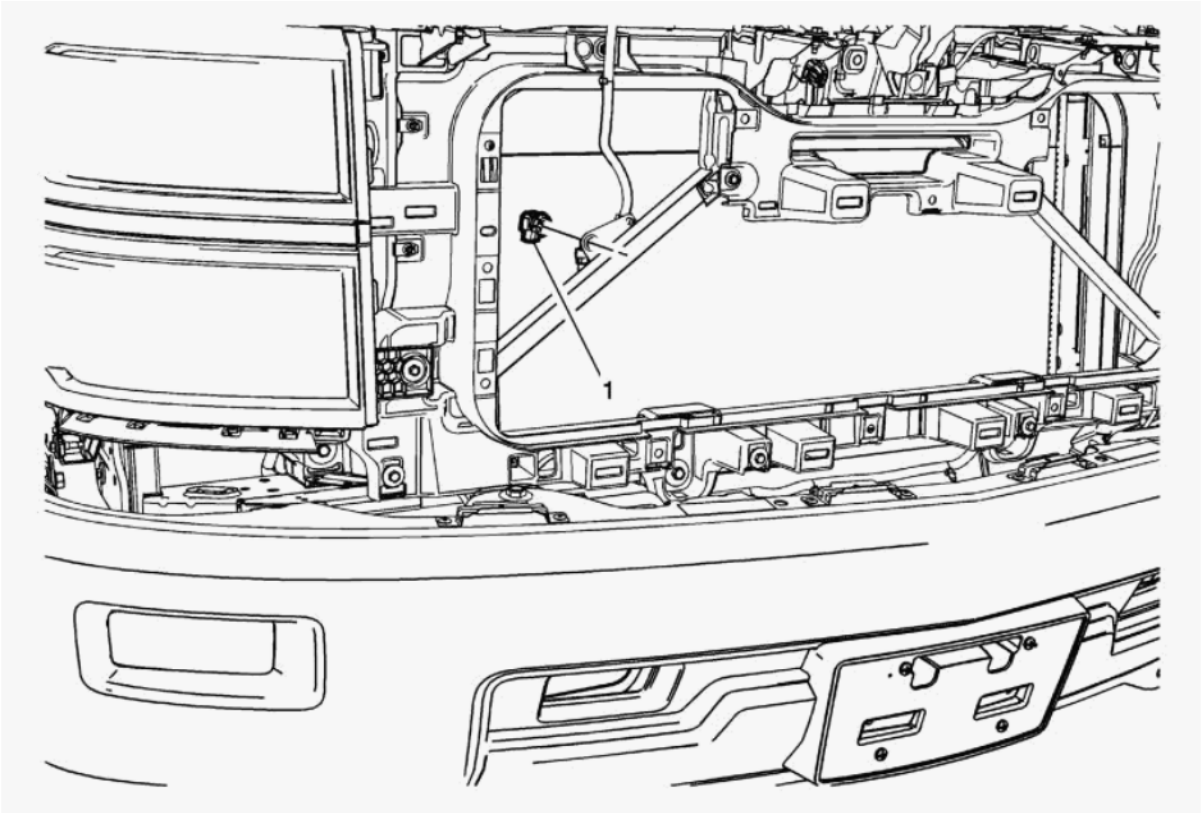


Fig. 9: Ambient Air Temperature Sensor (Chev 1500)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the front grille assembly. Refer to **Front Grille Replacement (Chevrolet)** .	
1	Ambient Air Temperature Sensor **Procedures** 1. Squeeze the tabs on the ambient temperature sensor, and push ambient temperature sensor back out of the ambient air temperature sensor bracket. 2. Disconnect ambient air temperature sensor electrical connector.

