

2021 ENGINE PERFORMANCE

Engine Controls And Fuel - 3.6L (LGZ) - Diagnostic Information And Procedures (1 Of 2) - Canyon, Colorado

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P0010, P0011, P0013, P0014, P0020, P0021, P0023, P0024, OR P2088-P2095

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 P0010

Intake Camshaft Position Actuator Solenoid Valve Control Circuit Bank 1

DTC P0011

Intake Camshaft Position System Performance Bank 1

DTC P0013

Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit Bank 1

DTC P0014

Exhaust Camshaft Position System Performance Bank 1

DTC P0020

Intake Camshaft Position Actuator Solenoid Valve Control Circuit Bank 2

DTC P0021

Intake Camshaft Position System Performance Bank 2

DTC P0023

Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit Bank 2

DTC P0024

Exhaust Camshaft Position System Performance Bank 2

DTC P2088

Intake Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Bank 1

DTC P2089

Intake Camshaft Position Actuator Solenoid Valve Control Circuit High Voltage Bank 1

DTC P2090

Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Bank 1

DTC P2091

Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit High Voltage Bank 1

DTC P2092

Intake Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Bank 2

DTC P2093

Intake Camshaft Position Actuator Solenoid Valve Control Circuit High Voltage Bank 2

DTC P2094

Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Bank 2

DTC P2095

Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit High Voltage Bank 2

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - Terminal 1/A @ Q6A Camshaft Position Actuator Solenoid Valve - Bank 1 Exhaust	P2090	P0013	P2091	P0014
Low Reference - Terminal 2/B @ Q6A Camshaft Position Actuator Solenoid Valve - Bank 1 Exhaust	-	P0013	-	P0014
Control - Terminal 1/A @ Q6B Camshaft Position Actuator Solenoid Valve - Bank 1 Intake	P2088	P0010	P2089	P0011
Low Reference - Terminal 2/B @ Q6B Camshaft Position Actuator Solenoid Valve - Bank 1 Intake	-	P0010	-	P0011
Control - Terminal 1/A @ Q6C Camshaft Position Actuator Solenoid Valve - Bank 2 Exhaust	P2094	P0023	P2095	P0024
Low Reference - Terminal 2/B @ Q6C Camshaft Position Actuator Solenoid Valve - Bank 2 Exhaust	-	P0023	-	P0024
Control - Terminal 1/A @ Q6D Camshaft Position Actuator Solenoid Valve - Bank 2 Intake	P2092	P0020	P2093	P0021
Low Reference - Terminal 2/B @ Q6D Camshaft Position Actuator Solenoid Valve - Bank 2 Intake	-	P0020	-	P0021

Circuit/System Description

For an overview of the component/system, refer to [Camshaft Actuator System Description](#)

Circuit	Description
Control	The output circuit is switched to 12 V to activate the component.
Low Reference	Grounded through the control module.

Component	Description
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.
Q6 Camshaft Position Actuator Solenoid Valve	A solenoid valve is an electro-mechanically operated valve. The valve is controlled by an electric current through the solenoid.

The solenoid valve controls the flow of engine oil to the hydraulic actuator that adjusts the angle of the camshaft relative to the position of the crankshaft.

Conditions for Running the DTC

P0010, P0013, P0020, P0023, P2088 - P2095

- Camshaft Position Actuator Solenoid Valve = On
- Ignition Switch Position = Run/Crank
- Ignition Voltage = Greater than 11 V

Frequency the DTC runs = Continuously - After the running conditions are met

P0011, P0014, P0021, P0024

- DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094, P2095 = Not set
- Camshaft Position Actuator Solenoid Valve = On
- Camshaft Position & Desired Camshaft Position = 5 to 20B°
- Desired Camshaft Position = Does not vary greater than 4.5B° - For greater than 1 s
- Engine = Running
- Ignition Voltage = Greater than 11 V

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

P0010, P0013, P0020, P0023, P2088 - P2095

Control Circuit = Commanded state does not match the actual state - For greater than 5 s

P0011, P0014, P0021, P0024

Desired Camshaft Position & Camshaft Position = Not within 8B° of each other - For greater than 30 s

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

Inspect the engine for any recent mechanical repairs. An incorrectly installed camshaft, camshaft actuator, or timing belt/chain can cause this DTC to set.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

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

NOTE:

- The engine oil level and the oil pressure are critical to the correct operation of the system.
- Engine oil condition has a major impact on the camshaft actuator system.
- If a crankshaft or camshaft position sensor DTC is set, the scan tool camshaft position actuator output control will be disabled.

1. Ignition - On / Vehicle - In Service Mode

2. Verify DTC P0335, P0336, P0340, P0341, P0345, P0346, P0365, P0366, P0390, P0391 is not set.

- If any of the DTCs are set

Refer to Diagnostic Trouble Code (DTC) List - Vehicle

- Go to next step: If none of the DTCs are set

3. Verify the following conditions do not exist:

- Engine Oil - Contaminated/Dirty/Fill Level = Low
- Engine Oil Pressure - Low - Refer to Oil Pressure Diagnosis and Testing
- If a condition exists

Repair as necessary

- **Go to next step: If no condition exists**

4. Engine - Idling

5. Perform the appropriate scan tool control function:

- Exhaust Camshaft Position Actuator Bank 1 - From 0 to 10B° and back to 0B°
- Exhaust Camshaft Position Actuator Bank 2 - From 0 to 10B° and back to 0B°
- Intake Camshaft Position Actuator Bank 1 - From 0 to 10B° and back to 0B°
- Intake Camshaft Position Actuator Bank 2 - From 0 to 10B° and back to 0B°
- Verify the appropriate scan tool parameter:
- Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Test Status = OK or Not Run
- Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit High Voltage Test Status = OK or Not Run
- Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit Open Test Status = OK or Not Run
- Intake Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Test Status = OK or Not Run
- Intake Camshaft Position Actuator Solenoid Valve Control Circuit High Voltage Test Status = OK or Not Run
- Intake Camshaft Position Actuator Solenoid Valve Control Circuit Open Test Status = OK or Not Run
- **If not the specified state**

Refer to: Circuit/System Testing

- **Go to next step: If the specified state**

6. Perform the appropriate scan tool control function:

- Exhaust Camshaft Position Actuator Bank 1 - From 0 to 10B° and back to 0B°
- Exhaust Camshaft Position Actuator Bank 2 - From 0 to 10B° and back to 0B°
- Intake Camshaft Position Actuator Bank 1 - From 0 to 10B° and back to 0B°
- Intake Camshaft Position Actuator Bank 2 - From 0 to 10B° and back to 0B°
- Verify the appropriate scan tool parameter:
- Exhaust Camshaft Position Variance Bank 1 = Less than 2B° - During each of the commanded states
- Exhaust Camshaft Position Variance Bank 2 = Less than 2B° - During each of the commanded states
- Intake Camshaft Position Variance Bank 1 = Less than 2B° - During each of the commanded states
- Intake Camshaft Position Variance Bank 2 = Less than 2B° - During each of the commanded states
- **If 2B° or greater**

Refer to: Circuit/System Testing

- **Go to next step: If less than 2B°**

7. Verify the appropriate scan tool parameter:

- Exhaust Camshaft Position Variance Bank 1 = Less than 2B° - During each of the commanded states
- Exhaust Camshaft Position Variance Bank 2 = Less than 2B° - During each of the commanded states
- Intake Camshaft Position Variance Bank 1 = Less than 2B° - During each of the commanded states
- Intake Camshaft Position Variance Bank 2 = Less than 2B° - During each of the commanded states

- Perform the action while monitoring the parameter:
- Wiggle the harness and connector: Q6 Camshaft Position Actuator Solenoid Valve
- Wiggle the harness and connector: K20 Engine Control Module
- **If 2B° or greater**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If less than 2B°**

8. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

9. 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 appropriate electrical connector: Q6 Camshaft Position Actuator Solenoid Valve
3. Test for less than 10 ohms between the test points: Low Reference circuit terminal 2/B & Ground
 - **If 10 ohms or greater**
 1. Disconnect the appropriate electrical connector: K20 Engine Control Module
 2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 2/B @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **Go to next step: If less than 10 ohms**
4. Ignition - On / Vehicle - In Service Mode
5. Perform the scan tool control function:
 - Exhaust Camshaft Position Actuator Solenoid Valve Bank 1 - Off
 - Exhaust Camshaft Position Actuator Solenoid Valve Bank 2 - Off
 - Intake Camshaft Position Actuator Solenoid Valve Bank 1 - Off
 - Intake Camshaft Position Actuator Solenoid Valve Bank 2 - Off
 - Verify a test lamp does not turn On between the test points: Control circuit terminal 1/A & Ground
 - **If the test lamp turns On**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Control circuit terminal 1/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: K20 Engine Control Module

- **Go to next step: If the test lamp does not turn On**

6. Remove - Test Lamp

7. Perform the scan tool control function:

- Exhaust Camshaft Position Actuator Solenoid Valve Bank 1 - On
- Exhaust Camshaft Position Actuator Solenoid Valve Bank 2 - On
- Intake Camshaft Position Actuator Solenoid Valve Bank 1 - On
- Intake Camshaft Position Actuator Solenoid Valve Bank 2 - On
- Verify the scan tool parameter:
- Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Test Status Bank 1 = OK or Not Run
- Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Test Status Bank 2 = OK or Not Run
- Intake Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Test Status Bank 1 = OK or Not Run
- Intake Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Test Status Bank 2 = OK or Not Run

- **If not the specified state**

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: K20 Engine Control Module
3. Test for infinite resistance between the test points: Control circuit terminal 1/A @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module

- **Go to next step: If the specified state**

8. Connect a 3 A fused jumper wire between the test points: Control circuit terminal 1/A & Ground

9. Perform the scan tool control function:

- Exhaust Camshaft Position Actuator Solenoid Valve Bank 1 - On
- Exhaust Camshaft Position Actuator Solenoid Valve Bank 2 - On
- Intake Camshaft Position Actuator Solenoid Valve Bank 1 - On
- Intake Camshaft Position Actuator Solenoid Valve Bank 2 - On
- Verify the scan tool parameter:
- Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Test Status Bank 1 = Malfunction
- Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Test Status Bank 2 = Malfunction
- Intake Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Test Status Bank 1 = Malfunction
- Intake Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Test Status Bank 2 = Malfunction

- **If not the specified state**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
2. Disconnect the appropriate electrical connector: K20 Engine Control Module
3. Test for less than 2 ohms between the test points: Control circuit terminal 1/A @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module

- **Go to next step: If the specified state**

10. Verify DTC P0011, P0014 is not set.

- **If the DTC is set**

1. Ignition/Vehicle - Off
2. Remove the component: Q6 Camshaft Position Actuator Solenoid Valve
3. Verify a condition does not exist with the component: Q6 Camshaft Position Actuator Solenoid Valve
 - Engine Oil - Leaking @ Harness Connector
 - Screen - Misaligned/Missing/Restricted/Torn
 - Valve - Scored/Visible Damage
 - If a condition exists - Replace the component: Q6 Camshaft Position Actuator Solenoid Valve
 - Go to next step: If no condition exists

NOTE: It may be necessary to use jumper wires if the connector indexing is different between the connectors.

4. Swap the two components: Q6 Camshaft Position Actuator Solenoid Valve - The original component that set the DTC & Another known good component from the vehicle
5. Engine - Running

NOTE:

- This step is testing the mechanical camshaft position actuator for the camshaft that set the DTC.
- Perform this test at the original location that set the DTC.

6. Perform the scan tool control function:

- Exhaust Camshaft Position Actuator Bank 1 - From 0 to 10B° and back to 0B°
- Exhaust Camshaft Position Actuator Bank 2 - From 0 to 10B° and back to 0B°
- Intake Camshaft Position Actuator Bank 1 - From 0 to 10B° and back to 0B°
- Intake Camshaft Position Actuator Bank 2 - From 0 to 10B° and back to 0B°
- Verify the appropriate scan tool parameter:
- Exhaust Camshaft Position Variance Bank 1 = Less than 2B° - During each of the commanded states
- Exhaust Camshaft Position Variance Bank 2 = Less than 2B° - During each of the commanded states
- Intake Camshaft Position Variance Bank 1 = Less than 2B° - During each of the commanded states
- Intake Camshaft Position Variance Bank 2 = Less than 2B° - During each of the commanded states
- If 2B° or greater - Replace the component: Camshaft Position Actuator
- If less than 2B° - Replace the component: Q6 Camshaft Position Actuator Solenoid Valve - The original component that set the DTC

- **Go to next step: If the DTC is not set**

11. Test or replace the component: Q6 Camshaft Position Actuator Solenoid Valve

Component Testing

Static Test

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: Q6 Camshaft Position Actuator Solenoid Valve

3. Test for 6 to 12 ohms between the test points: Control terminal 1/A & Low Reference terminal 2/B
 - **If not between 6 and 12 ohms**
Replace the component: Q6 Camshaft Position Actuator Solenoid Valve
 - **Go to next step: If between 6 and 12 ohms**
4. Test for infinite resistance between the test points: Each terminal of the component & The component's housing
 - **If less than infinite resistance**
Replace the component: Q6 Camshaft Position Actuator Solenoid Valve
 - **Go to next step: If infinite resistance**
5. All OK.

Dynamic Test

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: Q6 Camshaft Position Actuator Solenoid Valve
3. Connect a jumper wire between the test points: Low Reference terminal 2/B & Ground

CAUTION: Complete the testing as quickly as possible in order to prevent overheating and damaging the component.

4. Momentarily connect a 7.5 A fused jumper wire between the test points: Control terminal 1/A & B+

Verify the component turns On and Off when connecting and disconnecting the jumper wire: Q6 Camshaft Position Actuator Solenoid Valve

- **If the component does not turn On and Off**

Replace the component: Q6 Camshaft Position Actuator Solenoid Valve

- **Go to next step: If the component turns On and Off**

5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Camshaft Position Actuator Replacement - Bank 1](#)
- [Camshaft Position Actuator Replacement - Bank 2](#)
- [Camshaft Position Actuator Valve Solenoid Replacement - Bank 1 \(Right Side\) Exhaust](#)
- [Camshaft Position Actuator Valve Solenoid Replacement - Bank 2 \(Left Side\) Exhaust](#)
- [Camshaft Position Actuator Valve Solenoid Replacement - Bank 1 \(Right Side\) Intake](#)
- [Camshaft Position Actuator Valve Solenoid Replacement - Bank 2 \(Left Side\) Intake](#)
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0016, P0017, P0018, OR P0019

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 P0016

Crankshaft Position - Intake Camshaft Position Not Plausible Bank 1

DTC P0017

Crankshaft Position - Exhaust Camshaft Position Not Plausible Bank 1

DTC P0018

Crankshaft Position - Intake Camshaft Position Not Plausible Bank 2

DTC P0019

Crankshaft Position - Exhaust Camshaft Position Not Plausible Bank 2

Circuit/System Description

For an overview of the component/system, refer to [Camshaft Actuator System Description](#)

The ECM compares the signals of the crankshaft position sensor and both camshaft position sensors to detect if the signals are out of sync.

Conditions for Running the DTC

- DTC P0335, P0336, P0340, P0341, P0345, P0346, P0365, P0366, P0390, P0391, P0641, P0651 = Not set
- Engine = Cranking or Running
- Crankshaft Position Sensor & Camshaft Position Sensor = Synchronized
- Camshaft Position Actuator = Park position

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

The deviation of the relative camshaft position is greater than $-9B^{\circ}$ in one direction or greater than $9B^{\circ}$ in the other direction (measured in degrees of the crankshaft).

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

NOTE: The engine oil level and condition is critical to the correct operation of the system. The engine oil condition has a major impact on the camshaft actuator system. Debris in the oil can interfere with the camshaft position actuator solenoid valve and the mechanical camshaft actuator operation. Inspect for dirty or degraded engine oil.

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC P0010, P0013, P0020, P0023, P0335, P0336, P0340, P0341, P0345, P0346, P0365, P0366, P0390, P0391, P2088, P2089, P2090, P2091, P2092, P2093, P2094, P2095 is not set.

- If any of the DTCs are set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- Go to next step: If none of the DTCs are set

3. Engine - Idling - At normal operating temperature.
4. Verify DTC P0016, P0017, P0018, or P0019 is not set.

- If the DTC is set

1. Ignition/Vehicle - Off
2. Verify the following conditions do not exist:
 - B23 Camshaft Position Sensor - Incorrect installation
 - B26 Crankshaft Position Sensor - Incorrect installation
 - Q6 Camshaft Position Actuator Solenoid Valve - Incorrect installation/Stuck Closed/Stuck Open
 - Reluctor Ring - Misaligned @ Crankshaft
 - Timing Belt or Timing Chain - Excessive play
 - Timing Belt Tensioner or Timing Chain Tensioner - Incorrect installation
 - If a condition exists - Repair or replace as necessary
 - If none of the conditions exists - Refer to step 2.

- Go to next step: If the DTC is not set

5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- If the DTC sets

One of the above conditions still exist.

- Go to next step: If the DTC is not set

6. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Camshaft Position Actuator Valve Solenoid Replacement - Bank 1 \(Right Side\) Intake](#)
- [Camshaft Position Actuator Valve Solenoid Replacement - Bank 2 \(Left Side\) Intake](#)
- [Camshaft Position Actuator Valve Solenoid Replacement - Bank 1 \(Right Side\) Exhaust](#)
- [Camshaft Position Actuator Valve Solenoid Replacement - Bank 2 \(Left Side\) Exhaust](#)
- [Camshaft Position Sensor Replacement - Bank 1 \(Right Side\) Intake](#)
- [Camshaft Position Sensor Replacement - Bank 2 \(Left Side\) Intake](#)

- [Camshaft Position Sensor Replacement - Bank 1 \(Right Side\) Exhaust](#)
- [Camshaft Position Sensor Replacement - Bank 2 \(Left Side\) Exhaust](#)
- [Crankshaft Position Sensor Replacement](#)
- [Timing Chain Alignment Diagram](#)

DTC P0030-P0032, P0036-P0038, P0050-P0054, P0056-P0060, P0135, P0141, P0155, P0161, P103B, OR P103C

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 P0030

HO2S Heater Control Circuit Bank 1 Sensor 1

DTC P0031

HO2S Heater Control Circuit Low Voltage Bank 1 Sensor 1

DTC P0032

HO2S Heater Control Circuit High Voltage Bank 1 Sensor 1

DTC P0036

HO2S Heater Control Circuit Bank 1 Sensor 2

DTC P0037

HO2S Heater Control Circuit Low Voltage Bank 1 Sensor 2

DTC P0038

HO2S Heater Control Circuit High Voltage Bank 1 Sensor 2

DTC P0050

HO2S Heater Control Circuit Bank 2 Sensor 1

DTC P0051

HO2S Heater Control Circuit Low Voltage Bank 2 Sensor 1

DTC P0052

HO2S Heater Control Circuit High Voltage Bank 2 Sensor 1

DTC P0053

HO2S Heater Resistance Bank 1 Sensor 1

DTC P0054

HO2S Heater Resistance Bank 1 Sensor 2

DTC P0056

HO2S Heater Control Circuit Bank 2 Sensor 2

DTC P0057

HO2S Heater Control Circuit Low Voltage Bank 2 Sensor 2

DTC P0058

HO2S Heater Control Circuit High Voltage Bank 2 Sensor 2

DTC P0059

HO2S Heater Resistance Bank 2 Sensor 1

DTC P0060

HO2S Heater Resistance Bank 2 Sensor 2

DTC P0135

HO2S Heater Performance Bank 1 Sensor 1

DTC P0141

HO2S Heater Performance Bank 1 Sensor 2

DTC P0155

HO2S Heater Performance Bank 2 Sensor 1

DTC P0161

HO2S Heater Performance Bank 2 Sensor 2

DTC P103B

HO2S Heater Supply Voltage Sensing Circuit Performance

DTC P103C

HO2S Heater Supply Voltage Sensing Circuit Low Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P0031, P0037, P0051, P0057, P0053, P0059, P0135, P0155, P103C*	P0031, P0037, P0051, P0057, P0053, P0059, P0135, P0155, P103C*	P0690, P16B3	P0135, P0141, P0155, P0161
Control	P0031, P0037, P0051, P0057	P0030, P0036, P0050, P0056, P0059	P0032, P0038, P0052, P0058	P0135, P0141, P0155, P0161
*Additional DTCs may set.				

Typical Scan Tool Data

HO2S Heater Bank 1, 2 Sensor 1, 2

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Parameter Normal Range: 0.5 to 1.5 mA			
Ignition	0 mA	0 mA	0.5 to 2.0 mA
Control	0 mA	0 mA	0 mA

Circuit/System Description

Circuit	Description
Ignition	Supplied from a fuse.
Control	The output circuit is switched to ground to activate the component.

Component	Description
B52 Heated Oxygen Sensor	In addition to the hot exhaust gas, heated oxygen sensors have a resistor heating element to minimize the time required for the sensor to reach operating temperature. The ECM monitors the temperature and turns the heater on as necessary.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Conditions for Running the DTC

P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057, P0058

- Engine Speed = Greater than 400 RPM
- Ignition On - Engine Running
- Ignition Voltage = Greater than 11 V

Frequency the DTC runs = Continuously - After the running conditions are met - For greater than 7 s

P0053, P0054, P0059, P0060

- DTCs related to the following system/component = Not Set
 - B34 Engine Coolant Temperature Sensor
 - B75C Multifunction Intake Air Sensor
- ECT Sensor = Warmer than -30B°C (-22B°F)
- ECT Sensor & Intake Air Temperature = Within 8B°C (14B°F) of each other
- Engine = Running
- Ignition Off = Greater than 8 h

Frequency the DTC runs = Once - Per cold start-up - After the running conditions are met

P0135, P0141

- DTCs related to the following system/component = Not Set
 - B34 Engine Coolant Temperature Sensor
- HO2S Heater = Device controls are not active.
- HO2S Heater = Greater than 0% Duty Cycle

- Ignition Voltage = Greater than 10 V

Frequency the DTC runs = 2 times - Per drive cycle - After the running conditions are met - For greater than 120 s

P0155, P0161

- DTCs related to the following system/component = Not Set
 - B34 Engine Coolant Temperature Sensor
- HO2S Heater = Device controls are not active.
- HO2S Heater = Greater than 0% Duty Cycle
- Ignition Voltage = Greater than 10 V

Frequency the DTC runs = 1 times - Per drive cycle - After the running conditions are met - For greater than 120 s

P103B, P103C

- Engine = Running
- Ignition Voltage = Greater than 11 V

Frequency the DTC runs = Continuously - After the running conditions are met - For greater than 3 s

Conditions for Setting the DTC

P0030, P0036, P0050, P0056

Control Circuit = Open - For greater than 7 s

P0031, P0037, P0051, P0057

Control Circuit = Short to Ground - For greater than 7 s

P0032, P0038, P0052, P0058

Control Circuit = Short to Voltage - For greater than 7 s

P0053, P0054

HO2S Heater Resistance 8 to 15 ohms Per cold start-up

P0059, P0060

HO2S Heater Resistance 3.5 to 8.5 ohms Per cold start-up

P0135, P0141

HO2S Heater Current 0.3 to 2.5 A - For greater than 10 s

P0155, P0161

HO2S Heater Current 0.3 to 3.1 A - For greater than 5 s

P103B, P103C

HO2S Heater Supply Voltage Within 2 V of the battery voltage - For greater than 3 s

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

An open fuse in the HO2S heater circuit may be caused by a short in the sensor heating element. The short may not be present until the sensor operates for a period of time. If no fault is present in the heater circuit, monitor the current of each heater with a scan tool to determine if one of the heater elements is the cause of the open fuse.

If the condition is intermittent, wiggle the related wiring harnesses and connectors, with the ignition/vehicle on or engine running, while monitoring the scan tool circuit status parameters for the component. The parameters will display if there is a condition with the circuit or a connection.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

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. Engine - Idling - At normal operating temperature

NOTE: This step only applies to the following component DTCs: HO2S Heater

2. Verify DTC P103B, P103C is not set and no other DTCs are set.

- If DTC P103B, P103C is set and other DTCs are set

Refer to: Circuit/System Testing - Test 1

- If DTC P103B, P103C is not set and other DTCs are set

Refer to: Circuit/System Testing - Test 1

- If DTC P103B, P103C is set and no other DTCs are set

Refer to: Circuit/System Testing - Test 2

- **Go to next step: If no DTC is set**

3. Verify the scan tool parameter:

- HO2S Heater Control Circuit High Voltage Test Status Bank 1, 2 Sensor 1, 2 = OK or Not Run
- HO2S Heater Control Circuit Low Voltage Test Status Bank 1, 2 Sensor 1, 2 = OK or Not Run
- HO2S Heater Control Circuit Open Test Status Bank 1, 2 Sensor 1, 2 = OK or Not Run
- **If not the specified state**

Refer to: Circuit/System Testing - Test 1

- **Go to next step: If the specified state**

4. Verify the scan tool parameter:

HO2S Heater Bank 1, 2 Sensor 1, 2 = 0.3 to 2.4 A

- **If not between 0.3 and 2.4 A**

Refer to: Circuit/System Testing - Test 1

- **Go to next step: If between 0.3 and 2.4 A**

5. Verify the scan tool parameter: HO2S Heater Bank 1, 2 Sensor 1, 2 = The value should not spike or drop out.

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: B52 Heated Oxygen Sensor
- Wiggle the harness and connector: K20 Engine Control Module
- **If the value spikes or drops out**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If the value does not spike or drop out**

6. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to step 2

- **Go to next step: If the DTC is not set**

7. All OK.

Circuit/System Testing

Test 1

1. Ignition/Vehicle & All vehicle systems - Off
 2. Disconnect the appropriate electrical connector: B52 Heated Oxygen Sensor
 3. Ignition - On / Vehicle - In Service Mode
 4. Verify a test lamp turns On between the test points: Ignition circuit terminal 2 & Ground
 - **If the test lamp does not turn On and the circuit fuse is OK**
1. Ignition/Vehicle - Off & Remove - Test lamp

2. Test for less than 2 ohms between the test points: Ignition circuit terminal 2 & Output terminal @ Fuse

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Verify the fuse is OK and there is voltage at the fuse.