AMBIENT AIR TEMPERATURE SENSOR REPLACEMENT (CHEV 2500 3500)

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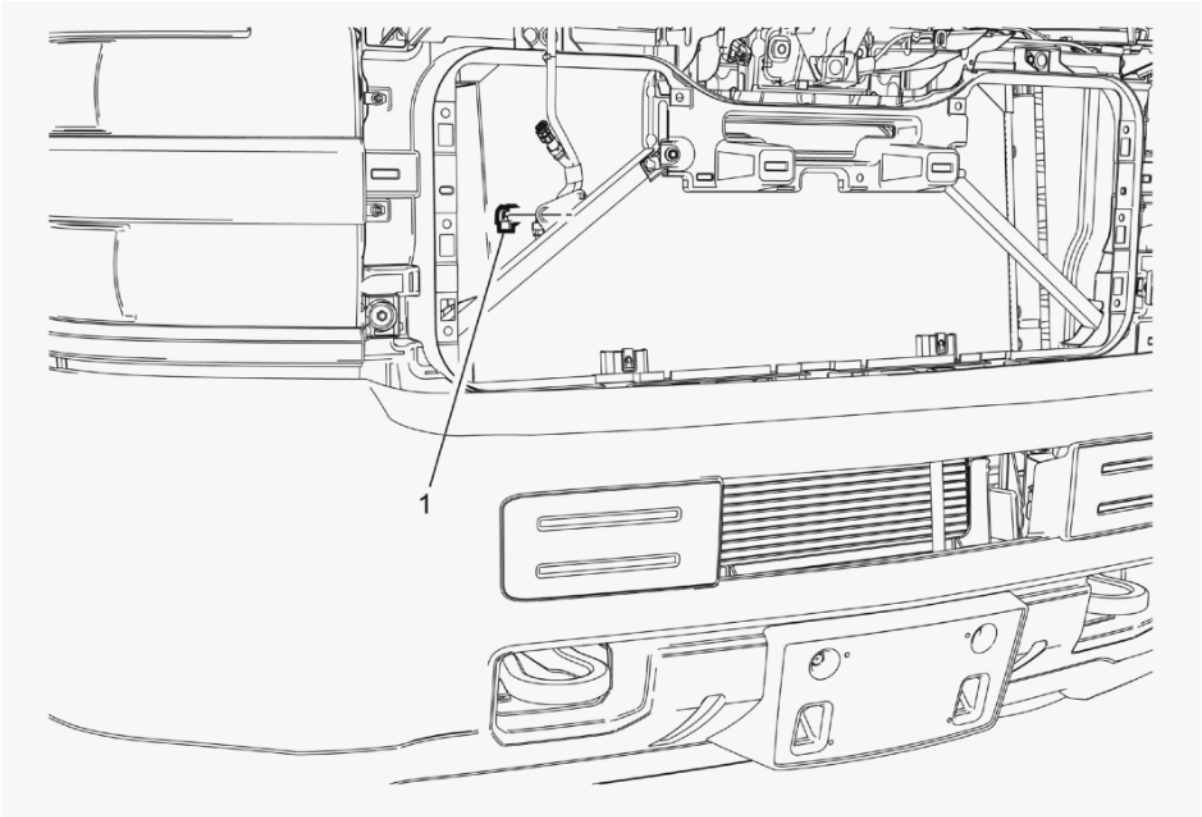


Fig. 10: Ambient Air Temperature Sensor (Chev 2500 3500)
Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
Preliminary Procedure Remove the front grille assembly. Refer to **Front Grille Replacement (Chevrolet 2500 3500)** .	
1	Ambient Air Temperature Sensor **Procedures** 1. Squeeze the tabs on the ambient air temperature sensor, and push ambient air temperature sensor back out of the ambient air temperature sensor bracket. 2. Disconnect ambient air temperature sensor electrical connector.

AMBIENT AIR TEMPERATURE SENSOR REPLACEMENT (GMC 2500 3500)