• **If the test lamp does not turn On and the circuit fuse is open**

1. Ignition/Vehicle - Off & Remove - Test lamp

2. Connect the electrical connector: B52 Heated Oxygen Sensor

3. Ignition - On / Vehicle - In Service Mode

4. Replace the component: Fuse

5. Verify the fuse does not open.

- If the fuse opens and there are components connected to the circuit - Disconnect a component and repeat procedure starting at step 4.4
- If the fuse opens with all components disconnected from the circuit - Repair the short to ground on the circuit.
- If the fuse does not open after disconnecting a component from the circuit - Replace the component disconnected last.
- Go to next step: If the fuse does not open with all components connected.

NOTE: It may be necessary to use a scan tool control function to operate a component.

6. Operate the component: Each component on the circuit - One at a time

Verify the fuse does not open when any of the components are activated.

- If the fuse opens - Replace the component that caused the fuse to open when activated.
- Go to next step: If the fuse does not open.

7. All OK.

• **Go to next step: If the test lamp turns On**

5. Verify a test lamp does not turn On between the test points: Ignition circuit terminal 2 & Control circuit terminal 1

• **If the test lamp turns On**

1. Ignition/Vehicle - Off & Remove - Test lamp

2. Disconnect the appropriate electrical connector: K20 Engine Control Module

3. Test for infinite resistance between the test points: Control circuit terminal 1 @ Component harness & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- If infinite resistance - Replace the component: K20 Engine Control Module

• **Go to next step: If the test lamp does not turn On**

6. Remove - Test Lamp

7. Engine - Running

8. Verify the scan tool parameter: HO2S Heater Control Circuit Open Test Status Bank 1, 2 Sensor 1, 2 = Malfunction

• **If not the specified state**

1. Ignition/Vehicle - Off

2. Disconnect the appropriate electrical connector: K20 Engine Control Module

3. Ignition - On / Vehicle - In Service Mode

4. Test for less than 1 V between the test points: Control circuit terminal 1 @ Component harness & Ground

- If 1 V or greater - Repair the short to voltage on the circuit.
- If less than 1 V - Replace the component: K20 Engine Control Module
- **Go to next step: If the specified state**

NOTE:

- **As little as 10 ohms of resistance in a circuit may cause a DTC to set.**
- **Performing this test may set additional DTCs.**

9. Connect a 3 A fused jumper wire between the test points: Control circuit terminal 1 & Ignition circuit terminal 2
10. Engine - Running
11. Verify the scan tool parameter: HO2S Heater Control Circuit High Voltage Test Status Bank 1, 2 Sensor 1, 2 = Malfunction
 - **If not the specified state**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Test for less than 2 ohms between the test points: Control circuit terminal 1 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **Go to next step: If the specified state**
12. Test or replace the component: B52 Heated Oxygen Sensor

Test 2

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: K20 Engine Control Module
3. Test for less than 2 ohms between the test points: Output terminal @ Fuse & The other end of the circuit @ Control module harness
 - **If 2 ohms or greater**
Repair the open/high resistance in the circuit:
 - **Go to next step: If less than 2 ohms**
4. Replace the component: K20 Engine Control Module

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Heated Oxygen Sensor Replacement - Bank 1 Sensor 1](#)
- [Heated Oxygen Sensor Replacement - Bank 1 Sensor 2](#)
- [Heated Oxygen Sensor Replacement - Bank 2 Sensor 1](#)
- [Heated Oxygen Sensor Replacement - Bank 2 Sensor 2](#)
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0068 OR P1101

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 P0068

Throttle Body Air Flow Performance

DTC P1101

Intake Air Flow System Performance

Circuit/System Description

Component	Description
B74 Manifold Absolute Pressure Sensor	The sensor is a capacitive pressure transducer. Electronics in the sensor convert pressure into an analog voltage signal. The sensor measures the pressure in the intake manifold between the throttle valve and the intake valves. When the engine is idling or decelerating, the sensor pressure should be low. When the engine is off or under wide-open throttle conditions the pressure should be the same or close to the barometric pressure.
B75C Multifunction Intake Air Sensor	The assembly has several functions: • The mass air flow sensor is a hot film type sensor that measures the mass of air (not the volume) entering the engine. The signal varies with engine load and is displayed by the scan tool in Hertz (Hz) and grams per second (g/s). • The intake air humidity sensor uses the same signal circuit as the intake air temperature sensor 2. The intake air humidity sensor modulates the pulse width of the signal. The intake air temperature sensor 2 modulates the frequency of the signal. That means the signal is both, PWM and FM modulated. • The barometric pressure sensor generates an analog voltage that is proportional to the ambient air pressure. • The intake air temperature sensor 1 varies its resistance depending on the temperature. • Low temperature produces a high resistance: 126.8 kohms @ -60B°C (-76B°F) • High temperature produces a low resistance: 62 ohms @ 150B°C (302B°F)
K20 Engine Control Module	The control module contains a microprocessor used to process input data to control outputs. The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.
Q38 Throttle Body	The component Q38 contains a contactless inductive position sensor. A fixed transmitter coil excites a movable rotor, which in turn induces a current in a fixed receiver coil. The current varies with the angle of the rotor. Electronics inside the sensor convert the current into digital data which is

Component	Description
	transmitted via a serial data circuit to the control module K20.

The ECM compares the measured mass air flow with the calculated air flow based on throttle position and the calculated air flow based on manifold absolute pressure.

This DTC sets when the control module detects an inconsistency between the pressure sensors and cannot identify which sensor failed.

Conditions for Running the DTC

P0068

- Engine Speed = Greater than 800 RPM
- Ignition Voltage = Greater than 6.4 V

Frequency the DTC runs = Continuously - After the running conditions are met

P1101

- DTC P0097, P0098, P0099, P0102, P0103, P0107, P0111, P0112, P0113, P0116, P0117, P0118, P0335, P0336 = Not set
- Engine Speed = 500 to 6, 800 RPM
- Engine Coolant Temperature = -7 to 150B°C (-4 to 302B°F)
- Intake Air Temperature Sensor = -20 to +125B°C (-4 to +257B°F)

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

The following scan tool parameters are not within a calibrated range of the calculated air flow, which is based on throttle position:

- Mass Airflow Sensor
- MAP Sensor

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type A DTC - Exceptions listed below

DTC P1101 = Type B DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC - Exceptions listed below

DTC P1101 = Type B DTC

Reference Information

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 P0641, P0651, P0697, P06A3 is not set.
 - **If any of the DTCs are set**

Refer to [DTC P0641, P0651, P0697, or P06A3](#)

- **Go to next step: If none of the DTCs are set**

3. Verify the scan tool parameter: Throttle Body Idle Air Flow Compensation = Less than 90%
 - **If 90% or greater**

Refer to [Throttle Body Inspection and Cleaning](#)

- **Go to next step: If less than 90%**

4. Perform the scan tool control function: Throttle Sweep - Start

Verify the scan tool parameter: Throttle Position Sensors 1 and 2 = Agree

- **If not the specified state**

Refer to [DTC P0121-P0123, P0222, P0223, P2135, U0606, or U0607](#)

- **Go to next step: If the specified state**

5. Verify the scan tool parameter: MAP Sensor = [Altitude Versus Barometric Pressure](#) - The value should be within the range listed in the table.

- **If not in the specified range**

Refer to [DTC P0106, P0107, or P0108](#)

- **Go to next step: If in the specified range**

6. Verify the following conditions do not exist:

- B74 Manifold Absolute Pressure Sensor - Leaking @ O-Ring - Missing / Visible Damage
- B75C Multifunction Intake Air Sensor - Contamination of the measuring element /Cracked/Loose Clamps / Visible Damage/Water intrusion
- Q38 Throttle Body
 - Coking/Loose Clamps /Visible Damage
 - Restricted - Moisture/Ice
- Air Cleaner Element - Dirty / Restricted
- Catalytic Converter - Blocked / Restricted/Visible Damage
- Engine - Mechanical Condition - Refer to [Symptoms - Engine Mechanical](#)
- Exhaust System - Leaking /Restricted/ Visible Damage - Refer to [Symptoms - Engine Exhaust](#)
- Intake Air Duct - Cracked / Loose Clamps / Restricted / Visible Damage
- Intake Manifold - Cracked / Loose Clamps / Restricted / Vacuum leak/Visible Damage
- Positive Crankcase Ventilation System
 - Leaking @ O-Ring - Missing / Visible Damage
 - Restricted - Moisture/Ice
 - Incorrect connection /Leaking / Restricted
- Vacuum Hoses - Kinked / Leaking / Incorrect connection / Restricted
- Vacuum leak @ Engine - Oil Level Indicator and Tube /Oil Filler Cap
- **If a condition exists**

Repair or replace the components as necessary.

- **Go to next step: If no condition exists**

7. Engine - Idling - At normal operating temperature

8. Verify the scan tool parameter:

- MAP Sensor = 26 to 52 kPa (3.8 to 7.5 PSI) @ Idle Speed
- MAP Sensor = The value should change with accelerator pedal input.
- **If not between 26 and 52 kPa (3.8 and 7.5 PSI) or does not change**

Refer to [**DTC P0106, P0107, or P0108**](#)

- **Go to next step: If between 26 and 52 kPa (3.8 and 7.5 PSI) and changes**

9. Increase the engine speed slowly to 3k RPM and then back to idle.

10. Perform the scan tool function: Review Stored Data

11. Observe the scan tool parameter frame by frame with a scan tool: MAF Sensor

Verify the scan tool parameter: MAF Sensor = The value should not spike or drop out.

- **If the value spikes or drops out**

Refer to [**DTC P0101-P0103**](#)

- **Go to next step: If the value does not spike or drop out**

12. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Repeat the procedure starting at step 1

- **Go to next step: If no DTC is set**

13. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [**Diagnostic Repair Verification**](#)

DTC P0089, P00C6, P228C, P228D, OR P2C1E-P2C20

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 P0089

Fuel Pressure Regulator Performance

DTC P00C6

Fuel Rail Pressure Low During Engine Cranking

DTC P228C

Fuel Pressure Regulator Control Performance - Low Pressure

DTC P228D

Fuel Pressure Regulator Control Performance - High Pressure

DTC P2C1E

Fuel Pressure Regulator Performance During Cold Start

DTC P2C1F

Fuel Pressure Regulator Performance - Low Pressure During Cold Start

DTC P2C20

Fuel Pressure Regulator Performance - High Pressure During Cold Start

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - Terminal 1	P0091, P00C9	P0090, P00C8	P0092, P00C9, P00CA	P0089, P00C6, P228C, P228D, P2C1E, P2C1F, P2C20
Control - Terminal 2	P0091, P0092, P00C9	P0090, P00C8	P0092, P00CA	P0089, P00C6, P228C, P228D, P2C1E, P2C1F, P2C20

Circuit/System Description

For an overview of the component/system, refer to [Fuel System Description](#)

Circuit	Description
Control - Terminal 1	The output circuit is switched to 12 V to activate the component. The output is PWM controlled.
Control - Terminal 2	The output circuit is switched to ground to activate the component. The output is PWM controlled.

Component	Description
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly. G18 High Pressure Fuel Pump
Q18 Fuel Pressure Regulator	Q18 is part of the component: G18 High Pressure Fuel Pump The fuel pressure regulator is a diaphragm relief valve. The diaphragm has fuel pressure on one side and regulator spring pressure on the other side. The fuel pressure regulator maintains the correct fuel pressure to the fuel injection system. The fuel pressure regulator delivers the

Component	Description
	needed fuel to the fuel rail. The unused fuel drops back into the reservoir of the fuel tank fuel pump module.

The fuel pressure regulator is a part of the high pressure fuel pump. The fuel pressure regulator is the solenoid valve that controls the pressure in the fuel rail.

Conditions for Running the DTC

P0089, P228C, P228D

- DTC P0016, P0017, P0018, P0019, P0090, P0091, P0092, P00C8, P00C9, P00CA, P0111, P0112, P0113, P0116, P0117, P0118, P0128, P0192, P0193, P0335, P0336, P0340, P0341, P0345, P0346, P0365, P0366, P0390, P0391, P0628 = Not set
- BARO = Greater than 70 kPa (10.2 PSI)
- Engine = Running
- Fuel Temperature = -10 to 100B°C (14 to 212B°F)
- IAT Sensor = Greater than -10B°C (14B°F)
- Ignition Voltage = Greater than 11 V
- Low Pressure Side of the Fuel System = Greater than 275 kPa (40 PSI)

Frequency the DTC runs = Continuously - After the running conditions are met - For greater than 10 s

P00C6

- DTC P0090, P0091, P0092, P00C8, P00C9, P00CA, P0116, P0117, P0118, P0128, P0192, P0193, P0335, P0336, P0340, P0341, P0345, P0346, P0365, P0366, P0390, P0391, P0628 = Not set
- Low Pressure Side of the Fuel System = Greater than 275 kPa (40 PSI)
- Engine = Not Running
- Run/Crank = Greater than 8 V
- ECT Sensor = Less than 85B°C (185B°F)
- BARO = Greater than 70 kPa (10.2 PSI)
- IAT Sensor = Greater than -10B°C (14B°F)

Frequency the DTC runs = Continuously - After the running conditions are met

P2C1E, P2C1F, P2C20

- DTC P0016, P0017, P0018, P0019, P0090, P0091, P0092, P00C8, P00C9, P00CA, P0111, P0112, P0113, P0116, P0117, P0118, P0128, P0192, P0193, P0335, P0336, P0340, P0341, P0345, P0346, P0365, P0366, P0390, P0391, P0627, P0628, P0629, P111E, P127C, P128A, P128B, P128F, P1682, P16E4, P16E5 = Not set
- BARO = Greater than 70 kPa (10.2 PSI)
- Fuel Rail Pressure Sensor Learn Inhibit - Engine In Catalyst Warm-Up Mode = No
- Fuel Temperature = -10 to 132B°C (14 to 270B°F)
- IAT Sensor = Greater than -10B°C (14B°F)
- Ignition Voltage = Greater than 11 V
- Low Pressure Side of the Fuel System = Greater than 300 kPa (44 PSI)

Conditions for Setting the DTC

P0089

Q18 Fuel Pressure Regulator = Not Within 0 to 240B° - For greater than 10 s

P00C6

Desired Fuel Rail Pressure - Engine Cranking	Engine Crank Time	Engine Coolant Temperature	Fuel Rail Pressure
Less than desired	11 s	-40B°C (-40B°F)	Actual pressure is not equal to the desired pressure
Less than desired	3 s	20 to 95B°C (68 to 203B°F)	Actual pressure is not equal to the desired pressure
Less than desired	5 s	Warmer than 112B°C (234B°F)	Actual pressure is not equal to the desired pressure
Greater than desired	During the first 10 engine revolutions.	Colder than -10B°C (14B°F)	Pressure drops greater than 2 MPa (290 PSI)
Greater than desired	During the first 10 engine revolutions.	0 to 8B°C (32 to 46B°F)	Pressure drops greater than 0.6 MPa (87 PSI)
Greater than desired	During the first 10 engine revolutions.	Warmer than 8B°C (46B°F)	Pressure drops greater than 0.5 MPa (73 PSI)

P228C, P228D, P2C1F, P2C20

The following parameters are not within 3 MPa (435 PSI) of each other:

- Desired Fuel Rail Pressure
- Fuel Rail Pressure

The above condition(s) must occur for greater than 10 s.

P2C1E

G18 High Pressure Fuel Pump - Control = Greater than the maximum threshold - For greater than 10 s

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type A DTC - Exceptions listed below

DTC P0089, P00C6 = Type B DTC

{P228C, P228D, P2C1E-P2C20} Engine = Reduced Engine Power

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC - Exceptions listed below

DTC P0089, P00C6 = Type B DTC

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

- [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 P0016, P0017, P0018, P0019, P0090, P0091, P0092, P00C8, P00C9, P00CA, P0111, P0112, P0113, P0116, P0117, P0118, P0128, P0192, P0193, P0335, P0336, P0340, P0341, P0345, P0346, P0365, P0366, P0390, P0391, P0628, P163A is not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **Go to next step: If none of the DTCs are set**

3. Engine - Idling
4. Verify the scan tool parameter: Fuel Rail Pressure Sensor = 3.0 to 7.5 MPa (400 to 1088 PSI)
 - **If not between 3.0 and 7.5 MPa (400 and 1088 PSI)**

Refer to: Circuit/System Testing

- **Go to next step: If between 3.0 and 7.5 MPa (400 and 1088 PSI)**

5. Perform the scan tool control function: Fuel Rail Pressure - Increase & Decrease

Verify the scan tool parameter: Fuel Rail Pressure = The value should change with each command.

- **If the value does not change**

Refer to: Circuit/System Testing

- **Go to next step: If the value changes**

6. Perform the following action: Clear the DTCs.

WARNING: Road test a vehicle under safe conditions and while obeying all traffic laws. Do not attempt any maneuvers that could jeopardize vehicle control. Failure to adhere to these precautions could lead to serious personal injury and vehicle damage.

7. Accelerate the vehicle with wide open throttle.

Verify DTC P0089, P00C6, P228C, P228D, P2C1E, P2C1F, P2C20 is not set.

- **If DTC P0089, P00C6, P228C, P228D, P2C1E, P2C1F, P2C20 is set**

Refer to: Circuit/System Testing

- **Go to next step: If DTC P0089, P00C6, P228C, P228D, P2C1E, P2C1F, P2C20 is not set**

8. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

9. All OK.

Circuit/System Testing

1. Ignition/Vehicle - Off

2. Verify the following conditions do not exist:

- Q17 Fuel Injector - Leaking/Restricted
- Camshaft Position Actuator - Binding or Sticking/Stuck
- Direct Fuel Injection Fuel Rail - Leaking/Restricted
- Fuel - Contaminated/Poor Quality
- Fuel Feed Pipe - Leaking/Restricted
- Fuel Pressure Regulator - Binding or Sticking/Stuck
- **If a condition exists**

Repair or replace as necessary

- **Go to next step: If no condition exists**

3. Remove the component: G18 High Pressure Fuel Pump

4. Verify a condition does not exist with the component: Camshaft Lobe(s) - Worn/Visible Damage

- **If a condition exists**

Replace the component: Camshaft

- **Go to next step: If no conditions exist**

5. Test or replace the component: G18 High Pressure Fuel Pump

Component Testing

NOTE: As little as 2 ohms of resistance in a circuit may cause a DTC to set.

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: G18 High Pressure Fuel Pump

3. Test for 9 to 13 ohms between the test points: Control terminal 1 & Control terminal 2

- **If not between 9 and 13 ohms**

Replace the component: G18 High Pressure Fuel Pump

- **Go to next step: If between 9 and 13 ohms**

4. Test for infinite resistance between the test points: Each terminal of the component & The component's housing

- **If less than infinite resistance**

Replace the component: G18 High Pressure Fuel Pump

- **Go to next step: If infinite resistance**

5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Camshaft Position Actuator Valve Solenoid Replacement - Bank 1 \(Right Side\) Exhaust](#)
- [Fuel Pressure Sensor Replacement - Fuel Injection Fuel Rail](#)
- [Fuel Pump Replacement](#) - G18 High Pressure Fuel Pump

DTC P0090-P0092, P00C8, P00C9, P00CA, OR P163A

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 P0090

Fuel Pressure Regulator Control Circuit

DTC P0091

Fuel Pressure Regulator Control Circuit Low Voltage

DTC P0092

Fuel Pressure Regulator Control Circuit High Voltage

DTC P00C8

Fuel Pressure Regulator High Control Circuit Open

DTC P00C9

Fuel Pressure Regulator High Control Circuit Low Voltage

DTC P00CA

Fuel Pressure Regulator High Control Circuit High Voltage

DTC P163A

Control Module Fuel Pressure Regulator 1 Control System Circuitry Performance - Internal Component Fault

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Low Reference - Terminal 1 @ G18 High Pressure Fuel Pump	P0091, P0092, P00C9	P0090, P00C8	P0092, P00CA	P0089, P00C6, P163A, P228C, P228D

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - Terminal 2 @ G18 High Pressure Fuel Pump	P0091, P00C9	P0090, P00C8	P0092, P00C9, P00CA	P0089, P00C6, P163A, P228C, P228D

Circuit/System Description

For an overview of the component/system, refer to [Fuel System Description](#)

Circuit	Description
Low Reference - Terminal 1 @ G18 High Pressure Fuel Pump	Grounded through the control module.
Control - Terminal 2 @ G18 High Pressure Fuel Pump	The output circuit is switched to 12 V to activate the component. The output is PWM controlled.

Component	Description
Fuel Pressure Regulator @ G18 High Pressure Fuel Pump	A solenoid valve is an electro-mechanically operated valve. The valve is controlled by an electric current through the solenoid.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

The fuel pressure regulator is a solenoid valve that restricts the flow of fuel to the high pressure fuel pump and thereby controls the pressure the pump can produce.

Conditions for Running the DTC

P0090 - P0092, P00C8, P00C9, P00CA

- Battery Voltage = Greater than 11 V
- Engine Speed = Greater than 50 RPM

Frequency the DTC runs = Continuously - After the running conditions are met - For greater than 2 s

P163A

- DTC P0016 - P0019, P0090 - P0092, P00C8, P00C9, P00CA, P0111 - P0114, P0117, P0118, P0192, P0193, P0231, P0232, P023F, P0335, P0336, P127C, P127D, P128A, P128B, P128F, P1682, P16E4, P16E5 = Not set
- BARO = Greater than 70 kPa (10.1 PSI)
- Battery Voltage = Greater than 11 V
- Engine = Running
- Fuel Pressure Sensor = Greater than 250 kPa (36 PSI)
- Fuel Temperature = -12 to 126B°C (10.4 to 259B°F)
- IAT Sensor 1 = Warmer than -20B°C (-4B°F)
- Low Fuel Indicator = Off

Frequency the DTC runs = Continuously - After the running conditions are met - For greater than 1.2 s

Conditions for Setting the DTC

P0090 - P0092, P00C8, P00C9, P00CA

Control Circuit = Commanded state does not match the actual state - For greater than 2 s

P163A

Fuel Pressure Regulator - Electrical Current = Not within a calibrated range - For greater than 1.2 s

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type A DTC - Exceptions listed below

DTC P163A = Type B DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC - Exceptions listed below

DTC P163A = Type B DTC

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or **Inline Harness Connector End Views - Index** or **Component Connector End Views - Index**

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

NOTE: **This test can only be performed once per ignition cycle. To run the test again, turn the ignition/vehicle Off, allow the engine control module to shut down completely, and then turn the ignition/vehicle back On.**

2. Perform the scan tool control function: Fuel Pressure Regulator - On and Off

Verify the scan tool parameter:

- Fuel Pressure Regulator Control Circuit High Voltage Test Status = Not Run or OK
- Fuel Pressure Regulator Control Circuit Open Test Status = Not Run or OK
- Fuel Pressure Regulator Control Circuit Low Voltage Test Status = Not Run or OK

- Fuel Pressure Regulator High Control Circuit High Voltage Test Status = Not Run or OK
- Fuel Pressure Regulator High Control Circuit Open Test Status = Not Run or OK
- Fuel Pressure Regulator High Control Circuit Low Voltage Test Status = Not Run or OK
- **If not the specified state**

Refer to: Circuit/System Testing

- **Go to next step: If the specified state**

3. Perform the scan tool control function: Fuel Pressure Regulator - On and Off

Verify a click can be heard or felt at the following component(s) when the scan tool control function was commanded: G18 High Pressure Fuel Pump

- **If a click cannot be heard or felt**

Refer to: Circuit/System Testing

- **Go to next step: If a click can be heard or felt**

4. Perform the scan tool control function: Fuel Pressure Regulator - On - Command the function On several times.

Verify the scan tool parameter:

- Fuel Pressure Regulator Control Circuit High Voltage Test Status = Not Run or OK
- Fuel Pressure Regulator Control Circuit Open Test Status = Not Run or OK
- Fuel Pressure Regulator Control Circuit Low Voltage Test Status = Not Run or OK
- Fuel Pressure Regulator High Control Circuit High Voltage Test Status = Not Run or OK
- Fuel Pressure Regulator High Control Circuit Open Test Status = Not Run or OK
- Fuel Pressure Regulator High Control Circuit Low Voltage Test Status = Not Run or OK
- Perform the action while monitoring the parameter:
- Wiggle the harness and connector: G18 High Pressure Fuel Pump
- Wiggle the harness and connector: K20 Engine Control Module
- **If not the specified state**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If the specified state**

5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC does not set**

6. All OK.

Circuit/System Testing

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: G18 High Pressure Fuel Pump
3. Connect a test lamp between the test points: Low Reference circuit terminal 1 & B+

4. Verify the test lamp is Off.

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

1. Disconnect the appropriate electrical connector: K20 Engine Control Module
2. Test for infinite resistance between the test points: Low Reference circuit terminal 1 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module

- **Go to next step: If the test lamp is always Off**

5. Ignition - On / Vehicle - In Service Mode

6. Verify the test lamp turns On.

- **If the test lamp does not turn On**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Disconnect the appropriate electrical connector: K20 Engine Control Module
3. Test for less than 2 ohms between the test points: Low Reference circuit terminal 1 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module

- **Go to next step: If the test lamp turns On**

7. Connect a test lamp between the test points: Control circuit terminal 2 & Ground

8. Perform the scan tool control function: Fuel Pressure Regulator - 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 appropriate electrical connector: K20 Engine Control Module
3. Test for infinite resistance between the test points: Control circuit terminal 2 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
4. Test for less than 2 ohms between the test points: Control circuit terminal 2 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module

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

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Disconnect the appropriate electrical connector: K20 Engine Control Module
3. Ignition - On / Vehicle - In Service Mode
4. Test for less than 1 V between the test points: Control circuit terminal 2 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module

- **Go to next step: If the test lamp turns On and Off**

9. Test or replace the component: G18 High Pressure Fuel Pump

Component Testing

NOTE: As little as 2 ohms of resistance in a circuit may cause a DTC to set.

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: G18 High Pressure Fuel Pump
3. Test for 9 to 13 ohms between the test points: Low Reference terminal 1 & Control terminal 2
 - **If not between 9 and 13 ohms**

Replace the component: G18 High Pressure Fuel Pump

- **Go to next step: If between 9 and 13 ohms**

4. Test for infinite resistance between the test points: Each terminal of the component & The component's housing

- **If less than infinite resistance**

Replace the component: G18 High Pressure Fuel Pump

- **Go to next step: If infinite resistance**

5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Fuel Pump Replacement](#) - G18 High Pressure Fuel Pump
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0096 OR P0111

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 P0096

Intake Air Temperature (IAT) Sensor 2 Performance

DTC P0111

Intake Air Temperature (IAT) Sensor 1 Performance

Circuit/System Description

This system consists of the following components:

- B74 Manifold Absolute Pressure Sensor
- B75C Multifunction Intake Air Sensor

This DTC sets when the sensor signals contradict each other.

Conditions for Running the DTC

- DTC P0097, P0098, P0112, P0113, P0117, P0118, P1682, P16A7, P2610 = Not set
- Time between current ignition cycle and the last time the engine was running = Greater than 8 h
- Ignition Voltage = Greater than 10.9 V

Frequency the DTC runs = Once - After the running conditions are met

Conditions for Setting the DTC

The following parameters are not within 25B°C (45B°F) of each other:

- Start-Up IAT Sensor 1
- Start-Up IAT Sensor 2

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

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

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 P0097, P0098, P00EA, P00EB, P0112, P0113, P0117, P0118, P1682, P16A7, P16BC, P2199, P2610 is not set.

- If any of the DTCs are set

Refer to Diagnostic Trouble Code (DTC) List - Vehicle

- Go to next step: If none of the DTCs are set

NOTE: To minimize the effects of residual engine heat and heating elements inside the sensor, perform step 3 of this procedure only if the ignition has been Off for longer than 8 h.

3. Verify the following parameters are within 25B°C (45B°F) of each other:

- Start-Up IAT Sensor 1
- Start-Up IAT Sensor 2
- **If not in the specified range**
- {Start-Up IAT Sensor 1} Refer to [DTC P0112, P0113, or P0114](#)
- {Start-Up IAT Sensor 2} Refer to [DTC P0097-P0099 or P00F4-P00F6](#)
- **Go to next step: If in the specified range**

4. Engine - Idling

5. Verify the scan tool parameter: = -39 to 149B°C (-38 to 300B°F) and changes

- IAT Sensor 1
- IAT Sensor 2
- {LT4, LT5} IAT Sensor 3
- **If not in the specified range or does not change**
- {IAT Sensor 1} Refer to [DTC P0112, P0113, or P0114](#)
- {IAT Sensor 2} Refer to [DTC P0097-P0099 or P00F4-P00F6](#)
- **Go to next step: If in the specified range and changes**

6. Verify the appropriate scan tool parameter:

- IAT Sensor 1
- IAT Sensor 2

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: B75C Multifunction Intake Air Sensor
- Wiggle the harness and connector: K20 Engine Control Module
- **If the value spikes or drops out**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If the value does not spike or drop out**

7. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

DTC P0097-P0099 OR P00F4-P00F6

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 P0097

Intake Air Temperature (IAT) Sensor 2 Circuit Low Voltage

DTC P0098

Intake Air Temperature (IAT) Sensor 2 Circuit High Voltage

DTC P0099

Intake Air Temperature (IAT) Sensor 2 Circuit Intermittent

DTC P00F4

Intake Air Humidity Sensor Circuit Low Voltage

DTC P00F5

Intake Air Humidity Sensor Circuit High Voltage

DTC P00F6

Intake Air Humidity Sensor Circuit Erratic

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0096, P0097, P00F4, P2199	P0096, P0098, P00F5, P2199	P0096, P0098*, P00F5, P2199	P0096, P00F6, P2199
Low Reference	-	P0096, P0098, P00F5, P2199, P2229	-	P0096, P2199, P2230
*Internal control module or component damage may occur if the circuit shorts to B+.				

Typical Scan Tool Data

IAT Sensor 2

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine = Idling - At Operating Temperature Parameter Normal Range: 0 to 100B°C (32 to 212B°F)			
Signal	-40B°C (-40B°F)	-40B°C (-40B°F)	-40B°C (-40B°F)
Low Reference	-	-40B°C (-40B°F)	-40B°C (-40B°F)

Intake Air Humidity Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine = Idling - At Operating Temperature Parameter Normal Range: 6 to 94%			
Signal	100%	0%	0%
Low Reference	-	0%	-

Circuit/System Description

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 5 V.
Ground	Grounded through the control module.

Component	Description
B75C Multifunction Intake Air Sensor	The intake air temperature sensor 2 is integrated in the mass air flow sensor. The intake air temperature sensor 2 varies its resistance depending on the temperature. The intake air humidity sensor uses the same signal circuit as the intake air temperature sensor 2. The intake air humidity sensor

Component	Description
	modulates the pulse width of the signal. The intake air temperature sensor 2 modulates the frequency of the signal. That means the signal is both, PWM and FM modulated.
K20 Engine Control Module	The control module contains a microprocessor used to process input data to control outputs. The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Conditions for Running the DTC

- {P00F6} DTC P1682 = Not set
- Ignition = On
- Ignition Voltage = Greater than 11 V

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

P0097

NOTE: The scan tool display range is between -40 and 150B°C (-40 and 302B°F).

IAT Sensor 2 = Colder than -60B°C (-76B°F) - For greater than 0.9 s

P0098

IAT Sensor 2 = Warmer than 150B°C (302B°F) - For greater than 0.9 s

P0099

IAT Sensor 2 = Signal noisy or erratic - For greater than 0.9 s

P00F4

Intake Air Humidity Sensor = Less than -6.25% - For greater than 0.9 s

P00F5

Intake Air Humidity Sensor = Greater than 106.25% - For greater than 0.9 s

P00F6

Intake Air Humidity Sensor = Signal noisy or erratic - For greater than 0.9 s

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC - Additional actions taken:

Cooling Fan = On

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Reference Information

Schematic Reference

[Engine Controls Wiring Schematics](#)

Connector End View Reference

[Master Electrical Component List](#) , or [Inline Harness Connector End Views - Index](#) or [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](#)

Special Tools

<special tool><special tool-no>EL-38522</special tool-no><special tool-desc>Variable Signal Generator</special tool-desc></special tool>

Equivalent regional tools: [Special Tools \(Mechanical Tools\)](#)

[Circuit/System Verification](#)

NOTE: If you were sent here from DTC P0096 - Refer to: Circuit/System Testing.

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC P0102, P103, P0641, P0651, P0697, P06A3 is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **Go to next step: If none of the DTCs are set**

3. Engine - Running

4. Verify the scan tool parameter:

- IAT Sensor 2 = -39 to 149B°C (-38 to 300B°F)
- Intake Air Humidity Sensor = 6 to 94%
- **If not in the specified range**

Refer to: Circuit/System Testing

- **Go to next step: If in the specified range**

5. Verify the scan tool parameter: Intake Air Humidity Sensor = The value should not spike or drop out.

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: B75C Multifunction Intake Air Sensor
- Wiggle the harness and connector: K20 Engine Control Module
- **If the value spikes or drops out**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If the value does not spike or drop out**

6. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

7. 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: B75C Multifunction Intake Air Sensor
3. Test for less than 5 ohms between the test points: Low Reference circuit terminal 3 & Ground
 - **If 5 ohms or greater**
 1. Disconnect the appropriate electrical connector: K20 Engine Control Module
 2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 3 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **Go to next step: If less than 5 ohms**
4. Ignition - On / Vehicle - In Service Mode
5. Verify the scan tool parameter: Intake Air Humidity Sensor = Less than 1%
 - **If 1% or greater**
 1. Ignition/Vehicle - Off
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Test for infinite resistance between the test points: Signal circuit terminal 8 & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module
 - **Go to next step: If less than 1%**
6. Ignition/Vehicle - Off
7. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 8 @ Component harness & Low Reference circuit terminal 3
8. Ignition - On / Vehicle - In Service Mode
9. Verify the scan tool parameter: Intake Air Humidity Sensor = Greater than 95%
 - **If 95% or less**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 8 & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - Go to next step: If less than 1 V

5. Ignition/Vehicle - Off

6. Test for less than 2 ohms between the test points: Signal circuit terminal 8 & The other end of the circuit @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

• **Go to next step: If greater than 95%**

10. Test or replace the component: B75C Multifunction Intake Air Sensor

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Mass Airflow Sensor with Intake Air Temperature Sensor Replacement](#) - B75C Multifunction Intake Air Sensor
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P00C7

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 P00C7

Intake Air Pressure Measurement System - Multiple Sensors Not Plausible

Circuit/System Description

This system consists of the following components:

- B75C Multifunction Intake Air Sensor
- B74 Manifold Absolute Pressure Sensor

This DTC sets when the control module detects an inconsistency between the pressure sensors and cannot identify which sensor failed.

Conditions for Running the DTC

- DTC P0106, P0107, P0108, P2227, P2228, P2229, P2230, P1682 = Not set
- Engine = Not Running
- Time between current ignition cycle and the last time the engine was running = Greater than 5.0 s
- Manifold Absolute Pressure = 50 to 115 kPa (7.2 to 16.6 PSI)
- Barometric Pressure = 50 to 115 kPa (7.2 to 16.6 PSI)

Frequency the DTC runs = Once - After the running conditions are met

Conditions for Setting the DTC

Manifold Absolute Pressure & Barometric Pressure = Not within 10 kPa (1.5 PSI) of each other.

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

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or **Inline Harness Connector End Views - Index** or **Component Connector End Views - Index**

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 P0106, P0107, P0108, P2227, P2228, P2229, P2230 is not set.
 - **If any of the DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**
 - **Go to next step: If none of the DTCs are set**
3. Verify the following conditions do not exist:
 - B75C Multifunction Intake Air Sensor - Contamination of the measuring element
 - B75C Multifunction Intake Air Sensor - Water intrusion
 - B74 Manifold Absolute Pressure Sensor - Contamination of the measuring element / Loose / Leaking
 - Air Cleaner Element - Dirty/Restricted
 - Exhaust System - Loose/Missing components/Restricted/Visible Damage - Refer to **Symptoms - Engine Exhaust**
 - Intake Air Duct - Collapsed/Loose Clamps/Restricted/Visible Damage
 - Positive Crankcase Ventilation System - Leaking / Loose Clamps/ Restricted/Visible Damage. Refer to **Crankcase Ventilation System Inspection/Diagnosis**
 - Intake Manifold - Cracked/Loose Clamps/Visible Damage. Refer to **INTAKE MANIFOLD OVERHAUL**
 - Vacuum Hoses - Incorrect connection/Kinked/Leaking/Restricted

- **If a condition exists**

Repair or replace as necessary

- **Go to next step: If no condition exists**

4. Verify the scan tool parameter:

- BARO Sensor = [Altitude Versus Barometric Pressure](#) - The value should be within the range listed in the table.
- MAP Sensor = [Altitude Versus Barometric Pressure](#) - The value should be within the range listed in the table.
- **If not in the specified range**
 - {BARO Sensor} Refer to [DTC P2227-P2230](#).
 - {MAP Sensor} Refer to [DTC P0106, P0107, or P0108](#).
- **Go to next step: If in the specified range**

5. All OK.

DTC P0101-P0103

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 P0101

Mass Air Flow (MAF) Sensor Performance

DTC P0102

Mass Air Flow (MAF) Sensor Circuit Low Frequency

DTC P0103

Mass Air Flow (MAF) Sensor Circuit High Frequency

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P0096, P0097, P00F4, P0102, P0178, P2199	P0096, P0097, P00F4, P0101, P0102, P2199	P0690	P0096, P0101, P0103
Signal	P0102	P0102	P0102*	P0101, P0103, P1101
Ground	-	P0096, P0097, P00F4, P0102, P2199	-	P0096, P0102

*Internal control module or component damage may occur if the circuit shorts to B+.

Typical Scan Tool Data

MAF Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine = Idling Parameter Normal Range: 8 to 20 g/s - 2, 700 to 3, 860 Hz			
Ignition	0 Hz	0 Hz	-
Signal	0 Hz	0 Hz	0 Hz
Ground	-	0 Hz	-
*Internal control module or component damage may occur if the circuit shorts to B+.			

Circuit/System Description

Circuit	Description
Ignition	Supplied from a fuse.
Signal	The control module input circuit has an internal resistance connected to 5 V.
Ground	Chassis Ground

Component	Description
B75C Multifunction Intake Air Sensor	The assembly has several functions: • The mass air flow sensor is a hot film type sensor that measures the mass of air (not the volume) entering the engine. The signal varies with engine load and is displayed by the scan tool in Hertz (Hz) and grams per second (g/s). • The intake air humidity sensor uses the same signal circuit as the intake air temperature sensor 2. The intake air humidity sensor modulates the pulse width of the signal. The intake air temperature sensor 2 modulates the frequency of the signal. That means the signal is both, PWM and FM modulated. • The barometric pressure sensor generates an analog voltage that is proportional to the ambient air pressure. • The intake air temperature sensor 1 varies its resistance depending on the temperature. • Low temperature produces a high resistance: 1, 166 ohms @ 40B°C (104B°F) • High temperature produces a low resistance: 97 ohms @ 130B°C (266B°F)
K20 Engine Control Module	The control module contains a microprocessor used to process input data to control outputs. The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Conditions for Running the DTC

P0101

- DTC P0102, P0103, P0107, P0108, P0111-P0114, P0116-P0118, P0128, P0335, P0336 = Not set
- Engine Coolant Temperature = -7 to 130B°C (19.4 to 266B°F)
- Engine Speed = 400 to 6100 RPM

- Intake Air Temperature Sensor = -20 to 129B°C (-4 to 264B°F)

Frequency the DTC runs = Continuously - After the running conditions are met - For greater than 1 s

P0102, P0103

- Battery Voltage = Greater than 9.1 V
- Engine Speed = Greater than 300 RPM

Frequency the DTC runs = Continuously - After the running conditions are met - For greater than 1 s

Conditions for Setting the DTC

P0101 Condition 1

The ratio between measured and estimated mass air flow is too low. - For greater than 1 s

Condition 2

The ratio between measured and estimated mass air flow is too high. - For greater than 1 s

P0102

MAF Sensor = Less than 850 Hz - For greater than 6 s

P0103

MAF Sensor = Greater than 7, 000 Hz - For greater than 6 s

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

Inspect the sensing element for contamination and clean it if possible. If the sensing element cannot be cleaned
- Replace the sensor.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or **Inline Harness Connector End Views - Index** or **Component Connector End Views - Index**

Electrical Information Reference

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

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Control Module References

Special Tools

<special tool><special tool-no>EL-38522</special tool-no><special tool-desc>Variable Signal Generator</special tool-desc></special tool>

Equivalent regional tools: [Special Tools \(Mechanical Tools\)](#)

Circuit/System Verification

NOTE: If you were sent here from DTC P0068, P0097, P0106, P0121, P1101 - Refer to: **Circuit/System Testing.**

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC P0641, P0651, P0697, P06A3, P06D2 is not set.
 - **If any of the DTCs are set**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)
 - **Go to next step: If none of the DTCs are set**
3. Verify the scan tool parameter: Throttle Body Idle Air Flow Compensation = Less than 90%
 - **If greater than 90%**
Refer to [Throttle Body Inspection and Cleaning](#)
 - **Go to next step: If less than 90%**
4. Perform the scan tool control function: Throttle Sweep - Start
Verify the scan tool parameter: Throttle Position Sensors 1 and 2 = Agree
 - **If not the specified state**
Refer to [DTC P0121-P0123, P0222, P0223, P2135, U0606, or U0607](#)
 - **Go to next step: If the specified state**
5. Verify the scan tool parameter: MAP Sensor = The value should be within the range listed in the table:
[Altitude Versus Barometric Pressure](#)
 - **If not in the specified range**
Refer to [DTC P0106, P0107, or P0108](#)
 - **Go to next step: If in the specified range**
6. Engine - Idling - At normal operating temperature
7. Verify the scan tool parameter: MAP Sensor = 26 to 52 kPa (3.8 to 7.5 PSI) - The value should change with accelerator pedal input.
 - **If not in the specified range or does not change**
Refer to [DTC P0106, P0107, or P0108](#)
 - **Go to next step: If in the specified range and changes**

8. Verify the scan tool parameter: MAF Sensor = 2.5 to 5.5 g/s

- **If not in the specified range**

Refer to: Circuit/System Testing

- **Go to next step: If in the specified range**

9. Increase the engine speed slowly to 3k RPM and then back to idle.

10. Perform the scan tool function: Review Stored Data

11. Observe the scan tool parameter frame by frame with a scan tool: MAF Sensor

Verify the scan tool parameter: MAF Sensor = The value should not spike or drop out.

- **If the value spikes or drops out**

Refer to: Circuit/System Testing

- **Go to next step: If the value does not spike or drop out**

12. Ignition/Vehicle & All vehicle systems - Off

13. Verify the following conditions do not exist:

- B74 Manifold Absolute Pressure Sensor - Leaking @ O-Ring - Missing/Visible Damage
- B75C Multifunction Intake Air Sensor - Contamination of the measuring element/Cracked/Loose Clamps/Water intrusion
- Q38 Throttle Body
 - Coking/Loose Clamps/Visible Damage
 - Restricted - Moisture/Ice
- Air Cleaner Element - Dirty/Restricted
- Engine - Mechanical Condition - Refer to [Symptoms - Engine Mechanical](#)
- Exhaust System - Leaking/Restricted/Visible Damage - Refer to [Symptoms - Engine Exhaust](#)
- Intake Air Duct - Collapsed/Loose Clamps/Restricted/Visible Damage
- Intake Manifold - Cracked/Loose Clamps/Visible Damage - Refer to [Intake Manifold Overhaul](#)
- Positive Crankcase Ventilation System
 - Leaking @ O-Ring - Missing/Visible Damage
 - Restricted - Moisture/Ice
 - Incorrect connection - Leaking/Restricted - Refer to [Crankcase Ventilation System Inspection/Diagnosis](#)
- Vacuum Hoses - Incorrect connection/Kinked/Leaking/Restricted
- Vacuum leak @ Engine - Oil Level Indicator and Tube/Oil Filler Cap
- **If a condition exists**

Repair or replace as necessary

- **Go to next step: If no condition exists**

14. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC is set**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

15. 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: B75C Multifunction Intake Air Sensor
3. Test for less than 5 ohms between the test points: Ground circuit terminal 7 & Ground
 - **If 5 ohms or greater**
 1. Disconnect the appropriate ground connection: Chassis Ground
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 7 @ Component harness & The other end of the circuit @ Chassis Ground
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **Go to next step: If less than 5 ohms**
4. Ignition - On / Vehicle - In Service Mode
5. Verify a test lamp turns On between the test points: Ignition circuit terminal 5 & Ground
 - **If the test lamp does not turn On and the circuit fuse is OK**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Test for less than 2 ohms between the test points: Ignition circuit terminal 5 @ Component harness & Output terminal @ Fuse
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not turn On and the circuit fuse is open**
 1. Ignition/Vehicle - Off
 2. Replace the component: Fuse
 3. Ignition - On / Vehicle - In Service Mode
 4. Verify the fuse does not open.
 - If the fuse opens and there are components connected to the circuit - Disconnect a component and repeat procedure starting at step 5.1
 - If the fuse opens with all components disconnected from the circuit - Repair the short to ground on the circuit.
 - If the fuse does not open after disconnecting a component from the circuit - Replace the component disconnected last.
 - Go to next step: If the fuse does not open.

NOTE: It may be necessary to use a scan tool control function to operate a component.

5. Operate the component: Each component on the circuit - One at a time

Verify the fuse does not open when any of the components are activated.

- If the fuse opens - Replace the component that caused the fuse to open when activated.
- Go to next step: If the fuse does not open.

6. All OK.

- **Go to next step: If the test lamp turns On**

6. Test for 4.8 to 5.2 V between the test points: Signal circuit terminal 6 & Ground

- **If less than 4.8 V**

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: K20 Engine Control Module
3. Test for infinite resistance between the test points: Signal circuit terminal 6 @ B75C Multifunction Intake Air Sensor & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
4. Test for less than 2 ohms between the test points: Signal circuit terminal 6 @ B75C Multifunction Intake Air Sensor & The other end of the circuit @ K20 Engine Control Module
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module

- **If greater than 5.2 V**

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: K20 Engine Control Module
3. Ignition - On / Vehicle - In Service Mode
4. Test for less than 1 V between the test points: Signal circuit terminal 6 @ B75C Multifunction Intake Air Sensor & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module

- **Go to next step: If between 4.8 and 5.2 V**

7. Engine - Idling

NOTE:

- Use the appropriate diagnostic test probe for best results.
- For this test, the action may need to be repeated several times.

8. Verify the scan tool parameter: MAF Sensor = Greater than 0 Hz

Perform the action while monitoring the parameter: Rapidly tap a 3 A fused jumper wire between the test points: Signal circuit terminal 6 & Ground

- **If 0 Hz**

Replace the component: K20 Engine Control Module

- **Go to next step: If greater than 0 Hz**

9. Replace the component: B75C Multifunction Intake Air Sensor

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Mass Airflow Sensor with Intake Air Temperature Sensor Replacement](#) - B75C Multifunction Intake Air Sensor
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0106, P0107, OR P0108

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

NOTE: This procedure may also diagnose malfunctions that are not detected by a DTC.

DTC P0106

Manifold Absolute Pressure (MAP) Sensor Performance

DTC P0107

Manifold Absolute Pressure (MAP) Sensor Circuit Low Voltage

DTC P0108

Manifold Absolute Pressure (MAP) Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0106, P0107, P0641*	P0106, P0107	P0108, P0641*	P0106
Signal	P0107	P0108	P0106, P0108	P0106, P1101
Low Reference	P0107	P0108, P0641	P0108, P0641	P0106
* Additional DTCs may set.				

Typical Scan Tool Data

MAP Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: • Accessories = Off • Engine = Idling - At normal operating temperature.			
Parameter Normal Range: 26 to 52 kPa (3.8 to 7.5 PSI)			
5 V Reference	0 kPa (0.0 PSI)	0 kPa (0.0 PSI)	127 kPa (18.4 PSI)
Signal	0 kPa (0.0 PSI)	127 kPa (18.4 PSI)	127 kPa (18.4 PSI)
Low Reference	-	127 kPa (18.4 PSI)	-

Circuit/System Description

Circuit	Description
5 V Reference	Regulated voltage supplied by the control module.
Signal	The control module input circuit has an internal resistance connected to 5 V.
Low Reference	Grounded through the control module.

Component	Description
B74 Manifold Absolute Pressure Sensor	The sensor is a capacitive pressure transducer. Electronics in the sensor convert pressure into an analog voltage signal.

Component	Description
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

The sensor measures the pressure in the intake manifold. The signal is used to determine the engine load.

When the engine is idling or decelerating, the sensor pressure should be low. When the engine is off or under wide-open throttle conditions the pressure should be the same or close to the barometric pressure.

Conditions for Running the DTC

P0106 Condition 1

- DTC P0102, P0103, P0107, P0108, P010C, P010D, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0128, P0335, P0336, P111E, P14B6, U060F, U1346, U2011 = Not set
- DTC P0112, P0113, P0117, P0118, P14B6 = Not pending
- Engine Coolant Temperature Sensor = -9 to 125B°C (15.8 to 257B°F)
- Engine Speed = 400 to 5, 400 RPM
- Intake Air Temperature Sensor = -20 to +129B°C (-4 to +264B°F)

Condition 2

- DTC P0107, P0108, P14B6, P2228, P2229, P2610, U060F, U1346, U2011 = Not set
- DTC P0107, P0108, P2228, P2229 = Not pending
- Ignition = On & Engine = Off
- Time between current ignition cycle and the last time the engine was running = Greater than 5 s

Frequency the DTC runs = Continuously - After the running conditions are met

P0107, P0108

Ignition = On

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

P0106

The difference between the manifold absolute pressure measured by the manifold absolute pressure sensor and a calculated value based on the throttle position exceeds the allowed range.

P0107

MAP Sensor = Less than 0.2 V - For greater than 4 s

P0108

MAP Sensor = Greater than 4.5 V - For greater than 4 s

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

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

Description and Operation

Engine Control Module Description

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

Special Tools

<special tool><special tool-no>EN-23738-A</special tool-no><special tool-desc>Vacuum Pump</special tool-desc></special tool>

Equivalent regional tools: Special Tools (Mechanical Tools)

Circuit/System Verification

NOTE: If you were sent here from DTC P0068, P0101, P0121, P1101 - Refer to: **Circuit/System Testing.**

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC P0641, P0651, P0697, P06A3 is not set.

- If any of the DTCs are set

Refer to DTC P0641, P0651, P0697, or P06A3

- Go to next step: If none of the DTCs are set

3. Verify the scan tool parameter: Throttle Body Idle Air Flow Compensation = Less than 90%

- If 90% or greater

Refer to Throttle Body Inspection and Cleaning

- Go to next step: If less than 90%

4. Perform the scan tool control function: Throttle Sweep - 1 to 100% Should be start?

Verify the scan tool parameter: Throttle Position Sensors 1 and 2 = Agree

- **If not the specified state**

Refer to [DTC P0121-P0123, P0222, P0223, P2135, U0606, or U0607](#)

- **Go to next step: If the specified state**

5. Verify the scan tool parameter: MAP Sensor = The value should be within the range listed in the table:
[Altitude Versus Barometric Pressure](#)

- **If not in the specified range**

Refer to: Circuit/System Testing

- **Go to next step: If in the specified range**

6. Engine - Idling - At normal operating temperature

7. Accessories - Off

8. Verify the scan tool parameter:

- MAP Sensor = 26 to 52 kPa (3.8 to 7.5 PSI) @ Idle Speed
- MAP Sensor = The value should change with accelerator pedal input.
- **If not between 26 and 52 kPa (3.8 and 7.5 PSI) or does not change**

Refer to: Circuit/System Testing

- **Go to next step: If between 26 and 52 kPa (3.8 and 7.5 PSI) and changes**

9. Verify the scan tool parameter: MAP Sensor = The value should not spike or drop out.

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: B74 Manifold Absolute Pressure Sensor
- Wiggle the harness and connector: K20 Engine Control Module
- **If the value spikes or drops out**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If the value does not spike or drop out**

10. Increase the engine speed slowly to 3k RPM and then back to idle.

11. Perform the scan tool function: Review Stored Data

12. Observe the scan tool parameter frame by frame with a scan tool: MAF Sensor

Verify the parameter changes smoothly and gradually in the recorded data as the engine speed was increased and decreased.