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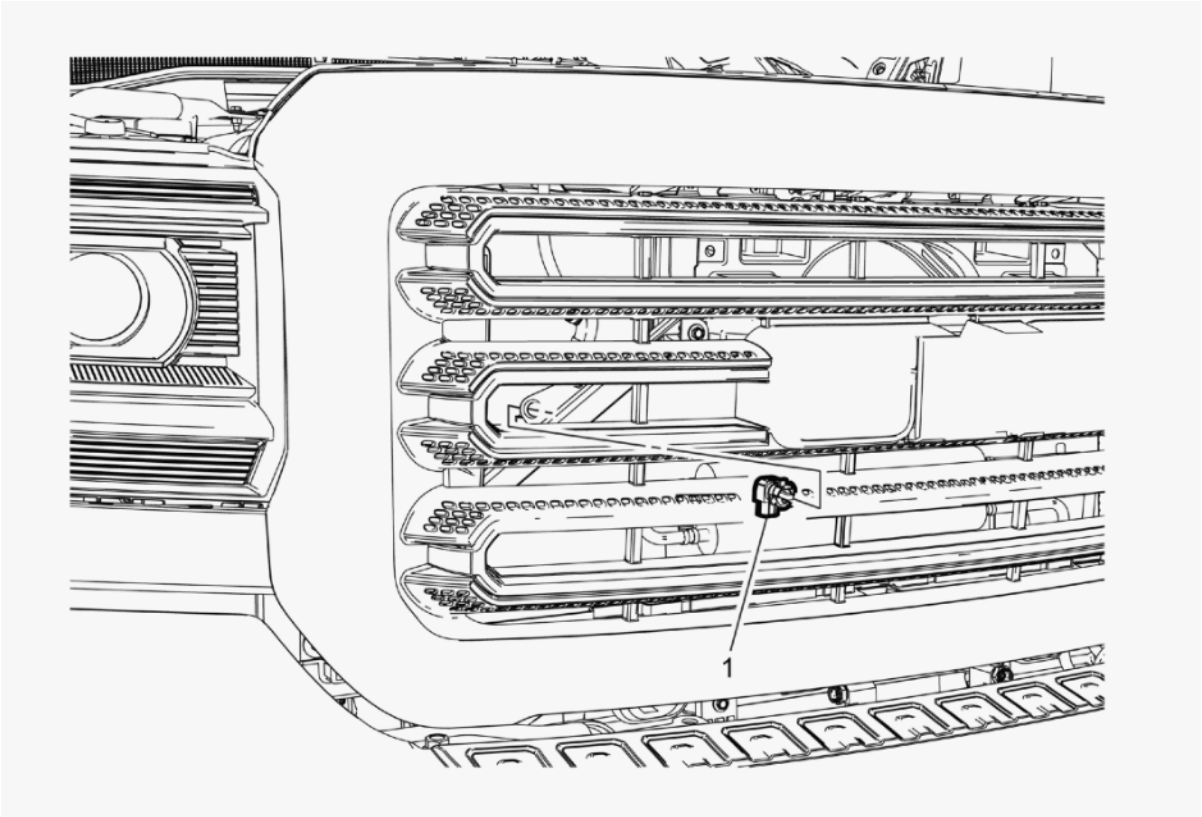


Fig. 11: Ambient Air Temperature Sensor (GMC 2500 3500)
Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
1	Ambient Air Temperature Sensor **Procedures** 1. Squeeze the tabs on the ambient temperature sensor, and push ambient temperature sensor back out of the ambient air temperature sensor bracket. 2. Maneuver ambient temperature sensor forward out away from the grille and disconnect the electrical connector.

AMBIENT AIR TEMPERATURE SENSOR REPLACEMENT (LP5 AVF)