- **If the value does not change smoothly and gradually**

Refer to [DTC P0101-P0103](#)

- **Go to next step: If the value changes smoothly and gradually**

13. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

14. All OK.

Circuit/System Testing

1. Ignition/Vehicle & All vehicle systems - Off

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.

2. Disconnect the appropriate electrical connector: B74 Manifold Absolute Pressure Sensor

3. Test for less than 5 ohms between the test points: Low Reference circuit terminal 2 & Ground

- **If 5 ohms or greater**

1. Disconnect the appropriate electrical connector: K20 Engine Control Module

2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 2 @ Component harness & The other end of the circuit @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

- **Go to next step: If less than 5 ohms**

4. Ignition - On / Vehicle - In Service Mode

5. Test for 4.8 to 5.2 V between the test points: 5 V Reference circuit terminal 1 & Low Reference circuit terminal 2

- **If less than 4.8 V**

1. Ignition/Vehicle - Off

2. Disconnect the appropriate electrical connector: K20 Engine Control Module

3. Test for infinite resistance between the test points: 5 V Reference circuit terminal 1 @ Component harness & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- Go to next step: If infinite resistance

4. Test for less than 2 ohms between the test points: 5 V Reference circuit terminal 1 @ Component harness & The other end of the circuit @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

- **If greater than 5.2 V**

1. Ignition/Vehicle - Off

2. Disconnect the appropriate electrical connector: K20 Engine Control Module

3. Ignition - On / Vehicle - In Service Mode

4. Test for less than 1 V between the test points: 5 V Reference circuit terminal 1 @ Component harness & Ground

- If 1 V or greater - Repair the short to voltage on the circuit.
- If less than 1 V - Replace the component: K20 Engine Control Module

- **Go to next step: If between 4.8 and 5.2 V**

6. Verify the scan tool parameter: MAP Sensor = Greater than 4.7 V

- **If 4.7 V or less**

1. Ignition/Vehicle - Off

2. Disconnect the appropriate electrical connector: K20 Engine Control Module

3. Test for infinite resistance between the test points: Signal circuit terminal 3 @ Component harness & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module
 - **Go to next step: If greater than 4.7 V**
7. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 3 & Low Reference circuit terminal 2
 8. Verify the scan tool parameter: MAP Sensor = Less than 0.2 V
 - **If 0.2 V or greater**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 3 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - Go to next step: If less than 1 V
 5. Ignition/Vehicle - Off
 6. Test for less than 2 ohms between the test points: Signal circuit terminal 3 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **Go to next step: If less than 0.2 V**
 9. Test or replace the component: B74 Manifold Absolute Pressure Sensor

Component Testing

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

Dynamic Test - Using Vehicle Harness

1. Ignition/Vehicle - Off
2. Remove the component: B74 Manifold Absolute Pressure Sensor - Leave the electrical connector connected.
3. Install the special tool:<special tool><special tool-no>EN-23738-A</special tool-no><special tool-desc>Vacuum Pump</special tool-desc></special tool> @ B74 Manifold Absolute Pressure Sensor
4. Use the tool to achieve a gauge reading between -13 and -21 kPa (-0.13 and -0.21 bar, -3.8 and -6.2 in Hg).

Verify the scan tool parameter: MAP Sensor = Decreases between 13 and 21 kPa (1.9 and 3.0 PSI)

- **If the parameter does not decrease between 13 and 21 kPa (1.9 and 3.0 PSI)**

Replace the component: B74 Manifold Absolute Pressure Sensor

- **Go to next step: If the parameter decreases between 13 and 21 kPa (1.9 and 3.0 PSI)**

5. Use the tool to achieve a gauge reading between -30 and -38 kPa (-0.3 and -0.38 bar, -8.8 and -11.2 in Hg).

Verify the scan tool parameter: MAP Sensor = Decreases between 30 and 38 kPa (4.4 and 5.5 PSI)

- **If the parameter does not decrease between 30 and 38 kPa (4.4 and 5.5 PSI)**

Replace the component: B74 Manifold Absolute Pressure Sensor

- **Go to next step: If the parameter decreases between 30 and 38 kPa (4.4 and 5.5 PSI)**

6. All OK.

Dynamic Test - Using Jumper Wires

1. Ignition/Vehicle - Off
2. Remove the component: B74 Manifold Absolute Pressure Sensor
3. Connect a 3 A fused jumper wire between the test points: 5 V Reference terminal 1 & 5 V
4. Connect a jumper wire between the test points: Low Reference terminal 2 & Ground
5. Connect a DMM between the test points: Signal terminal 3 @ B74 Manifold Absolute Pressure Sensor & Ground
6. Install the special tool:<special tool><special tool-no>EN-23738-A</special tool-no><special tool-desc>Vacuum Pump</special tool-desc></special tool> @ B74 Manifold Absolute Pressure Sensor
7. Use the tool to achieve a gauge reading between 0 and -15 kPa (0 and -0.15 bar, 0 and -4.4 in Hg).

Verify the DMM displays between 0.2 and 4.9 V. - The value should not spike or drop out.

- **If not between 0.2 and 4.9 V or has spikes or drops out**

Replace the component: B74 Manifold Absolute Pressure Sensor

- **Go to next step: If between 0.2 and 4.9 V and there are no spikes or drops out**

8. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Manifold Absolute Pressure Sensor Replacement](#)
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0112, P0113, OR P0114

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 P0112

Intake Air Temperature (IAT) Sensor 1 Circuit Low Voltage

DTC P0113

Intake Air Temperature (IAT) Sensor 1 Circuit High Voltage

DTC P0114

Intake Air Temperature (IAT) Sensor 1 Circuit Intermittent

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0112, P0114, P2199	P0111, P0113, P0114, P2199	P0113, P0114, P2199*	P0111, P2199
Low Reference	-	P0111, P0113, P0114, P2199, P2227, P2228, P2229	P0113, P0114, P2199, P2227, P2229*	-
*Internal control module or component damage may occur if the circuit shorts to B+.				

Typical Scan Tool Data

IAT Sensor 1

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine = Idling Parameter Normal Range: -39 to 149B°C (-38 to 300B°F)			
Signal	150B°C (302B°F)	-40B°C (-40B°F)	-40B°C (-40B°F)
Low Reference	-	-40B°C (-40B°F)	-40B°C (-40B°F)

Circuit/System Description

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 5 V.
Low Reference	Grounded through the control module.

Component	Description
B75C Multifunction Intake Air Sensor	The intake air temperature sensor 1 is integrated in the mass air flow sensor. The intake air temperature sensor 1 varies its resistance depending on the temperature.
K20 Engine Control Module	The control module contains a microprocessor used to process input data to control outputs. The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Conditions for Running the DTC

Engine = Running - For greater than 1 s

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

P0112

NOTE: The scan tool display range is between -40 and 150B°C (-40 and 302B°F).

IAT Sensor 1 = Warmer than 149B°C (300B°F) - For greater than 5 s

P0113

IAT Sensor 1 = Colder than -60B°C (-76B°F) - For greater than 5 s

P0114

IAT Sensor 1 = Intermittent - For greater than 5 s

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC

Cooling Fan = On

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or **Inline Harness Connector End Views - Index** or **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

NOTE: If you were sent here from DTC P0096, P0111 - Refer to: Circuit/System Testing.

1. Ignition - On / Vehicle - In Service Mode
2. Verify the scan tool parameter: IAT Sensor 1 = -39 to 149B°C (-36 to 300B°F)
 - **If not between -39 and 149B°C (-36 and 300B°F)**

Refer to: Circuit/System Testing

 - **Go to next step: If between -39 and 149B°C (-36 and 300B°F)**
3. Verify the scan tool parameter: IAT Sensor 1 = The value should not spike or drop out.

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: B75C Multifunction Intake Air Sensor
- Wiggle the harness and connector: K20 Engine Control Module
- **If the value spikes or drops out**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If the value does not spike or drop out**

4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

5. 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: B75C Multifunction Intake Air Sensor
3. Test for less than 5 ohms between the test points: Low Reference circuit terminal 3 & Ground
 - **If 5 ohms or greater**
 1. Disconnect the appropriate electrical connector: K20 Engine Control Module
 2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 3 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **Go to next step: If less than 5 ohms**
4. Ignition - On / Vehicle - In Service Mode
5. Verify the scan tool parameter: IAT Sensor 1 = Colder than -39B°C (-38B°F)
 - **If -39B°C (-38B°F) or warmer**
 1. Ignition/Vehicle - Off
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Test for infinite resistance between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module
 - **Go to next step: If colder than -39B°C (-38B°F)**
6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Low Reference circuit terminal 3
7. Verify the scan tool parameter: IAT Sensor 1 = Warmer than 149B°C (300B°F)
 - **If 149B°C (300B°F) or colder**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - Go to next step: If less than 1 V
5. Ignition/Vehicle - Off
6. Test for less than 2 ohms between the test points: Signal circuit terminal 1 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.

- If less than 2 ohms - Replace the component: K20 Engine Control Module
- **Go to next step: If warmer than 149B°C (300B°F)**

8. Test or replace the component: B75C Multifunction Intake Air Sensor

Component Testing

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: B75C Multifunction Intake Air Sensor
3. Test for 49 to 49, 882 ohms between the test points: Signal terminal 1 & Low Reference terminal 3
 - **If not between 49 and 49, 882 ohms**
Replace the component: B75C Multifunction Intake Air Sensor
 - **Go to next step: If between 49 and 49, 882 ohms**
4. Verify the value is within the range listed in the table: [Temperature Versus Resistance - Intake Air Temperature Sensor](#)
 - **If not in the specified range**
Replace the component: B75C Multifunction Intake Air Sensor
 - **Go to next step: If in the specified range**
5. Test for infinite resistance between the test points: Each terminal of the component & The component's housing
 - **If less than infinite resistance**
Replace the component: B75C Multifunction Intake Air Sensor
 - **Go to next step: If infinite resistance**
6. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Mass Airflow Sensor with Intake Air Temperature Sensor Replacement](#) - B75C Multifunction Intake Air Sensor
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0116-P0119

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 P0116

Engine Coolant Temperature (ECT) Sensor Performance

DTC P0117

Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage

DTC P0118

Engine Coolant Temperature (ECT) Sensor Circuit High Voltage

DTC P0119

Engine Coolant Temperature (ECT) Sensor Circuit Intermittent

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0117, P0119	P0118, P0119	P0118*, P0119	P0116, P0119, P0128
Low Reference	-	P0118, P0119**	*	P0119, P0128
*Internal control module or component damage may occur if the circuit shorts to B+.				
**Additional DTCs may set.				

Typical Scan Tool Data

ECT Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine = Idling - At normal operating temperature. Parameter Normal Range: 88 to 105B°C (190 to 221B°F)			
Signal	150B°C (302B°F)	-40B°C (-40B°F)	-40B°C (-40B°F)
Low Reference	-	-40B°C (-40B°F)	-

Circuit/System Description

For an overview of the component/system, refer to [Cooling System Description and Operation \(LGZ, LWN\)](#).

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 5 V.
Low Reference	Grounded through the control module.

Component	Description
B34 Engine Coolant Temperature Sensor	The sensor is a negative temperature coefficient thermistor. As the temperature of the air, fluid, or metal increases, the resistance of the sensor decreases, varying the voltage on the signal circuit.
K20 Engine Control Module	The control module contains a microprocessor used to process input data to control outputs. The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Conditions for Running the DTC

P0116

- DTC P0117, P0118, P0119, P0128 = Not set
- DTCs related to the following system/component = Not Set
 - B66 Intake Air Temperature Sensor
 - B115 Vehicle Speed Sensor

- IAT Sensor = Warmer than -7°C (19°F) @ Start-up
- Ignition = Off - For greater than 8 h
- Ignition = On
- Fuel level = Greater than 2.5%

Frequency the DTC runs = Once - Per ignition cycle - After the running conditions are met

P0117

Ignition = On

Frequency the DTC runs = Continuously - After the running conditions are met

P0118

- Engine = Running - For greater than 15 s
- IAT Sensor = Warmer than -7°C (19°F)

Frequency the DTC runs = Continuously - After the running conditions are met

P0119

DTC P0117, P0118 = Not set

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

P0116

- Start-Up ECT & Start-Up IAT = Not within 30°C (86°F) of each other - For less than 1 s
or
- Start-Up ECT & Start-Up IAT = Not within 30°C (86°F) of each other - For less than 1 s
Engine Block Heater = Not Detected
or
- Start-Up ECT & Start-Up IAT = Not within 30°C (86°F) of each other - For less than 1 s
Engine Block Heater = Not Detected
Engine Crank Time = Greater than 10 s

P0117

Engine Coolant Temperature = Warmer than 149°C (300°F) - For greater than 5 s

P0118

Engine Coolant Temperature = Colder than -39°C (-38°F) - For greater than 5 s

P0119

Engine Coolant Temperature = Intermittent - For greater than 3 s

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC

- A/C Compressor = Off
- Cooling Fan = On
- Engine Coolant Temperature - Gauge = Inoperative

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Diagnostic Aids

- After starting a cold engine, the following scan tool parameter value should rise steadily and then stabilize: ECT Sensor
- High resistance in either the IAT sensor signal or low reference circuit may cause a DTC to set.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

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 the scan tool parameter: ECT Sensor = -39 to 149B°C (-38 to 300B°F)
 - **If not between -39 and 149B°C (-38 and 300B°F)**

Refer to: Circuit/System Testing

- **Go to next step: If between -39 and 149B°C (-38 and 300B°F)**
3. Verify the scan tool parameter: ECT Sensor = The value should not spike or drop out.

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: B34 Engine Coolant Temperature Sensor
- Wiggle the harness and connector: X2, X3 @ K20 Engine Control Module

- **If the value spikes or drops out**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If the value does not spike or drop out**

4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

5. 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: X114 Inline Harness Connector

NOTE: Testing for steps 3 to 7 is performed on the control module K20 side of the harness connector.

3. Test for less than 10 ohms between the test points: Low Reference circuit terminal 2 @ Inline Harness Connector & Ground

- **If 10 ohms or greater**

1. Disconnect the electrical connector: X2 @ K20 Engine Control Module
2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 2 @ Inline Harness Connector & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module

- **Go to next step: If less than 10 ohms**

4. Ignition - On / Vehicle - In Service Mode

5. Verify the scan tool parameter: ECT Sensor = Colder than -39B°C (-38B°F)

- **If warmer than -39B°C (-38B°F)**

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: X3 @ K20 Engine Control Module
3. Test for infinite resistance between the test points: Signal circuit terminal 1 @ Inline Harness Connector & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module

- **Go to next step: If colder than -39B°C (-38B°F)**

6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Low Reference circuit terminal 2 @ Inline Harness Connector

7. Verify the scan tool parameter: ECT Sensor = Warmer than 149B°C (300B°F)

- **If 149B°C (300B°F) or colder**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)

2. Disconnect the electrical connector: X3 @ K20 Engine Control Module
3. Ignition - On / Vehicle - In Service Mode
4. Test for less than 1 V between the test points: Signal circuit terminal 1 @ Inline Harness Connector & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - Go to next step: If less than 1 V
5. Ignition/Vehicle - Off
6. Test for less than 2 ohms between the test points: Signal circuit terminal 1 @ Inline Harness Connector & Terminal 38 X3 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **Go to next step: If warmer than 149B°C (300B°F)**
8. Disconnect the electrical connector: B34 Engine Coolant Temperature Sensor
9. Connect the electrical connector: X114 Inline Harness Connector
10. Ignition - On / Vehicle - In Service Mode
11. Verify the scan tool parameter: ECT Sensor = Colder than -39B°C (-38B°F)
 - **If warmer than -39B°C (-38B°F)**

Replace the component: X114Component harness

 - **Go to next step: If colder than -39B°C (-38B°F)**
12. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Low Reference circuit terminal 2 @ B34 Engine Coolant Temperature Sensor
13. Verify the scan tool parameter: ECT Sensor = Warmer than 149B°C (300B°F)
 - **If colder than 149B°C (300B°F)**

Replace the component: X164Component harness

 - **Go to next step: If warmer than 149B°C (300B°F)**
14. Test or replace the component: B34 Engine Coolant Temperature Sensor

Component Testing

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: B34 Engine Coolant Temperature Sensor
3. Test the resistance between the test points: Each terminal of the component - B34 Engine Coolant Temperature Sensor

Verify the value is within the range listed in the table: [Temperature Versus Resistance - Engine Coolant Temperature Sensor](#)

- **If not in the specified range**

Replace the component: B34 Engine Coolant Temperature Sensor

- **Go to next step: If in the specified range**

4. Test for infinite resistance between the test points: Each terminal of the component & The component's housing

- **If less than infinite resistance**

Replace the component: B34 Engine Coolant Temperature Sensor

- **Go to next step: If infinite resistance**

5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Engine Coolant Temperature Sensor Replacement](#)
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0121-P0123, P0222, P0223, P2135, U0606, OR U0607

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 P0121

Throttle Position Sensor 1 Performance

DTC P0122

Throttle Position Sensor 1 Circuit Low Voltage

DTC P0123

Throttle Position Sensor 1 Circuit High Voltage

DTC P0222

Throttle Position Sensor 2 Circuit Low Voltage

DTC P0223

Throttle Position Sensor 2 Circuit High Voltage

DTC P2135

Throttle Position Sensor and Sensor 2 Correlation

DTC U0606

Lost Communication with Throttle Position Sensor 1

DTC U0607

Lost Communication with Throttle Position Sensor 2

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P06A3	P0122*, P0222*, U0606, U0607	P06A3	P0121, P2135*, U0606, U0607
Serial Data	P0122*, P0222*	P0122*, P0222*, U0606, U0607	P0123*, P0223*	P0121, P2135*, U0606, U0607

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
	U0606, U0607		U0606, U0607	
Low Reference	-	P0123*, P0223*, U0606, U0607	-	P0121, P2135*, U0606, U0607

*This DTC sets when there is an internal component issue: Q38 Throttle Body

Typical Scan Tool Data

Throttle Position Sensor 1

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: - Engine = Running - Accessories = Off			
Parameter Normal Range: 3.75 to 4.75 V			
5 V Reference	5.0 V	5.0 V	5.0 V
Serial Data	5.0 V	0.0 V	0.0 V
Low Reference	-	0.0 V	-

Throttle Position Sensor 2

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: - Engine = Running - Accessories = Off			
Parameter Normal Range: 0.45 to 0.90 V			
5 V Reference	0.0 V	0.0 V	0.0 V
Serial Data	0.0 V	5.0 V	5.0 V
Low Reference	-	5.0 V	-

Circuit/System Description

For an overview of the component/system, refer to [Throttle Actuator Control \(TAC\) System Description](#)

Circuit	Description
5 V Reference	Regulated voltage supplied by the control module.
Serial Data	The control module input circuit has an internal resistance connected to 5 V. Digitally encoded information for communication between devices.
Low Reference	Grounded through the control module.

Component	Description
Q38 Throttle Body	The assembly has several functions: The throttle valve is actuated by a bidirectional DC motor. A spring pulls the valve to a rest or default position, in which the valve is almost closed. The throttle actuator motor can push against the force of the

Component	Description
	spring to open or close the valve. The more current flow through the motor, the more the valve moves. The throttle body contains a contactless inductive position sensor. A fixed transmitter coil excites a movable rotor, which in turn induces a current in a fixed receiver coil. The current varies with the angle of the rotor. Electronics inside the sensor convert the current into digital data which is transmitted via a serial data circuit to the ECM.
K20 Engine Control Module	The control module contains a microprocessor used to process input data to control outputs. The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Conditions for Running the DTC

P0121

- DTC P0102, P0103, P0107, P0108, P0111 - P0114, P0116 - P0119, P0128, P0335, P0336, P111E, P14B6, U0606, U0607, U060F, U1346, U2011 = Not set
- Engine Speed = 0 to 5, 600 RPM
- Engine Coolant Temperature = -9 to 130B°C (16 to 266B°F)
- Intake Air Temperature = -20 to 129B°C (-4 to 264B°F)

Frequency the DTC runs = Continuously After the running conditions are met

P0122, P0123, P0222, P0223, P2135, U0606, U0607

- {P0122, P0123, P0222, P0223} DTC P06A3, U0606, U0607 = Not set
- {P2135} DTC P0122, P0123, P0222, P0223, P06A3, U0606, U0607 = Not set
- Ignition = On or Engine = Running
- Ignition and Start Signal = Greater than 6.4 V

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

P0121

Throttle Position Sensor 1 = Stuck in range - For greater than 1 s

P0122

Throttle Position Sensor 1 = Less than 0.3 V - For greater than 1 s

P0123

Throttle Position Sensor 1 = Greater than 4.7 V - For greater than 1 s

P0222

Throttle Position Sensor 2 = Less than 0.3 V - For greater than 1 s

P0223

Throttle Position Sensor 2 = Greater than 4.6 V - For greater than 1 s

P2135

Throttle Position Sensor 1, 2 = Not within 7 - 10% of each other - For greater than 1 s

U0606, U0607

Serial data message from component: Q38 Throttle Body = Not Received - For greater than 1 s

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type A DTC - Exceptions listed below

DTC P0121 = Type B DTC

- Reduced Engine Power = Active
- P16 Instrument Cluster = Reduced Engine Power
- Under certain conditions, the control module commands the engine Off.

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC - Exceptions listed below

DTC P0121 = Type B DTC

Diagnostic Aids

- A high resistance condition on the throttle position and throttle actuator control circuits could cause a DTC to set.
- If the accelerator pedal is pressed all the way down, the throttle blade angle and the scan tool Throttle Position angle parameter will only go to an angle less than 40%.
- Under cold start conditions, it might happen briefly that the desired and the actual throttle blade position do not match.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or **Inline Harness Connector End Views - Index** or **Component Connector End Views - Index**

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

Control Module References

Circuit/System Verification

NOTE: If you were sent here from DTC P0068, P0101, P0106, P1101 - Refer to: **Circuit/System Testing.**

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC P0601-P0607, P06A3, P16F3 is not set.

- **If any of the DTCs are set**

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

- **Go to next step: If none of the DTCs are set**

3. Verify the scan tool parameter: Throttle Body Idle Air Flow Compensation = Less than 90%

- **If 90% or greater**

Refer to **Throttle Body Inspection and Cleaning**

- **Go to next step: If less than 90%**

4. Verify DTC P0122, P0123, P0222, P0223, P2135, U0606, U0607 is not set.

- **If only DTC P0122, P0123, P0222, P0223, P2135 is set**

Replace the component: Q38 Throttle Body

- **If DTC U0606, U0607 and one or more of the DTCs P0122, P0123, P0222, P0223, P2135 is set**

Refer to: Circuit/System Testing

- **Go to next step: If none of the DTCs are set**

5. Perform the scan tool control function: Throttle Sweep - Start

Verify the scan tool parameter: Throttle Position Sensors 1 and 2 = Agree

- **If not the specified state**

Replace the component: Q38 Throttle Body

- **Go to next step: If the specified state**

6. Verify DTC P0122, P0123, P0222, P0223, P2135, U0606, U0607 is not set.

- **If any of the DTCs are set**

Refer to: Circuit/System Testing

- **Go to next step: If none of the DTCs are set**

7. Verify the scan tool parameter: MAP Sensor = The value should be within the range listed in the table:

Altitude Versus Barometric Pressure

- **If not in the specified range**

Refer to **DTC P0106, P0107, or P0108**

- **Go to next step: If in the specified range**

8. Engine - Running

9. Verify the scan tool parameter: MAP Sensor = 22 to 52 kPa (3.2 to 7.5 PSI) - The value should change with accelerator pedal input.

- **If not in the specified range or does not change**

Refer to [DTC P0106, P0107, or P0108](#)

- **Go to next step: If in the specified range and changes**

10. Observe the scan tool parameter: MAF Sensor & Engine Speed

11. Increase the engine speed slowly to 3,000 RPM and then back to idle.

12. Verify the scan tool parameter: MAF Sensor = The value should change smoothly and gradually as the engine speed is increased and decreased.

- **If the value does not change smoothly and gradually**

Refer to [DTC P0101-P0103](#)

- **Go to next step: If the value changes smoothly and gradually**

13. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC does not set**

14. All OK.

Circuit/System Testing

NOTE:

- **Disconnecting the component electrical connector causes additional DTCs to set.**
- **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: Q38 Throttle Body

3. Test for less than 5 ohms between the test points: Low Reference circuit terminal 4 & Ground

- **If 5 ohms or greater**

1. Disconnect the electrical connector: K20 Engine Control Module

2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 4 @ Component harness & The other end of the circuit @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.