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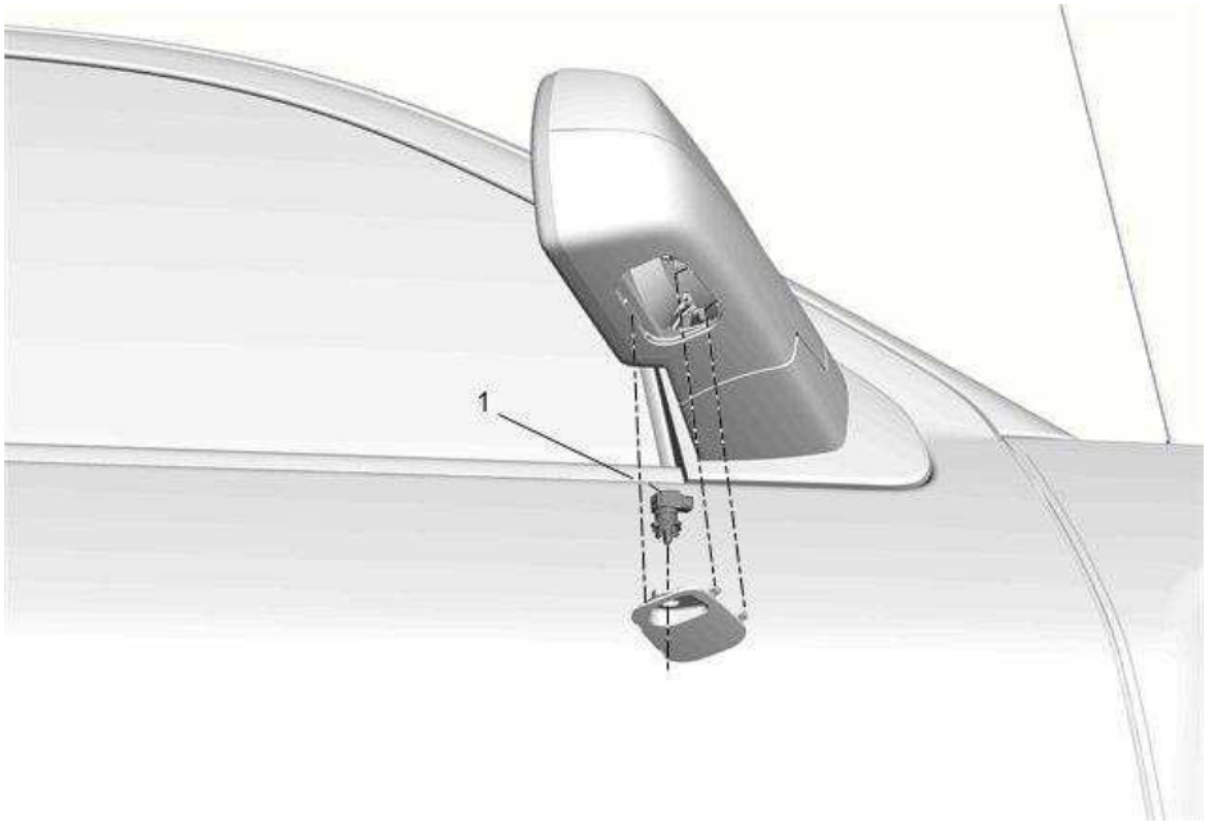


Fig. 12: Ambient Air Temperature Sensor (LP5 AVF)
Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
1	Ambient Air Temperature Sensor **Procedure** 1. Remove the outside rear view mirror housing cover 2. Disconnect the electrical connector. 3. Depress the ambient air temperature sensor tabs to remove from the outside rear view mirror housing cover.

AMBIENT AIR TEMPERATURE SENSOR REPLACEMENT (TL1 GAT WITH ACTIVE SHUTTER GMC)

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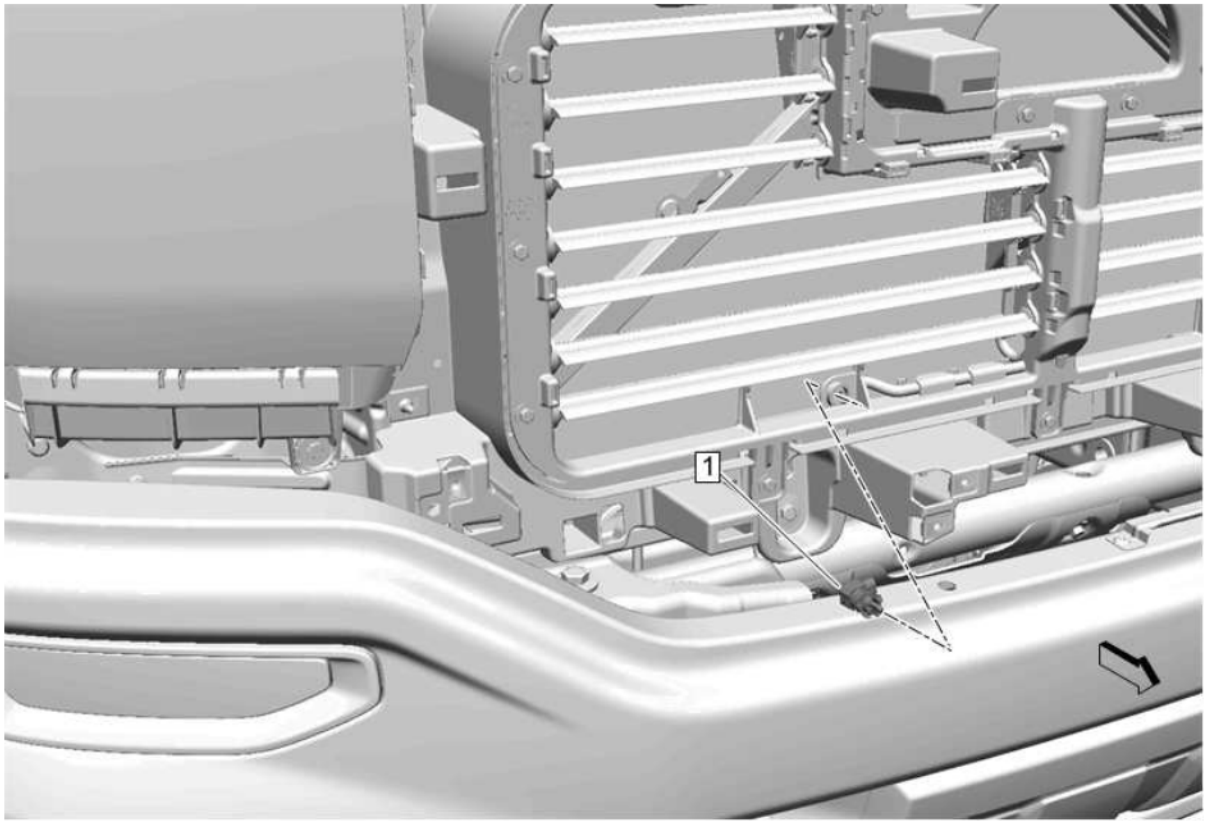