- If less than 2 ohms - Replace the component: K20 Engine Control Module

- **Go to next step: If less than 5 ohms**

4. Ignition - On / Vehicle - In Service Mode

5. Test for 4.8 to 5.2 V between the test points: 5 V Reference circuit terminal 5 & Low Reference circuit terminal 4

- **If less than 4.8 V**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: K20 Engine Control Module

3. Test for infinite resistance between the test points: 5 V Reference circuit terminal 5 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
4. Test for less than 2 ohms between the test points: 5 V Reference circuit terminal 5 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
- **If greater than 5.2 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: 5 V Reference circuit terminal 5 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module
- **Go to next step: If between 4.8 and 5.2 V**
6. Test for 4.8 to 5.2 V between the test points: Serial Data circuit terminal 3 & Ground
 - **If less than 4.8 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K20 Engine Control Module
 3. Test for infinite resistance between the test points: Serial Data circuit terminal 3 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
 4. Test for less than 2 ohms between the test points: Serial Data circuit terminal 3 The other end of the circuit
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **If greater than 5.2 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Serial Data circuit terminal 3 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - Go to next step: If less than 1 V - Replace the component: K20 Engine Control Module
 - **Go to next step: If between 4.8 and 5.2 V**
7. Test or replace the component: Q38 Throttle Body

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Throttle Body Assembly Replacement](#)
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0128 OR P01F0

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 P0128

Engine Coolant Temperature (ECT) Below Thermostat Regulating Temperature

DTC P01F0

Coolant Temperature Dropped Below Diagnostic Monitoring Temperature

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0117, P0119	P0118	P0118*	P0116, P0119, P0128
Low Reference	-	P0118, P0119 **	*	P0119, P0128
*Internal control module or component damage may occur if the circuit shorts to B+.				
**Additional DTCs may set.				

Typical Scan Tool Data

ECT Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine = Idling - At normal operating temperature. Parameter Normal Range: 88 to 105B°C (190 to 221B°F)			
Signal	150B°C (302B°F)	-40B°C (-40B°F)	-40B°C (-40B°F)
Low Reference	-	-40B°C (-40B°F)	-40B°C (-40B°F)

Circuit/System Description

For an overview of the component/system, refer to [Cooling System Description and Operation \(LGZ, LWN\)](#)

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 5 V.
Low Reference	Grounded through the control module.

Component	Description
B34 Engine Coolant Temperature Sensor	The sensor is a negative temperature coefficient thermistor. As the temperature of the air, fluid, or metal increases, the resistance of the sensor decreases, varying the voltage on the signal circuit.
K20 Engine Control Module	The control module contains a microprocessor used to process input data to control outputs. The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Conditions for Running the DTC

P0128

- DTCs related to the following system/component = Not Set
 - B34 Engine Coolant Temperature Sensor
 - B66 Intake Air Temperature Sensor
 - B75C Multifunction Intake Air Sensor
 - B115 Vehicle Speed Sensor
- Engine Run Time = 30 s to 30 min
- Fuel Alcohol Content = Less than 87%
- Ignition = Off - For greater than 30 s
- Start-Up ECT = -40 to 66B°C (-40 to 151B°F)
- Vehicle Distance Traveled During Drive Cycle = Greater than 1.6 km (1 mi)

Frequency the DTC runs = Once - Per ignition cycle - After the running conditions are met

P01F0

- DTC P0116, P0117, P0118, P0119, P111E = Not set
- Ambient Air Temperature = Greater than -9B°C (21B°F)
- Barometric Pressure = Greater than 55 kPa (8 PSI)
- Cylinder Deactivation System = Inactive
- Deceleration Fuel Cut-Off = Less than 23 s
- Engine Coolant Temperature = Greater than 66B°C (150B°F)
- Engine Run Time = For greater than 30 s
- Engine Speed = Less than 8, 200 RPM
- Vehicle Distance Traveled During Drive Cycle = Greater than 1.2 km (.8 mi)

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

P0128

Engine Coolant Temperature = Not within a calibrated range - For greater than 1 s

P01F0

Engine Coolant Temperature = Colder than 65B°C (149B°F) - For greater than 60 s

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC

Cooling Fan = On

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Diagnostic Aids

The parameters for intake air temperature and engine coolant temperature should be within 3B°C (5B°F) of each other if the ignition has been Off for greater than 8 h.

High resistance in the circuits of the component may set DTC P0128, P01F0 without setting the DTC for the component: B34 Engine Coolant Temperature Sensor

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or **Inline Harness Connector End Views - Index** or **Component Connector End Views - Index**

Description and Operation

Cooling System Description and Operation (LGZ, LWN)

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. Verify the condition does not exist: Incorrect fluid level or condition - Refer to **Loss of Coolant** , & **Cooling System Draining and Filling (Static Fill)** , or **Cooling System Draining and Filling (Vac n Fill)**

- **If a condition exists**

Repair or replace as necessary

- **Go to next step: If no condition exists**

2. Verify there are no DTCs set related to the following component/system: B34 Engine Coolant Temperature Sensor

- **If a related DTC is set**

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

- **Go to next step: If a related DTC is not set**

3. Engine - Running @ 1, 800 to 2, 200 RPM

Verify the scan tool parameter: ECT Sensor = Greater than 80B°C (176B°F) - Within 15 min

- **If 80B°C (176B°F) or colder**

Test or replace the component: Engine Coolant Thermostat

- **Go to next step: If warmer than 80B°C (176B°F)**

4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC does not set**

5. 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: X114 Inline Harness Connector

NOTE: Testing for steps 3 to 7 is performed on the control module K20 side of the harness connector.

3. Test for less than 10 ohms between the test points: Low Reference circuit terminal 2 @ X114 Inline Harness Connector & Ground
 - **If 10 ohms or greater**
 1. Disconnect the electrical connector: X2 @ K20 Engine Control Module
 2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 2 @ X114 Inline Harness Connector & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **Go to next step: If less than 10 ohms**
4. Ignition - On / Vehicle - In Service Mode
5. Verify the scan tool parameter: ECT Sensor = Colder than -39B°C (-38B°F)
 - **If warmer than -39B°C (-38B°F)**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: X3 @ K20 Engine Control Module
 3. Test for infinite resistance between the test points: Signal circuit terminal 1 @ X114 Inline Harness Connector & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module
 - **Go to next step: If colder than -39B°C (-38B°F)**
6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Low Reference circuit terminal 2 @ X114 Inline Harness Connector
7. Verify the scan tool parameter: ECT Sensor = Warmer than 149B°C (300B°F)
 - **If 149B°C (300B°F) or colder**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the electrical connector: X3 @ K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode

4. Test for less than 1 V between the test points: Signal circuit terminal 1 @ X114 Inline Harness Connector & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - Go to next step: If less than 1 V
5. Ignition/Vehicle - Off
6. Test for less than 2 ohms between the test points: Signal circuit terminal 1 @ X114 Inline Harness Connector & Terminal 38 X3 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **Go to next step: If warmer than 149B°C (300B°F)**
8. Disconnect the electrical connector: B34 Engine Coolant Temperature Sensor
9. Connect the electrical connector: X114 Inline Harness Connector
10. Ignition - On / Vehicle - In Service Mode
11. Verify the scan tool parameter: ECT Sensor = Colder than -39B°C (-38B°F)
 - **If warmer than -39B°C (-38B°F)**

Replace the component: X114Component harness
 - **Go to next step: If colder than -39B°C (-38B°F)**
12. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Low Reference circuit terminal 2 @ B34 Engine Coolant Temperature Sensor
13. Verify the scan tool parameter: ECT Sensor = Warmer than 149B°C (300B°F)
 - **If colder than 149B°C (300B°F)**

Replace the component: X114Component harness
 - **Go to next step: If warmer than 149B°C (300B°F)**
14. Test or replace the component: B34 Engine Coolant Temperature Sensor

Component Testing

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: B34 Engine Coolant Temperature Sensor
3. Test the resistance between the test points: Each terminal of the component - B34 Engine Coolant Temperature Sensor

Verify the value is within the range listed in the table: [Temperature Versus Resistance - Engine Coolant Temperature Sensor](#)

- **If not in the specified range**

Replace the component: B34 Engine Coolant Temperature Sensor
 - **Go to next step: If in the specified range**
4. Test for infinite resistance between the test points: Each terminal of the component & The component's housing
 - **If less than infinite resistance**

Replace the component: B34 Engine Coolant Temperature Sensor
 - **Go to next step: If infinite resistance**
 5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Engine Coolant Temperature Sensor Replacement](#)
- [Engine Coolant Thermostat Housing Replacement \(LGZ\)](#) - Engine Coolant Thermostat
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0131, P0132, P0137, P0138, P0151, P0152, P0157, OR P0158

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 P0131

HO2S Circuit Low Voltage Bank 1 Sensor 1

DTC P0132

HO2S Circuit High Voltage Bank 1 Sensor 1

DTC P0137

HO2S Circuit Low Voltage Bank 1 Sensor 2

DTC P0138

HO2S Circuit High Voltage Bank 1 Sensor 2

DTC P0151

HO2S Circuit Low Voltage Bank 2 Sensor 1

DTC P0152

HO2S Circuit High Voltage Bank 2 Sensor 1

DTC P0157

HO2S Circuit Low Voltage Bank 2 Sensor 2

DTC P0158

HO2S Circuit High Voltage Bank 2 Sensor 2

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal - Terminal 4	P0131, P0137, P0151, P0157	P0132, P0138, P0152, P0158	P0132, P0138, P0152, P0158	P0133, P013A, P013B, P013C, P013D, P013E, P013F, P014A,

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
				P014B, P0153, P015A, P015B, P015C, P015D
Signal - Terminal 3	P0131, P0137, P0151, P0157	P0132, P0138, P0152, P0158	P0132, P0138, P0152, P0158	P0133, P013A, P013B, P013C, P013D, P013E, P013F, P014A, P014B, P0153, P015A, P015B, P015C, P015D

Typical Scan Tool Data

HO2S Bank 1, 2 Sensor 1, 2

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Engine = Running - At normal operating temperature. Parameter Normal Range: 200 to 800 mV			
Signal - Terminal 4	0 V	1.5 to 2.1 V	1.5 to 2.1 V
Signal - Terminal 3	0 V	1.5 to 2.1 V	1.5 to 2.1 V

Circuit/System Description

Circuit	Description
Signal - Terminal 4	The control module input circuit has an internal resistance connected to 5 V.
Signal - Terminal 3	Grounded through the control module.

Component	Description
B52 Heated Oxygen Sensor	When the engine is started, the ECM operates in an open loop mode, ignoring the HO2S signal voltage while calculating the air to fuel ratio. While the engine runs, the HO2S heats up and begins to generate a voltage within a range of 40 to 1050 mV. Once sufficient HO2S voltage fluctuation is observed by the ECM, closed loop is entered. The control module uses the HO2S voltage to determine the air to fuel ratio. An HO2S voltage that increases toward 1000 mV indicates a rich fuel mixture. An HO2S voltage that decreases toward 0 mV indicates a lean fuel mixture.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Conditions for Running the DTC

P0131, P0132

- DTC P0030, P0031, P0032, P0135 = Not set

P0137, P0151, P0157

- DTCs related to the following system/component = Not Set
 - B74 Manifold Absolute Pressure Sensor
 - Q17 Fuel Injector

- Q38 Throttle Body
- Evaporative Emission (EVAP) System
- Fuel Tank Pressure Sensor
- Deceleration Fuel Cut-Off = Inactive
- Device controls are not active.
- Fuel Alcohol Content = Less than 87%
- Fuel level = Greater than 10%
- Fuel System = Closed Loop
- Ignition Voltage = Greater than 10 V

Frequency the DTC runs = Continuously - After the running conditions are met - For greater than 5 s

P0138, P0152, P0158

- DTCs related to the following system/component = Not Set
 - B74 Manifold Absolute Pressure Sensor
 - B75C Multifunction Intake Air Sensor
 - Q17 Fuel Injector
 - Q38 Throttle Body
 - Evaporative Emission (EVAP) System
 - Fuel Tank Pressure Sensor
- Engine = Running - For greater than 5 s
- Fuel Alcohol Content = Less than 87%
- Fuel level = Greater than 10%
- Fuel System = Closed Loop
- Ignition = Off - For greater than 8 h
- Ignition Voltage = Greater than 10 V

Frequency the DTC runs = Continuously - After the running conditions are met - For greater than 5 s

Conditions for Setting the DTC

P0131, P0137, P0151, P0157

Heated Oxygen Sensor = Less than 40 mV - For greater than 50 s

P0132, P0138, P0152, P0158

Heated Oxygen Sensor = Greater than 1050 mV - For greater than 15 s

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

Engine Controls Wiring Schematics

Connector End View Reference

[Master Electrical Component List](#) , or [Inline Harness Connector End Views - Index](#) or [Component Connector End Views - Index](#)

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 there are no DTCs set related to the following component/system: HO2S Heater
 - **If any of the DTCs are set**

Refer to: Circuit/System Testing [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **Go to next step: If the DTC is not set**

3. Engine - Running

4. Verify the scan tool parameter:

- HO2S Bank 1 Sensor 1 = 50 to 1,050 mV
- HO2S Bank 1 Sensor 2 = 50 to 1,050 mV
- HO2S Bank 2 Sensor 1 = 50 to 1,050 mV
- HO2S Bank 2 Sensor 2 = 50 to 1,050 mV
- **If not between 50 and 1,050 mV**

Refer to: Circuit/System Testing

- **Go to next step: If between 50 and 1,050 mV**

5. Verify the scan tool parameter:

- HO2S Bank 1 Sensor 1 = The value should not spike or drop out.
- HO2S Bank 1 Sensor 2 = The value should not spike or drop out.
- HO2S Bank 2 Sensor 1 = The value should not spike or drop out.
- HO2S Bank 2 Sensor 2 = The value should not spike or drop out.

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: B52 Heated Oxygen Sensor
- Wiggle the harness and connector: K20 Engine Control Module
- **If the value spikes or drops out**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If the value does not spike or drop out**

6. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

7. All OK.

Circuit/System Testing

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the appropriate electrical connector: B52 Heated Oxygen Sensor
3. Ignition - On / Vehicle - In Service Mode & Engine - Off
4. Test for 1.5 to 3.0 V between the test points: Signal circuit terminal 4 & Ground
 - **If less than 1.5 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: X2 @ K20 Engine Control Module
 3. Test for infinite resistance between the test points: Signal circuit terminal 4 & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
 4. Test for less than 2 ohms between the test points: Signal circuit terminal 4 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Test or replace the component: K20 Engine Control Module
 - **If greater than 3.0 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: X2 @ K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 4 & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module
 - **Go to next step: If between 1.5 and 3.0 V**
5. Verify the scan tool parameter:
 - HO2S Bank 1 Sensor 1 = 1.5 to 2.1 V
 - HO2S Bank 1 Sensor 2 = 1.5 to 2.1 V
 - HO2S Bank 2 Sensor 1 = 1.5 to 2.1 V
 - HO2S Bank 2 Sensor 2 = 1.5 to 2.1 V
 - **If less than 1.5 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the appropriate electrical connector: X2 @ K20 Engine Control Module
 3. Test for infinite resistance between the test points: Signal circuit terminal 3 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module

- **Go to next step: If between 1.5 and 2.1 V**

6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 4 & Signal circuit terminal 3
7. Verify the scan tool parameter:
 - HO2S Bank 1 Sensor 1 = 0.0 V
 - HO2S Bank 1 Sensor 2 = 0.0 V
 - HO2S Bank 2 Sensor 1 = 0.0 V
 - HO2S Bank 2 Sensor 2 = 0.0 V
 - **If greater than 0.0 V**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the electrical connector: X2 @ K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 3 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - Go to next step: If less than 1 V
 5. Ignition/Vehicle - Off
 6. Test for less than 2 ohms between the test points: Signal circuit terminal 3 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **Go to next step: If 0.0 V**
8. Verify the following conditions do not exist:
 - B52 Heated Oxygen Sensor - Water intrusion @ Harness Connector
 - Evaporative Emission Canister - Saturated with fuel
 - Exhaust System - Leaking
 - Fuel - Contaminated/Poor Quality - Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#)
 - Fuel Pressure - High/Low - Refer to [Fuel System Diagnosis](#)
 - Vacuum leak @ Engine/Hoses / Lines
 - **If a condition exists**

Repair or replace as necessary
 - **Go to next step: If no conditions exist**
9. Test or replace the component: B52 Heated Oxygen Sensor

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Heated Oxygen Sensor Replacement - Bank 1 Sensor 1](#)
- [Heated Oxygen Sensor Replacement - Bank 1 Sensor 2](#)
- [Heated Oxygen Sensor Replacement - Bank 2 Sensor 1](#)
- [Heated Oxygen Sensor Replacement - Bank 2 Sensor 2](#)
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P013A-P013F, P014A, P014B, P015A-P015D, OR P2270-P2273

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 P013A

HO2S Slow Response Rich to Lean Bank 1 Sensor 2

DTC P013B

HO2S Slow Response Lean to Rich Bank 1 Sensor 2

DTC P013C

HO2S Slow Response Rich to Lean Bank 2 Sensor 2

DTC P013D

HO2S Slow Response Lean to Rich Bank 2 Sensor 2

DTC P013E

HO2S Delayed Response Rich to Lean Bank 1 Sensor 2

DTC P013F

HO2S Delayed Response Lean to Rich Bank 1 Sensor 2

DTC P014A

HO2S Delayed Response Rich to Lean Bank 2 Sensor 2

DTC P014B

HO2S Delayed Response Lean to Rich Bank 2 Sensor 2

DTC P015A

HO2S Delayed Response Rich to Lean Bank 1 Sensor 1

DTC P015B

HO2S Delayed Response Lean to Rich Bank 1 Sensor 1

DTC P015C

HO2S Delayed Response Rich to Lean Bank 2 Sensor 1

DTC P015D

HO2S Delayed Response Lean to Rich Bank 2 Sensor 1

DTC P2270

HO2S Signal Stuck Lean Bank 1 Sensor 2

DTC P2271

HO2S Signal Stuck Rich Bank 1 Sensor 2

DTC P2272

HO2S Signal Stuck Lean Bank 2 Sensor 2

DTC P2273

HO2S Signal Stuck Rich Bank 2 Sensor 2

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal - Terminal 4	P0131, P0137, P0151, P0157	P0132, P0134, P0138, P0140, P0152, P0154, P0158, P0160	P0132, P0134, P0138, P0140, P0152, P0154, P0158, P0160	P013A, P013B, P013C, P013D, P013E, P013F, P014A, P014B, P015A, P015B, P015C, P015C, P015D
Signal - Terminal 3	P0131, P0137, P0151, P0157	P0132, P0134, P0138, P0140, P0152, P0154, P0158, P0160	P0132, P0134, P0138, P0140, P0152, P0154, P0158, P0160	P013A, P013B, P013C, P013D, P013E, P013F, P014A, P014B, P015A, P015B, P015C, P015C, P015D

Typical Scan Tool Data

HO2S 1, 2

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: - Engine = Idling - At normal operating temperature. - Fuel System = Closed Loop			
Parameter Normal Range: 200 to 800 mV			
Signal - Terminal 4	0 V	1.7 to 2.1 V	1.7 to 2.1 V
Signal - Terminal 3	0 V	1.7 to 2.1 V	1.7 to 2.1 V

Circuit/System Description

Circuit	Description
Signal - Terminal 4	The control module input circuit has an internal resistance connected to 5 V.
Signal - Terminal 3	The control module input circuit has an internal resistance connected to ground.

Component	Description
B52 Heated Oxygen Sensor	When the engine is started, the ECM operates in an open loop mode, ignoring the HO2S signal voltage while calculating the air to fuel ratio. While the engine runs, the HO2S heats up and begins to generate a voltage within a range of 40 to 1,050 mV. Once sufficient HO2S voltage

Component	Description
	fluctuation is observed by the ECM, closed loop is entered. The control module uses the HO2S voltage to determine the air to fuel ratio. An HO2S voltage that increases toward 1,000 mV indicates a rich fuel mixture. An HO2S voltage that decreases toward 0 mV indicates a lean fuel mixture.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Conditions for Running the DTC

P013A, P013C, P013E, P014A

- {P013A} DTC P013B, P013E, P013F, P2270, P2271 = Not set
- {P013C} DTC P013D, P014A, P014B, P2272, P2273 = Not set
- {P013E} DTC P013A, P013B, P013F, P2270, P2271 = Not set
- {P014A} DTC P013C, P013D, P014B, P2272, P2273 = Not set
- DTC P0131, P0132, P0134, P0151, P0152, P0154, P2195, P2196, P2197, P2198, P2A00, P2A03 = Not set
- DTCs related to the following system/component = Not Set
 - B34 Engine Coolant Temperature Sensor
 - B74 Manifold Absolute Pressure Sensor
 - B75C Multifunction Intake Air Sensor
 - B198 Fuel Composition Sensor
 - Q17 Fuel Injector
 - Q38 Throttle Body
 - Engine Misfire
 - Fuel Trim System
- {P013A} DTC P013E, P014A, P2270, P2272 = Run & Passed
- {P013C} DTC P014A, P2272 = Run & Passed
- {P013E} DTC P2270 = Run & Passed
- {P014A} DTC P2272 = Run & Passed
- Accelerator Pedal Position = Not Pressed
- Deceleration Fuel Cut-Off = Active
- Engine = Off - For greater than 8 h
- Engine Run Time = Greater than 5 min
- Fuel level = Greater than 10%
- HO2S Heater Resistance Learn Status = Valid
- Ignition Voltage = Greater than 10 V

Frequency the DTC runs = Once - Per drive cycle - After the running conditions are met

P013B, P013D, P013F, P014B

- {P013B} DTC P013A, P013E, P013F, P2270, P2271 = Not set
- {P013D} DTC P013C, P014A, P014B, P2272, P2273 = Not set
- {P013F} DTC P013A, P013B, P013E, P2270, P2271 = Not set
- {P014B} DTC P013C, P013D, P014A, P2272, P2273 = Not set

- DTC P0131, P0132, P0134, P0151, P0152, P0154, P2195, P2196, P2197, P2198, P2A00, P2A03 = Not set
- DTCs related to the following system/component = Not Set
 - B34 Engine Coolant Temperature Sensor
 - B74 Manifold Absolute Pressure Sensor
 - B75C Multifunction Intake Air Sensor
 - B198 Fuel Composition Sensor
 - Q17 Fuel Injector
 - Q38 Throttle Body
 - Engine Misfire
 - Fuel Trim System
- {P013B} DTC P013A, P013E, P013F, P2270, P2271 = Run & Passed
- {P013D} DTC P013C, P014A, P014B, P2272, P2273 = Run & Passed
- {P013F} DTC P013A, P013E, P2270, P2271 = Run & Passed
- {P014B} DTC P013C, P014A, P2272, P2273 = Run & Passed
- Engine = Off - For greater than 8 h
- Engine Run Time = Greater than 5 min
- Fuel level = Greater than 10%
- HO2S Heater Resistance Learn Status = Valid
- Ignition Voltage = Greater than 10 V

Frequency the DTC runs = Once - Per drive cycle - After the running conditions are met

P015A, P015B, P015C, P015D

- {P015A} DTC P0131, P0132, P013A, P013B, P013E, P013F, P2270, P2271 = Not set
- {P015B} DTC P0131, P0132, P013A, P013B, P013E, P013F, P015A, P2270, P2271 = Not set
- {P015C} DTC P0151, P0152, P013C, P013D, P014A, P014B, P2272, P2273 = Not set
- {P015D} DTC P0151, P0152, P013C, P013D, P014A, P014B, P015C, P2272, P2273 = Not set
- {P015D} DTC P015C = Passed
- DTCs related to the following system/component = Not Set
 - B9 Ambient Air Temperature Sensor
 - B34 Engine Coolant Temperature Sensor
 - B74 Manifold Absolute Pressure Sensor
 - B75C Multifunction Intake Air Sensor
 - B150 Fuel Tank Pressure Sensor
 - B198 Fuel Composition Sensor
 - Q17 Fuel Injector
 - Q38 Throttle Body
 - Engine Misfire
 - Evaporative Emission (EVAP) System
 - Fuel Trim System
- BARO Sensor = Greater than 70 kPa (10 PSI)
- {P015A, P015C} Deceleration Fuel Cut-Off = Active
- {P015B, P015D} Deceleration Fuel Cut-Off = Inactive
- {P015A, P015B} Calculated Catalyst Temperature = 550 to 910B°C (1, 022 to 1, 670B°F)
- {P015C, P015D} Calculated Catalyst Temperature = 500 to 1, 000B°C (932 to 1, 832B°F)

- {P015A, P015B} Engine Speed = 1, 100 to 3, 650 RPM
- {P015C, P015D} Engine Speed = 1, 000 to 2, 050 RPM
- {P015A, P015B} Engine Coolant Temperature = Warmer than 60B°C (140B°F)
- {P015C, P015D} Engine Coolant Temperature = Warmer than 50B°C (122B°F)
- Engine Run Time = Greater than 30 s
- EVAP Test = Not Running
- Fuel Control Loop Status = Closed Loop
- Fuel level = Greater than 10%
- Heated Oxygen Sensor = Greater than 690 mV
- {P015A, P015B} HO2S 1 Heater Command = On - For greater than 30 s
- {P015A, P015B} HO2S 2 Heater Command = On - For greater than 30 s
- {P015C, P015D} HO2S 1 Heater Command = On - For greater than 40 s
- {P015C, P015D} HO2S 2 Heater Command = On - For greater than 60 s
- HO2S Heater Resistance Learn Status = Valid
- IAT Sensor = Warmer than -40B°C (-40B°F)
- Ignition Voltage = Greater than 10 V
- {P015A} MAF Sensor = 2 to 20 g/s
- {P015B} MAF Sensor = 2 to 12 g/s
- {P015C, P015D} MAF Sensor = 4 to 20 g/s
- Scan Tool Device Control: = Not Activated
- {P015A, P015B} Vehicle Speed = 60 to 129 km/h (36 to 80 MPH)
- {P015C, P015D} Vehicle Speed = 61 to 140 km/h (38 to 87 MPH)

Frequency the DTC runs = Once - Per drive cycle - After the running conditions are met