Fig. 13: Ambient Air Temperature Sensor (TL1 GAT With Active Shutter GMC)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Grille Replacement (GMC) Front Grille Replacement (GMC 2500 3500) .	
1	Ambient Air Temperature Sensor **Procedures** 1. Squeeze the tabs on the ambient temperature sensor, and push ambient temperature sensor back out of the active shutter. 2. Disconnect the electrical connector.

INSTRUMENT CLUSTER REPLACEMENT

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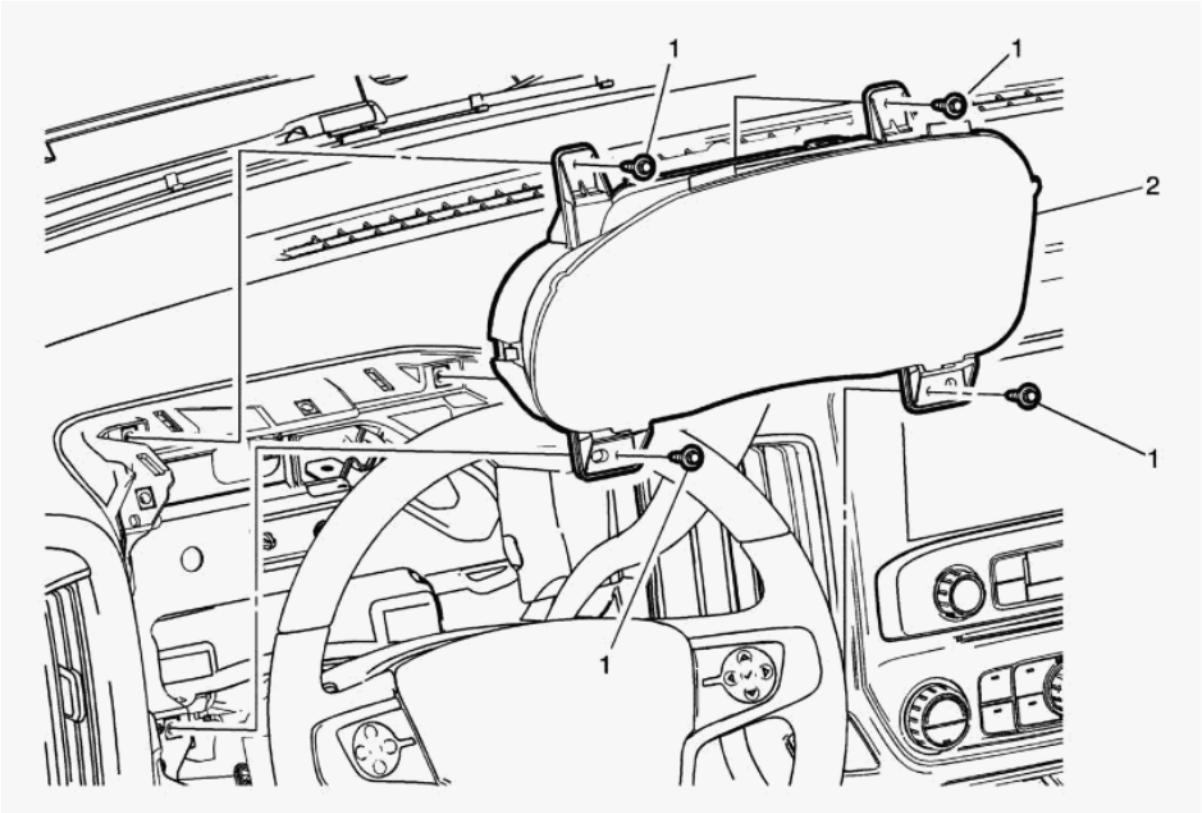