P2270, P2272

- {P2270} DTC P013A, P013B, P013E, P013F, P2270, P2271 = Not set
- {P2272} DTC P013C, P013D, P014A, P014B, P2272, P2273 = Not set
- DTCs related to the following system/component = Not Set
 - B34 Engine Coolant Temperature Sensor
 - B74 Manifold Absolute Pressure Sensor
 - B75C Multifunction Intake Air Sensor
 - B198 Fuel Composition Sensor
 - Q17 Fuel Injector
 - Q38 Throttle Body
 - Engine Misfire
 - Fuel Trim System
- Accelerator Pedal Position = Less than 3%
- Calculated Catalyst Temperature = 550 to 910B°C (1, 022 to 1, 670B°F)
- Deceleration Fuel Cut-Off = Active
- Engine Speed = 1, 100 to 3, 650 RPM
- EVAP Test = Not Running
- Fuel Control Loop Status = Closed Loop
- Fuel level = Greater than 10%
- HO2S 2 Heater Command = On - For greater than 30 s
- HO2S Heater Resistance Learn Status = Valid

- Ignition Voltage = Greater than 10 V
- MAF Sensor = 2 to 20 g/s
- Vehicle Speed = 60 to 129 km/h (36 to 80 MPH)

Frequency the DTC runs = Once - Per drive cycle - After the running conditions are met

P2271, P2273

- {P2271} DTC P013A, P013B, P013E, P013F, P2270, P2271 = Not set
- {P2273} DTC P013C, P013D, P014A, P014B, P2272 = Not set
- DTCs related to the following system/component = Not Set
 - B34 Engine Coolant Temperature Sensor
 - B74 Manifold Absolute Pressure Sensor
 - B75C Multifunction Intake Air Sensor
 - B198 Fuel Composition Sensor
 - Q17 Fuel Injector
 - Q38 Throttle Body
 - Engine Misfire
 - Fuel Trim System
- {P2271} P013A, P013E, P2270 = Run & Passed
- {P2273} P013C, P014A, P2272 = Run & Passed
- Deceleration Fuel Cut-Off = Active
- Fuel level = Greater than 10%
- HO2S Heater Resistance Learn Status = Valid
- Ignition Voltage = Greater than 10 V

Frequency the DTC runs = Once - Per drive cycle - After the running conditions are met

Conditions for Setting the DTC

P013A, P013C

MAF Sensor = Not within a calibrated range & HO2S 2 = 150 to 450 mV

P013B, P013D

MAF Sensor = Not within a calibrated range & HO2S 2 = 350 to 650 mV

P013E, P014A

MAF Sensor = Not within a calibrated range & HO2S 2 = Greater than 450 mV

P013F, P014B

MAF Sensor = Not within a calibrated range & HO2S 2 = Less than 350 mV

P015A, P015B, P015C, P015D

HO2S 1 = Not within a calibrated range - For greater than 60 s

P2270, P2272

MAF Sensor = Not within a calibrated range & HO2S 2 = Less than 760 mV

P2271, P2273

MAF Sensor = Not within a calibrated range & HO2S 2 = Greater than 100 mV

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC - Exceptions listed below

DTC P013A, P013B, P013C, P013D, P015A, P015B, P015C, P015D = Type A DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC - Exceptions listed below

DTC P013A, P013B, P015A, P015B = Type A DTC

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or **Inline Harness Connector End Views - Index** or **Component Connector End Views - Index**

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 there are no DTCs set related to the following component/system: HO2S Heater
 - **If a related DTC is set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**
 - **Go to next step: If a related DTC is not set**
3. Verify the condition does not exist:
 - B52 Heated Oxygen Sensor - Water intrusion @ Harness Connector
 - Coolant consumption - Refer to **Loss of Coolant**
 - Engine - Vacuum leak
 - Engine Oil - Oil consumption - Refer to **Oil Consumption Diagnosis**
 - Evaporative Emission Canister - Saturated with fuel
 - Exhaust System - Cracked/Leaking/Loose Clamps/Missing components/Restricted - Refer to **Symptoms - Engine Exhaust**

- Fuel - Contaminated/Poor Quality - Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#)
- Fuel Injectors - Restricted/Stuck - Refer to [Fuel Injector Diagnosis](#)
- Fuel Pressure - High/Low - Refer to [Fuel System Diagnosis](#)
- **If a condition exists**

Repair or replace as necessary

- **Go to next step: If no condition exists**

4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Replace the appropriate component: B52 Heated Oxygen Sensor

- **Go to next step: If the DTC is not set**

5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Heated Oxygen Sensor Replacement - Bank 1 Sensor 1](#)
- [Heated Oxygen Sensor Replacement - Bank 1 Sensor 2](#)
- [Heated Oxygen Sensor Replacement - Bank 2 Sensor 1](#)
- [Heated Oxygen Sensor Replacement - Bank 2 Sensor 2](#)
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0171, P0172, P0174, OR P0175

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 P0171

Fuel Trim System Lean Bank 1

DTC P0172

Fuel Trim System Rich Bank 1

DTC P0174

Fuel Trim System Lean Bank 2

DTC P0175

Fuel Trim System Rich Bank 2

Circuit/System Description

For an overview of the component/system, refer to [Fuel System Description](#)

Conditions for Running the DTC

P0171, P0172, P0174, P0175

- {P0171} DTC P0455 = Not set
- DTCs related to the following system/component = Not Set
 - B52 Heated Oxygen Sensor
 - B74 Manifold Absolute Pressure Sensor
 - B75C Multifunction Intake Air Sensor
 - B198 Fuel Composition Sensor
 - Q12 Evaporative Emission Purge Solenoid Valve
 - Q17 Fuel Injector
 - Engine Misfire
 - EVAP System
 - Fuel Trim System
- Barometric Pressure = Greater than 70 kPa (10.2 PSI)
- Device controls are not active.
- Engine Coolant Temperature = -20 to 150B°C (-7 to 302B°F)
- {P0171, P0172} Engine Speed = 400 to 6, 100 RPM
- {P0174, P0175} Engine Speed = 372 to 7, 000 RPM
- {P0172} EVAP Purge Solenoid Valve Command. = Less than 26%
- {P0175} EVAP Purge Solenoid Valve Command. = Less than 100%
- Fuel Control Loop Status = Closed Loop
- Fuel level = Greater than 10%
- IAT Sensor = -20 to 150B°C (-7 to 302B°F)
- MAF Sensor = 1 to 510 g/s
- Long Term Fuel Trim = Enabled
- MAP Sensor. = 10 to 255 kPa (2 to 37 PSI)

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

The limit to correct a lean air/fuel ratio has been exceeded. - After the running conditions are met - For greater than 3 min

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

- Inspect for aftermarket devices which may affect the operation of the system.
- The ideal fuel trim values are around 0%. A positive fuel trim value indicates that the ECM is adding fuel in order to compensate for a lean condition. A negative fuel trim value indicates that the ECM is reducing the amount of fuel in order to compensate for a rich condition.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

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 there are no DTCs set related to the following component/system:
 - B52 Heated Oxygen Sensor
 - B74 Manifold Absolute Pressure Sensor
 - B75C Multifunction Intake Air Sensor
 - B198 Fuel Composition Sensor
 - Q12 Evaporative Emission Purge Solenoid Valve
 - Q17 Fuel Injector
 - Engine Misfire
 - EVAP System
 - Fuel Trim System
 - **If a related DTC is set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle

- **Go to next step: If a related DTC is not set**

3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify DTC P0171, P0172, P0174, P0175 is not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If no DTC is set**

4. All OK.

Circuit/System Testing

1. Ignition - On / Vehicle - In Service Mode
2. Verify the scan tool parameter: MAP Sensor = [Altitude Versus Barometric Pressure](#) - The value should be within the range listed in the table.

- **If not in the specified range**

Refer to [DTC P0106, P0107, or P0108](#)

- **Go to next step: If in the specified range**

3. Engine - Idling - At normal operating temperature
4. Verify the scan tool parameter: Long Term Fuel Trim Bank 1, 2 = -10 to 10%

- **If greater than 10%**

1. Ignition/Vehicle - Off

2. Verify the following conditions do not exist:

- A cracked EVAP canister.
- Air Cleaner Element - Missing
- Exhaust System - Leaking/Missing components/Restricted - Refer to [Symptoms - Engine Exhaust](#)
- Fuel - Contaminated/Poor Quality - Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#)
- Fuel Injector - Malfunction - Refer to [Fuel Injector Diagnosis](#)
- Fuel Pressure Low - Refer to [Fuel System Diagnosis](#)
- Insufficient amount of fuel in the tank.
- Intake Manifold - Leaking
- Intake Air Duct - Loose Clamps/Cracked/Visible Damage
- Mass Airflow Sensor - Contamination of the measuring element/Water intrusion
- Positive Crankcase Ventilation System - Incorrect connection/Leaking/Restricted - Refer to [Crankcase Ventilation System Inspection/Diagnosis](#)
- Vacuum Hoses - Incorrect connection/Kinked/Leaking/Restricted
- If a condition exists - Repair or replace as necessary
- If no condition exists - Refer to [Symptoms - Engine Mechanical](#)

- **If less than -10%**

1. Ignition/Vehicle - Off

2. Verify the following conditions do not exist:

- Air Cleaner Element - Dirty/Restricted/Saturated with water
- Evaporative Emission (EVAP) System - Saturated with fuel/Missing components/Visible Damage
- Exhaust System/Catalyst System - Leaking/Missing components/Restricted/Severe discoloration caused by excessive temperatures/Visible Damage - Refer to [Symptoms - Engine Exhaust](#)
- Fuel - Contaminated/Poor Quality - Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#)
- Fuel Injector - Malfunction - Refer to [Fuel Injector Diagnosis](#)
- Fuel Pressure - High - Refer to [Fuel System Diagnosis](#)
- Intake Air Duct - Collapsed/Visible Damage
- MAF Sensor - Contamination of the measuring element
- Positive Crankcase Ventilation System - Saturated with fuel - Refer to [Crankcase Ventilation System Inspection/Diagnosis](#)
- If a condition exists - Repair or replace as necessary

- If no condition exists - Refer to [Symptoms - Engine Mechanical](#)

- **Go to next step: If between -10 and 10%**

5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify DTC P0171, P0172, P0174, P0175 is not set.

- **If the DTC sets**

Repeat step 4

- **Go to next step: If no DTC is set**

6. All OK.

Repair Instructions

- Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)
- Perform the special tool function: Fuel Trim Reset

DTC P0182, P0183, P0187, P0188, P0191, P0192, P111F, P126E, P126F, P127C, P128A, P128B, P16E4, OR P16E5

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 P0182

Fuel Temperature Sensor Circuit Low Voltage

DTC P0183

Fuel Temperature Sensor Circuit High Voltage

DTC P0187

Fuel Rail Temperature Sensor Circuit Low Voltage

DTC P0188

Fuel Rail Temperature Sensor Circuit High Voltage

DTC P0191

Fuel Rail Pressure Sensor Performance

DTC P0192

Fuel Rail Pressure Sensor Circuit Low Voltage

DTC P111F

Fuel Temperature Sensor 1 - Fuel Temperature Sensor 2 Not Plausible

DTC P126E

Fuel Rail Temperature Sensor 1 Performance

DTC P126F

Fuel Rail Temperature Sensor 2 Performance

DTC P127C

Fuel Rail Pressure Sensor 2 Circuit Low Voltage

DTC P128A

Fuel Rail Pressure Sensor 1 Internal Performance

DTC P128B

Fuel Rail Pressure Sensor 2 Internal Performance

DTC P16E4

Sensor Communication Circuit 3 Low Voltage

DTC P16E5

Sensor Communication Circuit 3 High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0182*, P0187*, P0641**	P128C**, P128D**, P128F**, P16E4, P16E5	P0641**, P16E5	P111F, P126E, P126F
Signal	P16E4	P16E5	P16E5	P111F, P126E, P126F
Low Reference	-	P16E5	-	P111F, P126E, P126F
*This DTC sets when there is an internal component issue: B310 Fuel Pressure/Temperature Sensor **Additional DTCs may set.				

Typical Scan Tool Data

Fuel Rail Pressure Sensor 1 & Fuel Rail Pressure Sensor 2

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine at Idle Parameter Normal Range: 3.9 to 4.2 MPa (565 to 609 PSI)			
5 V Reference	655.4 MPa (95058 PSI)	655.4 MPa (95058 PSI)	655.4 MPa (95058 PSI)
Signal	655.4 MPa (95058 PSI)	655.4 MPa (95058 PSI)	655.4 MPa (95058 PSI)
Low Reference	-	655.4 MPa (95058 PSI)	-

Fuel Rail Temperature Sensor 1 & Fuel Rail Temperature Sensor 2

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine at Idle Parameter Normal Range: -40 to 115B°C (-40 to 240B°F)			
5 V Reference	-40	-40	-40
Signal	-40	-40	-40
Low Reference	-	-40	-

Circuit/System Description

Circuit	Description
5 V Reference	Regulated voltage supplied by the control module.
Signal	Digitally encoded information for communication between devices.
Low Reference	Grounded through the control module.

Component	Description
B310 Fuel Pressure/Temperature Sensor	The sensor measures fuel rail pressure and fuel rail temperature.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

The control module uses the fuel rail pressure sensor to constantly adjust the high pressure fuel pump's feed rate so that the ideal pressure is maintained in the high pressure section (between the high pressure fuel pump and the injectors) by means of a closed loop control. The fuel rail pressure sensor transmits fuel pressure and temperature information via serial data to the control module K20. The sensor's internal microprocessor allows 4 separate sensor outputs from one 3 wire sensor.

Conditions for Running the DTC

P0182, P0183

- DTC P126E, P128C, P16E4, P16E5 = Not set
- DTC P126E, P128C = Not pending
- Ignition = On

DTC runs continuously when the above conditions are met.

P0187, P0188

- DTC P126E, P128C, P16E4, P16E5 = Not set
- DTC P126F, P128D = Not pending
- Ignition = On

DTC runs continuously when the above conditions are met.

P0191, P0192

- DTC P126E, P128C, P16E4, P16E5 = Not set
- DTC P126F, P128D = Not pending
- Ignition = On

DTC runs continuously when the above conditions are met.

P111F

- DTC P0182, P0183, P0187, P0188, P126E, P126F, P128C, P128D, P16E4, P16E5 = Not set
- DTC P128C, P128D, P16E4, P16E5 = Not pending
- Ignition = On

DTC runs continuously when the above conditions are met.

P126E, P126F

- DTC P128C, P16E4, P16E5 = Not set
- DTC P128C = Not pending
- Ignition = On

DTC runs continuously when the above conditions are met.

P127C

- DTC P126E, P128C, P16E4, P16E5 = Not set
- DTC P126F, P128D = Not pending
- Ignition = On

DTC runs continuously when the above conditions are met.

P128A, P128B

- DTC P128F, P16E4, P16E5 = Not set
- Ignition On

DTC runs continuously when the above conditions are met.

P16E4, P16E5

- DTC P0641, P0651, P0697, P06A3 = Not set
- Ignition On

DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

P0182

Fuel Rail Temperature Sensor 1 = Less than a predefined threshold - For greater than 4 s

P0183

Fuel Rail Temperature Sensor 1 = Greater than a predefined threshold - For greater than 4 s

P0187

Fuel Rail Temperature Sensor 2 = Less than a predefined threshold - For greater than 4 s

P0188

Fuel Rail Temperature Sensor 2 = Greater than a predefined threshold - For greater than 4 s

P0191

Fuel Rail Pressure Sensor 2 = Greater than a predefined threshold - For greater than 2.6 s

P0192

Fuel Rail Pressure Sensor 2 = Greater than a predefined threshold - For greater than 2.6 s

P111F

The following parameters are not within 10B°C (50B°F) of each other:

- Fuel Rail Temperature Sensor 1
- Fuel Rail Temperature Sensor 2

The above condition(s) must occur for greater than 8 s.

P126E

Fuel Rail Temperature Sensor 1 = Greater than the maximum threshold - For greater than 4 s

P126F

Fuel Rail Temperature Sensor 2 = Greater than the maximum threshold - For greater than 4 s

P127C

Fuel Rail Pressure Sensor 2 = Greater than a predefined threshold - For greater than 2.6 s

P128A

Fuel Rail Pressure Sensor 1 = Greater than a predefined threshold - For greater than 2.6 s

P128B

Fuel Rail Pressure Sensor 2 = Greater than a predefined threshold - For greater than 2.6 s

P16E4

Fuel Rail Pressure Sensor Signal = Less than a predefined threshold - For greater than 3.25 s

P16E5

Fuel Rail Pressure Sensor Signal = Greater than a predefined threshold - For greater than 3.25 s

Actions Taken When the DTC Sets

- DTC P0191, P0192, P127C, P128A, P128B, P16E4, P16E5 is a Type A DTC.
- DTCs P0182, P0183, P0187, P0188, P111F, P126E, P126F are Type B DTCs.

Conditions for Clearing the DTC

- DTC P0191, P0192, P127C, P128A, P128B, P16E4, P16E5 is a Type A DTC.
- DTCs P0182, P0183, P0187, P0188, P111F, P126E, P126F are Type B DTCs.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

[Master Electrical Component List](#) , or [Inline Harness Connector End Views - Index](#) or [Component Connector End Views - Index](#)

Description and Operation

[Fuel System Description](#)

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 the scan tool parameter: Fuel Rail Temperature Sensor 1 = -39 to 115B°C (-39 to 240B°F)
 - **If not between -39 and 115B°C (-39 and 240B°F)**

Refer to: Circuit/System Testing
 - **Go to next step: If between -39 and 115B°C (-39 and 240B°F)**
3. Verify the scan tool parameter: Fuel Rail Temperature Sensor 1 & Fuel Rail Temperature Sensor 2 = Within 10B°C (50B°F) of each other
 - **If not within 10B°C (50B°F) of each other**

Refer to: Circuit/System Testing
 - **Go to next step: If within 10B°C (50B°F) of each other**
4. Verify the scan tool parameter: Fuel Rail Temperature Sensor 1 = The value should not spike or drop out.

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: B310 Fuel Pressure/Temperature Sensor
- Wiggle the harness and connector: K20 Engine Control Module
- **If the value spikes or drops out**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If the value does not spike or drop out**

5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
6. Verify the DTC does not set.
 - **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

7. 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: B310 Fuel Pressure/Temperature Sensor
3. Test for less than 10 ohms between the test points: Low Reference circuit terminal 1 & Ground
 - **If 10 ohms or greater**
 1. Disconnect the electrical connector: X3 @ K20 Engine Control Module
 2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 1 @ Component harness & Terminal 41 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **Go to next step: If less than 10 ohms**
4. Ignition - On / Vehicle - In Service Mode
5. Test for 4.8 to 5.2 V between the test points: 5 V Reference circuit terminal 3 & Low Reference circuit terminal 1
 - **If less than 4.8 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: X3 @ K20 Engine Control Module
 3. Test for infinite resistance between the test points: 5 V Reference circuit terminal 3 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
 4. Test for less than 2 ohms between the test points: 5 V Reference circuit terminal 3 @ Component harness & Terminal 40 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **If greater than 5.2 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: X3 @ K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: 5 V Reference circuit terminal 3 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module
 - **Go to next step: If between 4.8 and 5.2 V**
6. Test for 4.8 to 5.2 V between the test points: Signal circuit terminal 2 & Low Reference circuit terminal 1
 - **If less than 4.8 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: X3 @ K20 Engine Control Module
 3. Test for infinite resistance between the test points: Signal circuit terminal 2 @ Component harness & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- Go to next step: If infinite resistance
- 4. Test for less than 2 ohms between the test points: Signal circuit terminal 2 @ Component harness & Terminal 60 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
- **If greater than 5.2 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: X3 @ K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 2 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module
- **Go to next step: If between 4.8 and 5.2 V**
- 7. Test or replace the component: B310 Fuel Pressure/Temperature Sensor

Component Testing

1. Connect a 3 A fused jumper wire between the test points: 5 V Reference terminal 3 & 5 V
2. Connect a jumper wire between the test points: Low Reference terminal 1 & Ground
3. Test for 2.5 to 4.0 V between the test points: Signal terminal 2 & Low Reference terminal 1
 - **If not between 2.5 and 4.0 V**

Replace the component: B310 Fuel Pressure/Temperature Sensor
 - **Go to next step: If between 2.5 and 4.0 V**
4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Fuel Pressure Sensor Replacement - Fuel Injection Fuel Rail](#) - B310 Fuel Pressure/Temperature Sensor
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P018B-P018D

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 P018B

Fuel Pressure Sensor Performance

DTC P018C

Fuel Pressure Sensor Circuit Low Voltage

DTC P018D

Fuel Pressure Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P018C, P0192, P0532, P0641, P2228	P018C	P018D, P0193, P0523, P0614, P2227*	P018B
Signal	P018C	P018C	P018D*	P018B
Low Reference	-	P018D	*	P018B
*Internal control module or component damage may occur if the circuit shorts to B+.				

Typical Scan Tool Data

Fuel Pressure Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine = Running Parameter Normal Range: 2.7 to 3.8 V			
5 V Reference	0 V	0 V	5 V
Signal	0 V	0 V	5 V
Low Reference	-	5 V	-

Circuit/System Description

For an overview of the component/system, refer to [Fuel System Description](#)

Circuit	Description
5 V Reference	Regulated voltage supplied by the control module.
Signal	The control module input circuit has an internal resistance connected to ground.
Low Reference	Grounded through the control module.

Component	Description
B47 Fuel Pressure Sensor	The sensor measures the pressure in the component: Fuel Line The signal voltage increases when the pressure increases.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

The control module uses the fuel pressure sensor to constantly adjust the fuel pump's feed rate so that the ideal pressure is maintained in the low pressure section (between the fuel pump and the high pressure fuel pump) by means of a closed loop control.

Conditions for Running the DTC

P018B

- DTC P018C, P018D, P0231, P0232, P023F, P0641, P1255, P0129, P12A6 = Not set
- Engine = Running - For greater than 5 s

- Fuel Pump Enable = On

Frequency the DTC runs = Continuously - After the running conditions are met

P018C, P018D

Ignition = On

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

P018B

Fuel Pressure Sensor = Change is less than 30 kPa (4.4 PSI) - For greater than 5 s

P018C

Fuel Pressure Sensor = Less than 0.2 V - For greater than 1 s

P018D

Fuel Pressure Sensor = Greater than 4.8 V - For greater than 1 s

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

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or **Inline Harness Connector End Views - Index** or **Component Connector End Views - Index**

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 P0231, P0232, P023F, P0641, P1255, P0129, P12A6 is not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **Go to next step: If none of the DTCs are set**

3. Engine - Running

4. Verify the scan tool parameter: Fuel Pressure Sensor = 2.7 to 3.8 V

- **If not between 2.7 and 3.8 V**

Refer to: Circuit/System Testing

- **Go to next step: If between 2.7 and 3.8 V**

5. Verify the scan tool parameter: Fuel Pressure Sensor = The value should not spike or drop out.

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: B47 Fuel Pressure Sensor
- Wiggle the harness and connector: K111 Fuel Pump Driver Control Module
- **If the value spikes or drops out**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If the value does not spike or drop out**

6. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC does not set**

7. 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: B47 Fuel Pressure Sensor
3. Test for less than 10 ohms between the test points: Low Reference circuit terminal 2 & Ground
 - **If 10 ohms or greater**
 1. Disconnect the electrical connector: X1 @ K20 Engine Control Module
 2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 2 @ Component harness & Terminal 44 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **Go to next step: If less than 10 ohms**
4. Ignition - On / Vehicle - In Service Mode

5. Test for 4.8 to 5.2 V between the test points: 5 V Reference circuit terminal 3 & Low Reference circuit terminal 2

- **If less than 4.8 V**

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: X4 @ K20 Engine Control Module
3. Test for infinite resistance between the test points: 5 V Reference circuit terminal 3 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
4. Test for less than 2 ohms between the test points: 5 V Reference circuit terminal 3 @ Component harness & Terminal 39 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module

- **If greater than 5.2 V**

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: X4 @ K20 Engine Control Module
3. Ignition - On / Vehicle - In Service Mode

NOTE: Internal control module or component damage may occur if the circuit shorts to B+.

4. Test for less than 1 V between the test points: 5 V Reference circuit terminal 3 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module

- **Go to next step: If between 4.8 and 5.2 V**

6. Verify the scan tool parameter: Fuel Pressure Sensor = Less than 0.2 V

- **If 0.2 V or greater**

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: X4 @ K20 Engine Control Module
3. Ignition - On / Vehicle - In Service Mode
4. Test for less than 1 V between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module

- **Go to next step: If less than 0.2 V**

7. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & 5 V Reference circuit terminal 3

8. Verify the scan tool parameter: Fuel Pressure Sensor = Greater than 4.8 V

- **If 4.8 V or less**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
2. Disconnect the electrical connector: X4 @ K20 Engine Control Module
3. Test for infinite resistance between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
4. Test for less than 2 ohms between the test points: Signal circuit terminal 1 @ Component harness & Terminal 59 @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module
- **Go to next step: If greater than 4.8 V**

9. Test or replace the component: B47 Fuel Pressure Sensor

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Fuel Pressure Sensor Replacement - Fuel Feed Pipe](#)
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216B, P216C, P216E, OR P216F

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 P0201

Cylinder 1 Injector Control Circuit

DTC P0202

Cylinder 2 Injector Control Circuit

DTC P0203

Cylinder 3 Injector Control Circuit

DTC P0204

Cylinder 4 Injector Control Circuit

DTC P0205

Cylinder 5 Injector Control Circuit

DTC P0206

Cylinder 6 Injector Control Circuit

DTC P0261

Cylinder 1 Injector Control Circuit Low Voltage

DTC P0262

Cylinder 1 Injector Control Circuit High Voltage

DTC P0264

Cylinder 2 Injector Control Circuit Low Voltage

DTC P0265

Cylinder 2 Injector Control Circuit High Voltage

DTC P0267

Cylinder 3 Injector Control Circuit Low Voltage

DTC P0268

Cylinder 3 Injector Control Circuit High Voltage

DTC P0270

Cylinder 4 Injector Control Circuit Low Voltage

DTC P0271

Cylinder 4 Injector Control Circuit High Voltage

DTC P0273

Cylinder 5 Injector Control Circuit Low Voltage

DTC P0274

Cylinder 5 Injector Control Circuit High Voltage

DTC P0276

Cylinder 6 Injector Control Circuit Low Voltage

DTC P0277

Cylinder 6 Injector Control Circuit High Voltage

DTC P2147

Cylinder 1 Injector High Control Circuit Low Voltage

DTC P2148

Cylinder 1 Injector High Control Circuit High Voltage

DTC P2150

Cylinder 2 Injector High Control Circuit Low Voltage

DTC P2151

Cylinder 2 Injector High Control Circuit High Voltage

DTC P2153

Cylinder 3 Injector High Control Circuit Low Voltage

DTC P2154

Cylinder 3 Injector High Control Circuit High Voltage

DTC P2156

Cylinder 4 Injector High Control Circuit Low Voltage

DTC P2157

Cylinder 4 Injector High Control Circuit High Voltage

DTC P216B

Cylinder 5 Injector High Control Circuit Low Voltage

DTC P216C

Cylinder 5 Injector High Control Circuit High Voltage

DTC P216E

Cylinder 6 Injector High Control Circuit Low Voltage

DTC P216F

Cylinder 6 Injector High Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Short between the circuits
Control circuit terminal 2 @ Q17A Fuel Injector 1	P2147	P0201	P2148	P1248
Control circuit terminal 1 @ Q17A Fuel Injector 1	P0261	P0201	P0262	P1248
Control circuit terminal 2 @ Q17B Fuel Injector 2	P2150	P0202	P2151	P1249
Control circuit terminal 1 @ Q17B Fuel Injector 2	P0264	P0202	P0265	P1249
Control circuit terminal 2 @ Q17C Fuel Injector 3	P2153	P0203	P2154	P124A
Control circuit terminal 1 @ Q17C Fuel Injector 3	P0267	P0203	P0268	P124A
Control circuit terminal 2 @ Q17D Fuel Injector 4	P2156	P0204	P0270, P2157	P124B
Control circuit terminal 1 @ Q17D Fuel Injector 4	P0270, P2156	P0204	P0271, P2157	P124B
Control circuit terminal 2 @ Q17E Fuel Injector 5	P216B	P0205	P216C	P124C
Control circuit terminal 1 @ Q17E Fuel Injector 5	P0273	P0205	P0274	P124C
Control circuit terminal 2 @ Q17F Fuel Injector 6	P216E	P0206	P216F	P124D
Control circuit terminal 1 @ Q17F Fuel Injector 6	P0276	P0206	P0277	P124D

Typical Scan Tool Data

Fuel Injector Control Circuit Test Status

Circuit	Short to Ground	Open	Short to Voltage	Short between the circuits
Operating Conditions: Engine at Idle Parameter Normal Range: OK or Not Run				
Control circuit terminal 2	High Control Circuit Low Voltage	Open	High Control Circuit High Voltage	High Control Circuit Shorted to Control Circuit
Control circuit terminal 1	Control Circuit Low Voltage	Open	Control Circuit High Voltage	High Control Circuit Shorted to Control Circuit

Circuit/System Description

For an overview of the component/system, refer to [Fuel System Description](#)

Circuit	Description
Control circuit terminal 2	Regulated voltage supplied by the control module.
Control circuit terminal 1	The output circuit is switched to ground to activate the component.

Component	Description
Q17 Fuel Injector	Fuel injectors are solenoid valves that inject fuel either into the intake system or directly into the cylinder. The amount of fuel injected depends on the length of the electrical pulse that is applied. The fuel injectors of this system have an operating voltage range of 50 to 90 V.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Conditions for Running the DTC

- DTC P062B = Not set
- Engine is Running
- Battery Voltage = Greater than 11 V

DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

P0201, P0202, P0203, P0204, P0205, P0206

Control circuit = Open - For greater than 1 s

P0261, P0264, P0267, P0270, P0273, P0276

Low Control = Short to Ground - For greater than 1 s

P0262, P0265, P0268, P0271, P0274, P0277

Low Control = Short to Voltage - For greater than 1 s

P2147, P2150, P2153, P2156, P216B, P216E

High Control = Short to Ground - For greater than 1 s

P2148, P2151, P2154, P2157, P216C, P216F

High Control = Short to Voltage - For greater than 1 s

Actions Taken When the DTC Sets

DTCs P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216B, P216C, P216E, P216F are Type A DTCs.

Conditions for Clearing the DTC

DTCs P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216B, P216C, P216E, P216F are Type A DTCs.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or **Inline Harness Connector End Views - Index** or **Component Connector End Views - Index**

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

Special Tools

<special tool><special tool-no>EL-44603</special tool-no><special tool-desc>Injector Test Lamp</special tool-desc></special tool>

Equivalent regional tools: **Special Tools (Mechanical Tools)**

Circuit/System Verification

1. Engine running.
2. Verify the scan tool parameter:
 - Cylinder 1 Injector Control Circuit Status = OK
 - Cylinder 2 Injector Control Circuit Status = OK
 - Cylinder 3 Injector Control Circuit Status = OK

- Cylinder 4 Injector Control Circuit Status = OK
- Cylinder 5 Injector Control Circuit Status = OK
- Cylinder 6 Injector Control Circuit Status = OK
- **If not the specified state**

Refer to: Circuit/System Testing

- **Go to next step: If the specified state**

3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

4. Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

5. All OK.

Circuit/System Testing

1. Ignition/Vehicle - Off

2. Disconnect the appropriate electrical connector: Q17 Fuel Injector

3. Ignition - On / Vehicle - In Service Mode

4. Test for 11.2 to 11.7 V between the test points: Control circuit terminal 2 & Ground

- **If less than 11.2 V**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: X3 @ K20 Engine Control Module

3. Test for infinite resistance between the test points: Control circuit terminal 2 & @ Component harness & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- Go to next step: If infinite resistance

4. Test for less than 2 ohms between the test points: Control circuit terminal 2 @ Component harness &

- {Q17A Fuel Injector 1} Terminal 69 @ Control module harness
- {Q17B Fuel Injector 2} Terminal 68 @ Control module harness
- {Q17C Fuel Injector 3} Terminal 72 @ Control module harness
- {Q17D Fuel Injector 4} Terminal 70 @ Control module harness
- {Q17E Fuel Injector 5} Terminal 67 @ Control module harness
- {Q17F Fuel Injector 6} Terminal 71 @ Control module harness
- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

- **If greater than 11.7 V**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: X3 @ K20 Engine Control Module

3. Ignition - On / Vehicle - In Service Mode

4. Test for less than 1 V between the test points: Control circuit terminal 2 @ Component harness & Ground

- If 1 V or greater - Repair the short to voltage on the circuit.
- If less than 1 V - Replace the component: K20 Engine Control Module

- **Go to next step: If between 11.2 and 11.7 V**

5. Ignition/Vehicle - Off

6. Install the special tool:<special tool><special tool-no>EL-44603</special tool-no><special tool-desc>Injector Test Lamp</special tool-desc></special tool> @ Q17 Fuel Injector - Component harness

7. Engine cranking.

8. Verify the test lamp flashes

- **If the test lamp does not flash**

1. Ignition/Vehicle - Off & Remove - Test lamp

2. Disconnect the electrical connector: X4 @ K20 Engine Control Module

3. Test for infinite resistance between the test points: Control circuit terminal 1 @ Component harness & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- Go to next step: If infinite resistance

4. Test for less than 2 ohms between the test points: Control circuit terminal 1 @ Component harness &

- {Q17A Fuel Injector 1} Terminal 49 @ Control module harness
- {Q17B Fuel Injector 2} Terminal 48 @ Control module harness
- {Q17C Fuel Injector 3} Terminal 52 @ Control module harness
- {Q17D Fuel Injector 4} Terminal 50 @ Control module harness
- {Q17E Fuel Injector 5} Terminal 47 @ Control module harness
- {Q17F Fuel Injector 6} Terminal 51 @ Control module harness
- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- Go to next step: If less than 2 ohms

5. Ignition - On / Vehicle - In Service Mode

6. Test for less than 1 V between the test points: Control circuit terminal 1 @ Component harness & Ground

- If 1 V or greater - Repair the short to voltage on the circuit.
- If less than 1 V - Replace the component: K20 Engine Control Module

- **Go to next step: If the test lamp flashes**

9. Test or replace the component: Q17 Fuel Injector

Component Testing

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: Q17 Fuel Injector

NOTE: The specified resistances are valid for components at room temperature.

3. Test for 1 to 3 ohms between the test points: Control circuit terminal 2 & Control circuit terminal 1

- **If not between 1 and 3 ohms**

Replace the component: Q17 Fuel Injector

- **Go to next step: If between 1 and 3 ohms**

4. Test for infinite resistance between the test points: Each terminal of the component & The component's housing

- **If less than infinite resistance**

Replace the component: Q17 Fuel Injector

- **Go to next step: If infinite resistance**

5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Fuel Injector Replacement](#)
- Fuel Rail Pressure Sensor or Fuel Rail Learn
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0231, P0232, OR P023F

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 P0231

Fuel Pump Control Circuit Low Voltage

DTC P0232

Fuel Pump Control Circuit High Voltage

DTC P023F

Fuel Pump Control Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	P0231	P023F	P0232	P023F
Low Reference	-	P023F	-	P023F

Circuit/System Description

For an overview of the component/system, refer to [Fuel System Description](#)

Circuit	Description
Control	The output circuit is switched to 12 V to activate the component. The output is PWM controlled.
Low Reference	Grounded through the control module.

Component	Description
G12 Fuel Pump	The fuel pump has a DC motor that is controlled by a PWM signal to achieve the desired fuel pressure.
K111 Fuel Pump Driver Control Module	The control module K111 monitors the fuel system for any condition which may adversely affect emissions. If a condition is detected it sets a DTC and sends a serial data

Component	Description
	message to the engine control module which then sets DTC P069E.

The control module K111 supplies the fuel pump with a PWM signal in order to achieve the desired fuel line pressure.

Conditions for Running the DTC

P0231, P023F

- Ignition = On
- Ignition Voltage = 9 to 32 V

Frequency the DTC runs = Continuously - After the running conditions are met - For greater than 1 s

P0232

- Fuel Pump Command = 0%
- Fuel Pump Enable Circuit = Off

Frequency the DTC runs = Continuously - After the running conditions are met - For greater than 4 s

Conditions for Setting the DTC

P0231

Fuel Pump Control Circuit = Greater than 14.48 A

P0232

Fuel Pump Control Circuit = Greater than 3.86 V

P023F

Fuel Pump Control Circuit = Less than 500 mA

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type A DTC - Exceptions listed below

DTC P0232 = Type B DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC - Exceptions listed below

DTC P0232 = Type B DTC

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

[Master Electrical Component List](#) , or [Inline Harness Connector End Views - Index](#) or [Component Connector End Views - Index](#)

- [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. Perform the scan tool control function: Fuel Pump @ K20 Engine Control Module - On and Off

Verify the component turns On and Off: G12 Fuel Pump

- **If the component does not turn On and Off**

Refer to: Circuit/System Testing

- **Go to next step: If the component turns On and Off**

3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

4. 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: G12 Fuel Pump
3. Verify a test lamp turns On between the test points: Low Reference circuit terminal 2 & B+
 - **If the test lamp does not turn On**
 1. Disconnect the electrical connector: K111 Fuel Pump Driver Control Module
 2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 2 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K111 Fuel Pump Driver Control Module
 - **Go to next step: If the test lamp turns On**

4. Connect a test lamp between the test points: Control circuit terminal 1 & Low Reference circuit terminal 2
5. Ignition - On / Vehicle - In Service Mode
6. Perform the scan tool control function: Fuel Pump @ K20 Engine Control Module - 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: K111 Fuel Pump Driver Control Module
3. Test for infinite resistance between the test points: Control circuit terminal 1 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
4. Test for less than 2 ohms between the test points: Control circuit terminal 1 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K111 Fuel Pump Driver Control Module

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

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Disconnect the electrical connector: K111 Fuel Pump Driver Control Module
3. Ignition - On / Vehicle - In Service Mode
4. Test for less than 1 V between the test points: Control circuit terminal 1 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K111 Fuel Pump Driver Control Module

- **Go to next step: If the test lamp turns On and Off**

7. Test or replace the component: G12 Fuel Pump

Component Testing

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: K111 Fuel Pump Driver Control Module
3. Connect a DMM, set on the diode setting, between the test points:
 - Red lead @ Low Reference terminal 16
 - Black lead @ Ground terminal 9
4. Verify the DMM displays between 0.4 and 0.8 V.
 - **If not between 0.4 and 0.8 V**

Replace the component: K111 Fuel Pump Driver Control Module

- **Go to next step: If between 0.4 and 0.8 V**

5. Connect a DMM, set on the diode setting, between the test points:
 - Red lead @ Ground terminal 9
 - Black lead @ Low Reference terminal 16
6. Verify the DMM displays the following: O.L.
 - **If not the specified value**

Replace the component: K111 Fuel Pump Driver Control Module

- **Go to next step: If the specified value**

7. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Fuel Tank Fuel Pump Module Replacement](#) - G12 Fuel Pump
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P026B, P05EC, P0601-P0607, P060A, P060B, P0610, P061C, P062B, P062F, P0630, P064D, P064E, P134C, P160A, P160D, P160E, P161C, P16E9-P16F0, P16F3, P2610, P262B, P264F, P27B5, P30D6-P30DD, P3186, OR P3191

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 P026B

Fuel Injection Timing Performance

DTC P05EC

Cold Start Injection Timing Performance

DTC P0601

Control Module Read Only Memory Performance

DTC P0602

Control Module Not Programmed

DTC P0603

Control Module Long Term Memory Reset

DTC P0604

Control Module Random Access Memory Performance

DTC P0605

Control Module Programming Read Only Memory Performance

DTC P0606

Control Module Processor Performance

DTC P0607

Control Module Performance

DTC P060A

Control Module Monitoring Processor Performance

DTC P060B

Control Module Analog to Digital Converter Performance

DTC P0610

Control Module Vehicle Options Incorrect

DTC P061C

Control Module Engine Speed System Circuitry Performance

DTC P062B

Control Module Fuel Injector Control Performance

DTC P062F

Control Module Long Term Memory Performance

DTC P0630

VIN Not Programmed or Mismatched - Engine/Powertrain Control Module

DTC P064D

Control Module Heated Oxygen Sensor System Circuitry Performance

DTC P064E

Control Module Heated Oxygen Sensor System Circuitry Performance Bank 2

DTC P134C

Internal Control Module Torque Algorithm Performance

DTC P160A

Vehicle Speed Limit Not Programmed

DTC P160D

Incorrect Engine Calibration Detected

DTC P160E

Engine Calibration Monitoring Not Programmed

DTC P161C

Tire Size Not Programmed

DTC P16E9

Control Module Serial Peripheral Interface Bus 2

DTC P16EA

Control Module Serial Peripheral Interface Bus 3

DTC P16EB

Control Module Serial Peripheral Interface Bus 4

DTC P16EC

Control Module Serial Peripheral Interface Bus 5

DTC P16EE

Control Module Serial Peripheral Interface Bus 6

DTC P16EF

Control Module Serial Peripheral Interface Bus 7

DTC P16F0

Control Module Serial Peripheral Interface Bus 8

DTC P16F3

Control Module Redundant Memory Performance

DTC P2610

Control Module Ignition Off Timer Performance

DTC P262B

Control Module Power Off Timer Performance

DTC P264F

Engine Serial Number Not Programmed

DTC P27B5

Control Module Transmission Gear Ratio Control Performance

DTC P30D6

Control Module Processor Serial Peripheral Interface Bus

DTC P30D7

Control Module Processor Serial Peripheral Interface Bus 2

DTC P30D8

Control Module Processor Serial Peripheral Interface Bus 3

DTC P30D9

Control Module Processor Serial Peripheral Interface Bus 4

DTC P30DA

Control Module Processor Serial Peripheral Interface Bus 5

DTC P30DB

Control Module Processor Serial Peripheral Interface Bus 6

DTC P30DC

Control Module Processor Serial Peripheral Interface Bus 7

DTC P30DD

Control Module Processor Serial Peripheral Interface Bus 8

DTC P3186

Control Module Security Peripheral Hardware Performance

DTC P3191

Internal Control Module Fuel Pressure Performance

Circuit/System Description

These DTCs apply to microprocessor integrity conditions within the engine control module. This diagnostic also checks if the ECM is programmed.

Conditions for Running the DTC

P026B, P05EC, P16F3

- DTC P0101, P0102, P0103, P0106, P0107, P0108, P2227, P2228, P2229, P2230 = Not set
- Engine Speed = Greater than 680 RPM
- Frequency the DTC runs = Continuously - After the running conditions are met

P0601, P0602, P0604, P0605, P0607, P060A, P060B, P0610, P061C, P0630, P160A, P160D, P160E, P161C, P264F, P3191

- Ignition = On
- Frequency the DTC runs = Continuously - After the running conditions are met

P0603, P062F

- Ignition = On
- Frequency the DTC runs = Once - Per drive cycle - After the running conditions are met

P0606, P062B, P16E9-P16F0, P30D6-P30DD

- Run/Crank = Greater than 11 V
- Frequency the DTC runs = Continuously - After the running conditions are met

P064D, P064E, P134C, P27B5

- Battery Voltage = Greater than 11 V
- Engine = Running - Greater than 3 min

P2610, P262B

- Run/Crank = Inactive
- Frequency the DTC runs = Once - After ignition Off - After the running conditions are met - For 20 s

Conditions for Setting the DTC

Control Module = Internal Malfunction or System Programming Malfunctions

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type A DTC - Exceptions listed below

- DTC P026B, P05EC, P064D, P064E, P2610, P262B = Type B DTC
- DTC P3191 = Type C DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC - Exceptions listed below

- DTC P026B, P05EC, P064D, P064E, P2610, P262B = Type B DTC
- DTC P3191 = Type C DTC

Diagnostic Aids

A weak battery, low component/system voltage, or poor connections may cause this DTC to set.

Reference Information

Connector End View Reference

[Master Electrical Component List](#) , or [Inline Harness Connector End Views - Index](#) or [Component Connector End Views - Index](#)

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 P0602, P0630, P160A, P160D, P160E, P161C, P264F is not set.
 - **If the DTC is set**
 1. Perform all necessary programming and setup procedures for the control module: K20 Engine Control Module
 2. Verify the DTC does not set.
 - If the DTC sets - Replace the component: K20 Engine Control Module
 - Go to next step: If the DTC does not set
 3. All OK.
 - **Go to next step: If the DTC is not set**
3. Verify DTC P026B, P05EC, P0605, P0607, P060A, P060B, P0610, P061C, P064D, P064E, P134C, P2610, P27B5, P3191 is not set.

- **If the DTC is set**

Replace the component: K20 Engine Control Module

- **Go to next step: If the DTC is not set**

4. Verify DTC P0685 - P0690, P1682, P16A7, P16AF, P16B3, P16BC, P16BD, P16BF is not set.

- **If the DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **Go to next step: If the DTC is not set**

5. Verify DTC P0601, P0603, P0604, P0606, P062B, P062F, P16F3, P16E9-P16F0, P262B, P30D6-P30DD is not set.

- **If the DTC is set**

1. Ignition - On / Vehicle - In Service Mode

2. Verify the scan tool parameter: Battery Voltage = The value should not spike or drop out.

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: K20 Engine Control Module
- Wiggle the harness and connector: X50A Fuse Block - Underhood
- If the value spikes or drops out - Repair as necessary - B+ circuit or Ground
- If the value does not spike or drop out - Replace the component: K20 Engine Control Module

- **Go to next step: If the DTC is not set**

6. 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 P0300-P0306

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 P0300

Engine Misfire Detected

DTC P0301

Cylinder 1 Misfire Detected

DTC P0302

Cylinder 2 Misfire Detected

DTC P0303

Cylinder 3 Misfire Detected

DTC P0304

Cylinder 4 Misfire Detected

DTC P0305

Cylinder 5 Misfire Detected

DTC P0306

Cylinder 6 Misfire Detected

Circuit/System Description

For an overview of the component/system, refer to:

- [Electronic Ignition System Description](#)
- [Fuel System Description](#)

A misfiring cylinder causes slight variations in the rotational speed of the crankshaft. The engine control module (ECM) is able to detect these variations by closely monitoring the crankshaft position sensor signal. The signals of the camshaft position sensors are used to determine which cylinder is misfiring. If the ECM detects a misfire rate sufficient to cause emission levels to exceed mandated standards, DTC P0300 sets. Under certain driving conditions, a misfire rate can be high enough to cause the catalytic converter to overheat, possibly damaging the converter. The malfunction indicator lamp (MIL) flashes when catalyst damaging misfire conditions are present and DTC P0300 is set.

Conditions for Running the DTC

- DTC P0010, P0011, P0013, P0014, P0016, P0017, P0068, P00C8, P00C9, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0117, P0118, P0119, P0122, P0123, P0191, P0192, P0193, P0222, P0223, P0335, P0336, P0340, P0341, P0365, P0366, P0601, P0604, P0606, P0651, P16A0, P16A1, P16A2, P16F3, P2101, P2135, P2227, P2228, P2229, P2230 = Not set
- Crankshaft/Camshaft Sensors = Synchronized
- Engine Coolant Temperature = -7 to 127B°C (19.4 to 261B°F)
- Engine Load = 0%
- Engine Speed = Greater than 1, 400 RPM
- Engine Speed = Less than 1, 000 RPM - DTC P0315 is set.
- Fuel Cut-Off System = Inactive
- Fuel level = Greater than 11%
- Rough Road Signal = Not Detected
- System Voltage = 9 to 32 V

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

P0300

The control module K20 detects a crankshaft rotation speed variation indicating a misfire rate sufficient to cause emissions levels to exceed a predetermined value or a misfire rate high enough to cause catalyst damage.

P0301, P0302, P0303, P0304, P0305, P0306

The control module K20 detects a crankshaft rotation speed variation indicating a single cylinder misfire rate sufficient to cause emissions levels to exceed mandated standards.

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC

Malfunction Indicator Lamp (MIL) = Flashing - During catalyst damaging misfire.

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Diagnostic Aids

- {If equipped} Command the Cylinder Deactivation system On with a scan tool, then observe the misfire counters when commanding the system Off. If the misfire counters are incrementing, inspect for a sticking valve lifter.
- DTC P0300 may set when there is a condition with the component circuits: B52 Heated Oxygen Sensor
- High resistance in the circuits of the component may set DTC P0300 - P0306 without setting the DTC for the component: Q17 Fuel Injector
- If the condition is intermittent, wiggle the related wiring harnesses and connectors, with the ignition/vehicle on or engine running, while monitoring the scan tool circuit status parameters for the component. The parameters will display if there is a condition with the circuit or a connection.
- Verify the following conditions do not exist:
 - Accessory drive bracket - Defective/Loose/Visible Damage
 - Belt Driven Device - Defective/Loose/Visible Damage
 - Brake Rotor - Excessive runout
 - Drive Belt - Defective/Loose/Visible Damage
 - Drive Shaft - Excessive runout
 - During certain road conditions: Rough
 - Tire and wheel assemblies which exhibit excessive runout can produce vibrations even if the assemblies are balanced.
 - Transmission - Incorrect Operation

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Special Tools

<special tool><special tool-no>J-26792</special tool-no><special tool-desc>Ignition Spark Tester</special tool-desc></special tool>

Equivalent regional tools: **Special Tools (Mechanical Tools)**

Circuit/System Verification

1. Engine - Running
2. Verify there is no abnormal noise from the component: Engine

- **If an abnormal noise is present**

Refer to [Symptoms - Engine Mechanical](#)

- **Go to next step: If no abnormal noise is present**

3. Perform the scan tool learn/reset function: [Crankshaft Position Variation Learn](#)

4. Verify there are no DTCs set related to the following component/system:

- B23 Camshaft Position Sensor
- B26 Crankshaft Position Sensor
- B52 Heated Oxygen Sensor
- Q17 Fuel Injector
- T8 Ignition Coil
- Fuel System
- Ignition System
- Mechanical Condition
- **If other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **Go to next step: If no other DTCs are set**

5. Verify the scan tool parameter: Cylinder 1 - 6 Current Misfire Counter = Does not Increment

- **If the parameter value increments**

Refer to: Circuit/System Testing

- **Go to next step: If the parameter value does not increment**

6. Perform the scan tool control function: Cylinder Power Balance - Enable

Verify the sound of the engine changes the same way when turning off each individual injector.

- **If the engine sound does not change the same way for one or more cylinders**

Refer to: Circuit/System Testing

- **Go to next step: If the engine sound changes the same way for all cylinders**

7. Verify the scan tool parameter: Cylinder 1 - 6 Current Misfire Counter = Does not Increment

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: K20 Engine Control Module
- Wiggle the harness and connector: Q17 Fuel Injector
- Wiggle the harness and connector: T8 Ignition Coil
- Wiggle the component: Vacuum Hoses
- **If the parameter value does not increment**

Repair or replace as necessary

- **Go to next step: If the parameter value increments**

8. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC does not set**

9. All OK.

Circuit/System Testing

1. Verify the following conditions do not exist:

- Engine - Vacuum leak
- Exhaust System - Leaking/Missing components/Restricted - Refer to [Symptoms - Engine Exhaust](#)
- Fuel - Contaminated/Dirty/Fill Level = Low - Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#)
- Fuel Pressure - High/Low - Refer to [Fuel System Diagnosis](#)
- Positive Crankcase Ventilation System - Leaking/Incorrect connection/Restricted
- Vacuum Hoses - Kinked/Leaking/Incorrect connection/Restricted
- **If a condition exists**

Repair or replace as necessary

- **Go to next step: If no conditions exist**

2. Ignition/Vehicle - Off

3. Remove the appropriate component: T8 Ignition Coil - Leave the electrical connector connected.

4. Verify a condition does not exist with the component: Spark Plug Boot - Carbon Tracking/Fluid intrusion/Visible Damage

- **If a condition exists**

Repair or replace as necessary

- **Go to next step: If no condition exists**

5. Install - <special tool><special tool-no>J-26792</special tool-no><special tool-desc>Ignition Spark Tester</special tool-desc></special tool> @ T8 Ignition Coil & Ground

6. Engine - Running

NOTE: An erratic or weak spark is considered a no spark condition.