Fig. 14: Instrument Cluster
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the instrument panel cluster trim plate. Refer to **Instrument Panel Cluster Trim Plate Replacement** .	
1	Instrument Cluster Bolt (Qty: 4) **CAUTION:** **Refer to** **Fastener Caution** . **Tighten** 2.5 N.m (22 lb in)
2	Instrument Cluster Assembly **Procedure** 1. Disconnect the electrical connector. 2. Refer to **Control Module References** for programming and set up information.

DESCRIPTION AND OPERATION

AUDIBLE WARNINGS DESCRIPTION AND OPERATION

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The audible warnings alert the driver of a system concern or a critical vehicle condition. If equipped with an serial data communicating audio amplifier, the audio amplifier generates the audible warnings through the speakers. If not equipped with an audio amplifier, the radio generates the audible warnings through the speakers. The radio or audio amplifier receives audible warning requests via serial data. If the radio or audio amplifier receives multiple audible warning requests, the warning with the highest priority sounds first. Different audible warnings may sound with a different frequency or a different chime pattern, depending on the system or module making the request. The chime volume may be selectable through vehicle personalization.

Audible Warnings or Chimes

The following is a list of common audible warnings or chimes. For additional chimes or complete system description, refer to the appropriate system's Description and Operation or the vehicle owner's manual.

- Driver Seat Belt Reminder - If the vehicle is started and the seat belt is unbuckled, the BCM requests the radio or audio amplifier sound a chime to indicated that the belt is unbuckled. This is accompanied by a flashing driver seat belt indicator on the instrument cluster. If the belt remains unbuckled, the chime cycle may continue multiple times if the vehicle is driven and the indicator will remain on solid.
- Passenger Seat Belt Reminder - If the passenger presence system determines that their is an occupant in the passenger seat and the vehicle is started with the passenger seat belt unbuckled, the BCM requests the radio or audio amplifier sound a chime to indicated that the belt is unbuckled. This is accompanied by a flashing passenger seat belt indicator. If the belt remains unbuckled, the chime cycle may continue multiple times if the vehicle is driven and the indicator will remain on solid. If an object is placed on the passenger seat, the passenger presence system may interpret this as a passenger occupying the seat. Because the passenger seat belt is unbuckled, the passenger seat belt reminder chime will sound. To correct this, remove the object from the passenger seat.
- Exterior Lamps On Warning - If the exterior lamps are left on after the ignition is turned off and the driver door is opened, the BCM will request the radio or audio amplifier sound a chime as an indicator that the exterior lamps are on.
- Electric Parking Brake (if equipped) - If the electric parking brake switch is pressed while the vehicle is in motion, the parking brake control module will request the radio or audio amplifier sound a chime. To release the parking brake, the brake pedal must be pressed when the electric parking brake switch is pressed. If the brake pedal is not pressed, the parking brake control module will request the radio or audio amplifier sound a chime. A message will also appear on the driver information center.
- Delayed Locking - If the keyless entry transmitter is not in the vehicle and the door lock switch is pressed with the driver door open, the BCM will request the radio or audio amplifier sound a chime three times to indicate that the vehicle has entered a delayed locking state. The doors will automatically lock five seconds after the last door is closed.
- Object Detection - The object detection system sends various chime requests to the radio or audio amplifier during normal operation.

Additional Warnings

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

- Turn Signal Indicators - The radio or audio amplifier activates the audible warning as requested by the BCM.
- Vehicle Overspeed Message - The radio or audio amplifier activates the audible warning as requested by the BCM.
- Fuel Level Low Message - The radio or audio amplifier activates the audible warning as requested by the BCM.

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- Oil Pressure Indicator - The radio or audio amplifier activates the audible warning as requested by the BCM.
- Tire Pressure Low Indicator - The radio or audio amplifier activates the audible warning as requested by the BCM.
- Antilock Brake Indicator - The radio or audio amplifier activates the audible warning as requested by the electronic brake control module.
- Engine Cooling System Messages - The radio or audio amplifier activates the audible warning as requested by the engine control module.
- Transmission Messages - The radio or audio amplifier activates the audible warning as requested by the transmission control module.

Backup Alarm (with 8S3)

When transmission placed in reverse, the Body Control Module (BCM) activates the KR61 Trailer Backup Lamps Relay which supplies 12V to the reverse lamps and the Backup Alarm simultaneously.

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

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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 (with RPO UDC)

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, oil pressure, battery voltage, fuel level, 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 one color multifunction display that is located in the instrument cluster. The driver information center has several screens that can be scrolled through by twisting the trip reset stem.

Instrument Cluster (with RPO UDD)

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, oil pressure, battery voltage, fuel level, 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.

Instrument Cluster (with RPO UHS)

The instrument cluster is a multifunction module that provides the vehicle operator with information such as vehicle speed and engine RPM using analog gauges. Oil pressure, battery voltage, fuel level, and coolant temperature can also be displayed using an interactive LCD display. The instrument cluster is highly reconfigurable, with four different themes available for selection. The instrument cluster also provides the operator with operational warnings and message through various indicators and the driver information center. Because the instrument cluster is an LCD display, driver information center elements are located in various zones of the display, depending on how the instrument panel is configured.

Instrument Cluster (with RPO UDV)

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 an interactive LCD display. The instrument cluster is highly reconfigurable, with four different themes available for selection. The instrument cluster also provides the operator with operational warnings and message through various indicators and the driver information center. Because the instrument cluster is an LCD display, driver information center elements are located in various zones of the display, depending on how the instrument panel is configured.

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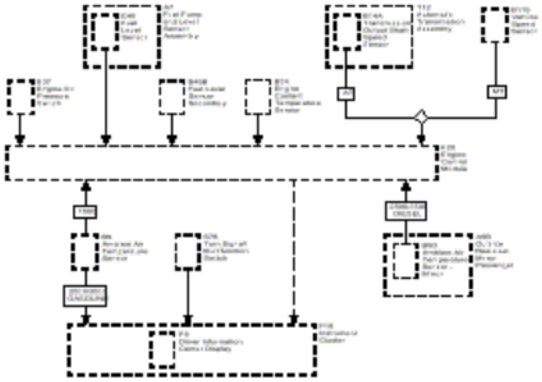


Fig. 15: Instrument Cluster Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
AT	Automatic Transmission
MT	Manual Transmission
GASOLINE	Gasoline
DIESEL	Diesel
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
B9D	B9D Ambient Air Temperature Sensor - Mirror
A9B	A9B Outside Rearview Mirror - Passenger

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 Gauge (Gasoline and Diesel)

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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 serial data to the BCM. The BCM then sends the information via serial data to the instrument cluster to display the engine speed.

Compass

The vehicle compass information is gather through the compass module or vehicle communication interface module (VCIM). The compass module or VCIM 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.

Outside Air Temperature (1500 series)

The Ambient Air Temperature Sensor is located behind the grille and varies it's resistance with temperature. The Engine Control Module (ECM) reads the resistance value to determine temperature. The time of and rate of the temperature update is based on an algorithm in the ECM software. Factors such as, last reading, current reading, length of time vehicle is been off/on, power mode, vehicle speed, driven distance, and sensor location are all considered by the ECM to know when to update the displayed temperature. For example, if the sensor is located near the engine compartment, and the vehicle has been turned off for only 10 minutes then restarted, the ECM will wait until the vehicle is driven to get more accurate air flow across the sensor before it updates the

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display.

Outside Air Temperature (2500/3500 series with Gasoline Engine)

The Ambient Air Temperature Sensor is located behind the grille and varies it's resistance with temperature. The Instrument Cluster reads the resistance value to determine temperature. The time of and rate of the temperature update is based on an algorithm in the Instrument Cluster software. Factors such as, last reading, current reading, length of time vehicle is been off/on, power mode, vehicle speed, driven distance, and sensor location are all considered by the Instrument Cluster to know when to update the displayed temperature on the Info Display Module. For example, if the sensor is located near the engine compartment, and the vehicle has been turned off for only 10 minutes then restarted, the Instrument Cluster will wait until the vehicle is driven to get more accurate air flow across the sensor before it updates the display.

Outside Air Temperature (2500/3500 series with Diesel Engine)

The Ambient Air Temperature Sensor is located in the Passenger Outside Rearview Mirror and varies it's resistance with temperature. The Engine Control Module (ECM) reads the resistance value to determine temperature. The time of and rate of the temperature update is based on an algorithm in the Engine Control Module (ECM) software. Factors such as, last reading, current reading, length of time vehicle is been off/on, power mode, vehicle speed, driven distance, and sensor location are all considered by the Engine Control Module (ECM) to know when to update the displayed temperature on the Info Display Module.

2500/3500 series trucks with diesel engines are also equipped with an Ambient Air Temperature Sensor located behind the grille. This sensor is not used for any purpose and does not affect engine control operations or outside air temperature display functions in any way.

Driver Information Center Display (with RPO UDD)

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 zones. The left zone is a list of the applications that can be displayed. The right zone contains choices to customize what information is displayed for the respective application chosen. In the middle is the interactive application display zone. The application display zone allows access to the navigation application, audio application, phone application, or settings applications. The information display zone contains multiple pages that display vehicle information. The compass and PRNDL are displayed at all times in the lower portion of the display zone.

The driver information center can also be configured with several different themes. Changing the theme is accomplished using the infotainment system faceplate settings page. The chosen theme is used for both the faceplate and the driver information center displays.

Instrument Cluster Configuration (with RPO UHS, UDV)

The instrument cluster is highly interactive and reconfigurable. The operator can select from four different display configures and each of these configuration may contain one, two, or three separate display zones. Regardless of which configuration is selected, the vehicle odometer and PRNDL are always displayed in the lower left and lower right corners of the display.

The different display configurations are:

- Simple - The most basic of the available configurations, the Simple configuration includes four static

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information display zones and one interactive information display zone. The infotainment display zone is located on the left side of the display and displays phone, turn-by-turn navigation, and audio information. The speedometer and compass are located in the upper middle of the display. On the right side of the display is a graphical representation of the fuel level and fuel range.

Below the speedometer, in the lower middle of the display, is the interactive information display zone. The information display zone contains multiple pages that can be scrolled through and selected using the steering wheel mounted driver information center switch.

- Performance - The Performance configuration contains three static information zones, one interactive information display zone, and one interactive application display zone. The speedometer and tachometer/fuel level gauge are located on the left and right of the display. In between the speedometer and tachometer is a static information display zone that displays current information while the operator scrolls through other pages in the interactive application display zone.

  In the middle of the speedometer is an interactive information display zone. This display zone has a limited number of selection and will only display a digital speedometer, a navigation map, a settings page with sub-menus, or a blank page.

  Below the tachometer and extending into the lower middle of the display is an interactive application display zone. The application display zone allows access to the navigation application, audio application, phone application, settings application, or information application. Unlike the information display zone that is located within the speedometer, the information application is fully featured and allows access to all available information pages.

- Balanced - The Balanced configuration contains three static information zones, two interactive information display zones, and one interactive application display zone. The tachometer is located on the left side of the display, the speedometer in the middle, and the coolant temperature/fuel level gauge on the right.

  Located in the tachometer is an interactive information display zone.

  In the speedometer is an interactive information display zone. This display zone has a limited number of selection and will only display a digital speedometer, a navigation map, a settings page with sub-menus, or a blank page.

  An interactive application display zone is located in the coolant temperature/fuel level gauge. The application display zone allows access to the navigation application, audio application, phone application, or settings application.

- Enhanced - The Enhanced configuration contains four static information zones, two interactive information display zones, and one interactive application display zone. The speedometer in the upper middle of the display, a navigation map or compass in located on the upper left, and a fuel level gauge and fuel range display on the right.

  Located on the left and right lower portion of the display are interactive information display zones.

  An interactive application display zone is located in the middle of the display. The application display zone allows access to the navigation application, audio application, phone application, or settings application.

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