7. Verify there is spark at the tool.

- **If there is no spark**

Refer to [Electronic Ignition System Diagnosis](#)

- **Go to next step: If there is spark**

8. Ignition/Vehicle - Off

9. Remove the appropriate component: Spark Plug

10. Verify the component specifications are correct: Spark Plug - Gap / Heat Range /Torque - Refer to [Ignition System Specifications](#)

- **If not correct**

Repair or replace as necessary

- **Go to next step: If correct**

11. Verify a condition does not exist with the component: Spark Plug - Carbon Tracking/Fouled/Visible Damage

- **If a condition exists**

Repair or replace as necessary

- **Go to next step: If no condition exists**

12. Swap the two components: Spark Plug - The original component that set the DTC & Another known good component from the vehicle

13. Engine - Running

14. Verify the scan tool parameter: Cylinder 1 - 6 Current Misfire Counter = Increments - At the original component location the DTC set.

- **If the parameter value does not increment**

Replace the component: Spark Plug - The original component that set the DTC

- **Go to next step: If the parameter value increments**

15. Perform the following procedure/test: Fuel Injector Balance - Refer to [Fuel Injector Diagnosis](#)

Verify the procedure/test passes.

- **If the procedure/test does not pass**

Replace the component that failed the test: Q17 Fuel Injector

- **Go to next step: If the procedure/test passes**

16. Verify the condition does not exist: An engine mechanical condition - Refer to [Symptoms - Engine Mechanical](#)

- **If a condition exists**

Repair or replace as necessary

- **Go to next step: If no condition exists**

17. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

After any repair, perform DTC P0420 Circuit/System Verification, to verify the performance of the component: Catalytic Converter - Refer to [DTC P0420 or P0430](#)

- [Ignition Coil Replacement - Bank 1](#)
- [Ignition Coil Replacement - Bank 2](#)
- [Gas Engine Ignition Spark Plug Replacement](#)

DTC P0315

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 P0315

Crankshaft Position System Variation Not Learned

Circuit/System Description

The crankshaft position sensor variation or reluctor ring learn is used to calculate reference period errors caused by slight tolerance variations in the crankshaft and the crankshaft position sensor. The calculated error allows the ECM to accurately compensate for reference period variations. This enhances the ability of the ECM to detect misfire events over a wider range of engine speed and load. The compensation values are stored in ECM memory after a learn procedure has been performed.

Conditions for Running the DTC

Engine = Running

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

Crankshaft Position Variation Learn = Not Learned

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type A DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC

Diagnostic Aids

This test procedure requires that the vehicle battery has passed a load test and is completely charged. Refer to [Battery Inspection/Test](#)

Reference Information

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. Perform the scan tool learn/reset function: [Crankshaft Position Variation Learn](#)
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Replace the component: K20 Engine Control Module

- **Go to next step: If the DTC is not set**

4. 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 P0324-P0328, P0330-P0333, P06B6, OR P06B7

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 P0324

Knock Sensor System Performance

DTC P0325

Knock Sensor 1 Circuit

DTC P0326

Knock Sensor 1 Performance

DTC P0327

Knock Sensor 1 Circuit Low Voltage

DTC P0328

Knock Sensor 1 Circuit High Voltage

DTC P0330

Knock Sensor 2 Circuit

DTC P0331

Knock Sensor 2 Performance

DTC P0332

Knock Sensor 2 Circuit Low Voltage

DTC P0333

Knock Sensor 2 Circuit High Voltage

DTC P06B6

Control Module Knock Sensor Processor 1 Performance

DTC P06B7

Control Module Knock Sensor Processor 2 Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Knock Sensor 1 Signal - Terminal 1/A	P0327, P06B6	P0325	P0328	P0324*, P0326**
Knock Sensor 1 Signal - Terminal 2/B	P0327	P0325	P0328	P0324*, P0326**
Knock Sensor 2 Signal - Terminal 1/A	P0332, P06B7	P0330	P0333	P0324*, P0331**
Knock Sensor 2 Signal - Terminal 2/B	P0332	P0330	P0333	P0324*, P0331**
*Signal Performance = High				
**Signal Performance = Low				

Circuit/System Description

For an overview of the component/system, refer to [Electronic Ignition System Description](#)

Circuit	Description
Signal - Terminal 1/A	The control module input circuit has an internal resistance connected to 5 V.
Signal - Terminal 2/B	The control module input circuit has an internal resistance connected to 1.33 V.

Component	Description
B68 Knock Sensor	The sensor uses piezo-electric crystal technology that produces an AC voltage signal of varying amplitude and frequency based on the engine vibration or noise level. The amplitude and frequency depend upon the level of knock that the knock sensor detects.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

The knock sensor measures vibrations of the engine block. To some extent it is comparable to a microphone. The sensor produces an AC voltage that is proportional in frequency and amplitude to the vibrations. The ECM can deduce from the signal if and which cylinder is knocking. This enables the ECM to adjust the spark timing so that the best fuel efficiency is gained. The ECM learns a minimum knock sensor noise level at idle and uses calibrated values for the rest of the engine speed range.

Conditions for Running the DTC

P0324

- Engine = Running - For greater than 2 s
- Engine Coolant Temperature = Warmer than -40B°C (-40B°F)
- Engine Speed = 400 to 8500 RPM
- Intake Air Temperature = Warmer than -40B°C (-40B°F)
- Mass Air Flow Per Cylinder = Less than 2, 000 mg

Frequency the DTC runs = Continuously - After the running conditions are met

P0326, P0331

- Engine = Running - For greater than 2 s

- Engine Coolant Temperature = Warmer than -40B°C (-40B°F)
- Engine Speed = 2250 to 8500 RPM - Cumulative = Greater than 167 engine revolutions
- Intake Air Temperature = Warmer than -40B°C (-40B°F)
- Mass Air Flow Per Cylinder = Less than 2, 000 mg

Frequency the DTC runs = Continuously - After the running conditions are met

P0325, P0330

- Engine = Running - Greater than 200 engine revolutions For greater than 2 s
- Engine Speed = 400 to 5, 500 RPM - Greater than 75 engine revolutions
- Engine Coolant Temperature = Warmer than -40B°C (-40B°F)
- Mass Air Flow Per Cylinder = 20 to 2, 000 mg
- Intake Air Temperature = Warmer than -40B°C (-40B°F)

Frequency the DTC runs = Continuously - After the running conditions are met

P0327, P0328, P0332, P0333

Engine Speed = Less than 8, 500 RPM

Frequency the DTC runs = Continuously - After the running conditions are met

P06B6, P06B7

- Engine = Running - For greater than 2 s
- Engine Speed = 400 to 5, 500 RPM - Greater than 75 engine revolutions
- Mass Air Flow Per Cylinder = 20 to 2, 000 mg

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

P0324

Knock Sensor Signal = Excessive engine knocking

P0325, P0330

Signal circuit = Open - For greater than 5 s

P0326, P0331

Signal Performance = Low Frequency

P0327, P0332

Signal circuit = Short to Ground - For greater than 5 s

P0328, P0333

Signal circuit = Short to Voltage - For greater than 5 s

P06B6, P06B7

A fault of the processor that evaluates the knock sensor signal was detected.

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC

The ignition timing is retarded to reduce potentially engine-damaging knocking.

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Diagnostic Aids

- Inspect the knock sensor for physical damage. A damaged sensor may cause a DTC to set.
- The knock sensor mounting surface should be free of burrs, casting flash, and foreign material.
- Tightening the retaining bolt too much or simply dropping the knock sensor on the ground can damage it.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

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. Engine - Running
2. Verify DTC P0325, P0327, P0328, P0330, P0332, P0333, P06B6, P06B7 is not set.
 - **If only DTC P0325, P0327, P0328, P0330, P0332, P0333 is set**

Refer to: Circuit/System Testing

- **If only DTC P06B6, P06B7 is set**

Replace the component: K20 Engine Control Module

- **Go to next step: If none of the DTCs are set**

3. Verify the scan tool parameter: Cylinder 1 - 6 Knock Detected = No

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: B68 Knock Sensor

- Wiggle the harness and connector: K20 Engine Control Module
- **If not the specified state**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If the specified state**

4. Verify DTC P0324, P0326, P0331 is not set.

- **If the DTC is set**

1. Verify a condition does not exist with the component: B68 Knock Sensor

- Incorrect installation - Refer to [Fastener Specifications](#)
- Interference with other components or objects - Bracket/Engine Wiring Harness/Hoses / Lines
- Visible Damage
- If a condition exists - Repair or replace as necessary
- Go to next step: If no condition exists

2. Verify the condition did not cause the DTC to set:

- Accessory drive bracket - Loose/Visible Damage
- Drive Belt & Belt Driven Device - Loose/Visible Damage
- Engine - Mechanical Condition - Refer to [Symptoms - Engine Mechanical](#)
- Fuel - Contaminated/Poor Quality
- If a condition exists - Repair or replace as necessary
- If all conditions test normal - Test or replace the component: B68 Knock Sensor

- **Go to next step: If none of the DTCs are set**

5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

6. All OK.

Circuit/System Testing

1. Ignition/Vehicle - Off

2. Disconnect the appropriate electrical connector: B68 Knock Sensor

3. Ignition - On / Vehicle - In Service Mode

4. Test for 1 to 2 V between the test points: Signal circuit terminal 2/B & Ground

- **If less than 1 V**

1. Ignition/Vehicle - Off

2. Disconnect the appropriate electrical connector: K20 Engine Control Module

3. Test for infinite resistance between the test points: Signal circuit terminal 2/B @ Component harness & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- Go to next step: If infinite resistance

4. Test for less than 2 ohms between the test points: Signal circuit terminal 2/B @ Component harness & The other end of the circuit @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module
- **If greater than 2 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 2/B @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module
- **Go to next step: If between 1 and 2 V**
- 5. Test for 2 to 4 V between the test points: Signal circuit terminal 1/A & Ground
 - **If less than 2 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Test for infinite resistance between the test points: Signal circuit terminal 1/A @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
 4. Test for less than 2 ohms between the test points: Signal circuit terminal 1/A @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **If greater than 4 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 1/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: K20 Engine Control Module
 - **Go to next step: If between 2 and 4 V**
- 6. Test or replace the component: B68 Knock Sensor

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Knock Sensor Replacement - Bank 1](#)
- [Knock Sensor Replacement - Bank 2](#)
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0335 OR P0336

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 P0335

Crankshaft Position Sensor Circuit

DTC P0336

Crankshaft Position Sensor Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0335, P0557, P057C, P0651, P118C	P0335	P0557, P0558, P0651, P118C	P0336
Signal	P0335, P0506	P0335, P0506	P0335	P0336
Low Reference	-	P0335, P0506	-	P0336

Circuit/System Description

For an overview of the component/system, refer to [Electronic Ignition System Description](#)

Circuit	Description
5 V Reference	Regulated voltage supplied by the control module.
Signal	The control module input circuit has an internal resistance connected to 5 V.
Low Reference	Grounded through the control module.

Component	Description
B26 Crankshaft Position Sensor	The sensor contains a hall-effect sensor and additional electronics that processes the signal. It detects the change of strength of the magnetic field caused by the reluctor ring. When the strength changes, the sensor changes the amount of current it consumes. This results in a square wave signal of the current, while the voltage stays constant. The control module detects the frequency in which the current changes, which is proportional to the rotational speed.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.
Reluctor Ring	There are 58 teeth or invisible magnetic segments on the edge of the crankshaft position reluctor ring mounted on the crankshaft. Each tooth or magnetic segment on the ring is spaced at a 60 segment spacing with 2 missing segments for a reference gap.

The ECM uses information from the crankshaft position sensor and the camshaft position sensor(s) for sequencing and timing of the spark events.

Conditions for Running the DTC

P0335 Condition 1

- DTC P0101, P0102, P0103 = Not set
- MAF Sensor = Greater than 1.5 g/s

Condition 2

- Camshaft Position Sensor = Signal received
- Starter = Active

Condition 3

- Engine = Running

Condition 4

- DTC P0365, P0366 = Not set
- Engine = Running

Frequency the DTC runs = Continuously - After the running conditions are met

P0336 Condition 1

- DTC P0335 = Not set
- Engine Speed = Greater than 100 RPM
- MAF Sensor = Greater than 1.5 g/s

Condition 2

- Engine = Running

Condition 3

- DTC P0101, P0102, P0103 = Not set
- MAF Sensor = Greater than 1.5 g/s

Condition 4

- Camshaft Position Sensor = Signal received
- Starter = Active

Condition 5

- DTC P0365, P0366 = Not set
- Engine = Running

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

P0335

Crankshaft Position Sensor = No Signal - For greater than 4 s

P0336

Crankshaft Position Sensor = Signal synchronization lost 10 times within 10 s.

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC

- Camshaft Position Actuator = Park position
- Camshaft Position Sensor = Used for engine position

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

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 P0641, P0651 is not set.

- **If the DTC is set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle

- **Go to next step: If the DTC is not set**

3. Engine - Running
4. Verify DTC P0336 is not set.

- **If the DTC is set**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

5. Verify the scan tool parameter: Crankshaft Position Active Counter = Increments

- **If the parameter value does not increment**

Refer to: Circuit/System Testing

- **Go to next step: If the parameter value increments**

6. Verify the scan tool parameter: Crankshaft Position Resync Counter = 0 Counts - The engine should not stumble/stall.

- Perform the action while monitoring the parameter:

- Wiggle the harness and connector: B26 Crankshaft Position Sensor
- Wiggle the harness and connector: K20 Engine Control Module
- **If greater than 0 counts**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If 0 counts**

7. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

8. 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: B26 Crankshaft Position Sensor

3. Test for less than 10 ohms between the test points: Low Reference circuit terminal 2 & Ground

- **If 10 ohms or greater**

1. Disconnect the appropriate electrical connector: K20 Engine Control Module

2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 2 @ Component harness & The other end of the circuit @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

- **Go to next step: If less than 10 ohms**

4. Ignition - On / Vehicle - In Service Mode

5. Test for 4.8 to 5.2 V between the test points: 5 V Reference circuit terminal 1 & Ground

- **If less than 4.8 V**

1. Ignition/Vehicle - Off

2. Disconnect the appropriate electrical connector: K20 Engine Control Module

3. Test for infinite resistance between the test points: 5 V Reference circuit terminal 1 @ Component harness & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- Go to next step: If infinite resistance

4. Test for less than 2 ohms between the test points: 5 V Reference circuit terminal 1 @ Component harness & The other end of the circuit @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

- **If greater than 5.2 V**

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: K20 Engine Control Module
3. Ignition - On / Vehicle - In Service Mode
4. Test for less than 1 V between the test points: 5 V Reference circuit terminal 1 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module

- **Go to next step: If between 4.8 and 5.2 V**

6. Rapidly tap a 3 A fused jumper wire between the test points: Signal circuit terminal 3 & Ground

Verify the scan tool parameter: Crankshaft Position Active Counter = Increments

- **If the parameter value does not increment**

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: K20 Engine Control Module
3. Ignition - On / Vehicle - In Service Mode
4. Test for less than 1 V between the test points: Signal circuit terminal 3 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - Go to next step: If less than 1 V
5. Ignition/Vehicle - Off
6. Test for infinite resistance between the test points: Signal circuit terminal 3 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
7. Test for less than 2 ohms between the test points: Signal circuit terminal 3 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module

- **Go to next step: If the parameter value increments**

7. Verify DTC P0336 is not set.

- **If the DTC is set**

Verify the following conditions do not exist:

- B26 Crankshaft Position Sensor & Reluctor Ring - Excessive play/Foreign material passing between the components/Incorrect air gap /Incorrect installation/Loose/Visible Damage
- Camshaft Sprocket - Visible Damage /Worn
- Crankshaft Sprocket - Visible Damage /Worn
- Engine Oil - Contaminated/Dirty
- Timing Chain or Timing Belt - Visible Damage /Worn
- Timing Chain Tensioner or Timing Belt Tensioner - Visible Damage /Worn
 - If a condition exists - Repair or replace as necessary
 - If no condition exists - Test or replace the component: B26 Crankshaft Position Sensor

- **Go to next step: If the DTC is not set**

8. Test or replace the component: B26 Crankshaft Position Sensor

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Crankshaft Position Sensor Replacement](#)
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0340, P0341, P0345, P0346, P0365, P0366, P0390, OR P0391

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 P0340

Intake Camshaft Position Sensor Circuit Bank 1

DTC P0341

Intake Camshaft Position Sensor Performance Bank 1

DTC P0345

Intake Camshaft Position Sensor Circuit Bank 2

DTC P0346

Intake Camshaft Position Sensor Performance Bank 2

DTC P0365

Exhaust Camshaft Position Sensor Circuit Bank 1

DTC P0366

Exhaust Camshaft Position Sensor Performance Bank 1

DTC P0390

Exhaust Camshaft Position Sensor Circuit Bank 2

DTC P0391

Exhaust Camshaft Position Sensor Performance Bank 2

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0340, P0345, P0365, P0390, P0641*	P0340, P0345, P0365, P0390	P0345, P0641*	-
Signal	P0340, P0345, P0365, P0390	P0340, P0345, P0365, P0390	P0340, P0345, P0365, P0390	P0341, P0346, P0366, P0391

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Low Reference	-	P0340, P0345, P0365, P0390	-	-
*Additional DTCs may set.				

Circuit/System Description

For an overview of the component/system, refer to [Electronic Ignition System Description](#)

Circuit	Description
5 V Reference	Regulated voltage supplied by the control module.
Signal	The control module input circuit has an internal resistance connected to 5 V.
Low Reference	Grounded through the control module.

Component	Description
B23 Camshaft Position Sensor	The sensor contains a hall-effect sensor and additional electronics that processes the signal. It detects the change of strength of the magnetic field caused by the reluctor ring. When the strength changes, the sensor changes the amount of current it consumes. This results in a square wave signal of the current, while the voltage stays constant. The control module detects the frequency in which the current changes, which is proportional to the rotational speed.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.
Reluctor Ring	There are 4 equally spaced teeth on the edge of the camshaft position reluctor ring mounted on the camshaft.

The ECM uses information from the crankshaft position sensor and the camshaft position sensor(s) for sequencing and timing of the spark events.

Conditions for Running the DTC

P0340, P0345, P0365, P0390 Condition 1

- DTC P0101, P0102, P0103 = Not set
- MAF Sensor = Greater than 1.5 g/s

Condition 2

- Camshaft Position Sensor = Signal received
- M64 Starter Motor = Active

Condition 3

- Engine = Running
- M64 Starter Motor = Inactive

Condition 4

- DTC P0335, P0336, P0641, P0651 = Not set
- Crankshaft = Synchronized

- M64 Starter Motor = Active

Condition 5

- DTC P0335, P0336, P0641, P0651 = Not set
- Crankshaft = Synchronized

Frequency the DTC runs = Continuously - After the running conditions are met

P0341, P0346, P0366, P0391 Condition 1

- DTC P0335, P0336, P0641, P0651 = Not set
- Crankshaft = Synchronized
- M64 Starter Motor = Active

Condition 2

- DTC P0335, P0336, P0641, P0651 = Not set
- Crankshaft = Synchronized

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

P0340, P0345, P0365, P0390 Condition 1

Camshaft Position Sensor = No Signal - For greater than 5.5 s

Condition 2

Camshaft Position Sensor = No Signal - For greater than 4 s - Starter is engaged.

Condition 3

Camshaft Position Sensor = Less than 4 pulse(s) - For greater than 3 s

Condition 4

Camshaft Position Sensor = No Signal - During the first 1 engine revolutions.

Condition 5

Camshaft Position Sensor = No Signal - During 100 engine revolution(s)

P0341, P0346, P0366, P0391 Condition 1

Camshaft Position Sensor = Less than 4 pulse(s) - During 2 engine revolution(s)

Condition 2

Camshaft Position Sensor = Greater than 6 pulses - During 2 engine revolution(s)

Condition 3

Camshaft Position Sensor = Less than 398 pulse(s) - Greater than 402 pulses - During 100 engine revolution(s)

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC

- Control module command = Reduced Engine Power
- Camshaft Position Actuator = Park position

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Diagnostic Aids

The cranking period may take longer.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

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 P0641, P0651 is not set.

- **If the DTC is set**

Refer to **DTC P0641, P0651, P0697, or P06A3**

- **Go to next step: If the DTC is not set**

3. Engine - Running
4. Verify DTC P0341, P0366 is not set.

- **If the DTC is set**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

5. Verify the scan tool parameter:
 - Exhaust Camshaft Position Active Counter = Increments
 - Intake Camshaft Position Active Counter = Increments
 - **If the parameter value does not increment**

Refer to: Circuit/System Testing

- **Go to next step: If the parameter value increments**

6. Verify the scan tool parameter: Exhaust Camshaft Position Active Counter or Intake Camshaft Position Active Counter = Increments

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: B23 Camshaft Position Sensor
- Wiggle the harness and connector: K20 Engine Control Module
- **If the parameter value does not increment**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If the parameter value increments**

7. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

8. 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 appropriate electrical connector: B23 Camshaft Position Sensor
3. Test for less than 10 ohms between the test points: Low Reference circuit terminal 2 & Ground
 - **If 10 ohms or greater**
 1. Disconnect the appropriate electrical connector: K20 Engine Control Module
 2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 2 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **Go to next step: If less than 10 ohms**
4. Ignition - On / Vehicle - In Service Mode
5. Test for 4.8 to 5.2 V between the test points: 5 V Reference circuit terminal 1 & Ground
 - **If less than 4.8 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Test for infinite resistance between the test points: 5 V Reference circuit terminal 1 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
 4. Test for less than 2 ohms between the test points: 5 V Reference circuit terminal 1 @ Component harness & The other end of the circuit @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module
- **If greater than 5.2 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: 5 V Reference circuit terminal 1 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module
- **Go to next step: If between 4.8 and 5.2 V**
- 6. Test for 4.8 to 5.2 V between the test points: Signal circuit terminal 3 & Ground
 - **If less than 4.8 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Test for infinite resistance between the test points: Signal circuit terminal 3 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
 4. Test for less than 2 ohms between the test points: Signal circuit terminal 3 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **If greater than 5.2 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 3 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module
 - **Go to next step: If between 4.8 and 5.2 V**
- 7. Verify DTC P0341, P0366 is not set.
 - **If the DTC is set**

Verify the following conditions do not exist:

 - B23 Camshaft Position Sensor & Reluctor Ring - Excessive play/Foreign material passing between the components/Incorrect air gap /Incorrect installation/Loose/Visible Damage
 - Engine Oil - Contaminated/Dirty
 - Timing Chain or Timing Belt - Visible Damage /Worn
 - Timing Chain Tensioner or Timing Belt Tensioner - Visible Damage /Worn
 - If a condition exists - Repair or replace as necessary
 - If no condition exists - Test or replace the component: B23 Camshaft Position Sensor
 - **Go to next step: If the DTC is not set**
- 8. Test or replace the component: B23 Camshaft Position Sensor

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Camshaft Position Sensor Replacement - Bank 1 \(Right Side\) Exhaust](#)
- [Camshaft Position Sensor Replacement - Bank 2 \(Left Side\) Exhaust](#)
- [Camshaft Position Sensor Replacement - Bank 1 \(Right Side\) Intake](#)
- [Camshaft Position Sensor Replacement - Bank 2 \(Left Side\) Intake](#)
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0351-P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, OR P2316

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 P0351

Ignition Coil 1 Control Circuit

DTC P0352

Ignition Coil 2 Control Circuit

DTC P0353

Ignition Coil 3 Control Circuit

DTC P0354

Ignition Coil 4 Control Circuit

DTC P0355

Ignition Coil 5 Control Circuit

DTC P0356

Ignition Coil 6 Control Circuit

DTC P2300

Ignition Coil 1 Control Circuit Low Voltage

DTC P2301

Ignition Coil 1 Control Circuit High Voltage

DTC P2303

Ignition Coil 2 Control Circuit Low Voltage

DTC P2304

Ignition Coil 2 Control Circuit High Voltage

DTC P2306

Ignition Coil 3 Control Circuit Low Voltage

DTC P2307

Ignition Coil 3 Control Circuit High Voltage

DTC P2309

Ignition Coil 4 Control Circuit Low Voltage

DTC P2310

Ignition Coil 4 Control Circuit High Voltage

DTC P2312

Ignition Coil 5 Control Circuit Low Voltage

DTC P2313

Ignition Coil 5 Control Circuit High Voltage

DTC P2315

Ignition Coil 6 Control Circuit Low Voltage

DTC P2316

Ignition Coil 6 Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - Terminal 3/C @ T8A Ignition Coil 1	P0300, P2300	P0300, P0351	P0300, P2301	P0300, P0351
Control - Terminal 3/C @ T8B Ignition Coil 2	P0300, P2303	P0300, P0352	P0300, P2304	P0300, P0352
Control - Terminal 3/C @ T8C Ignition Coil 3	P0300, P2306	P0300, P0353	P0300, P2307	P0300, P0353
Control - Terminal 3/C @ T8D Ignition Coil 4	P0300, P2309	P0300, P0354	P0300, P2310	P0300, P0354
Control - Terminal 3/C @ T8E Ignition Coil 5	P0300, P2312	P0300, P0355	P0300, P2313	P0300, P0355
Control - Terminal 3/C @ T8F Ignition Coil 6	P0300, P2315	P0300, P0356	P0300, P2316	P0300, P0356
Ground - Terminal 1/A @ T8A Ignition Coil 1	-	P0300, P0351	-	P0300, P0351
Ground - Terminal 1/A @ T8B Ignition Coil 2	-	P0300, P0352	-	P0300, P0352
Ground - Terminal 1/A @ T8C Ignition Coil 3	-	P0300, P0353	-	P0300, P0353
Ground - Terminal 1/A @ T8D Ignition Coil 4	-	P0300, P0354	-	P0300, P0354

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ground - Terminal 1/A @ T8E Ignition Coil 5	-	P0300, P0355	-	P0300, P0355
Ground - Terminal 1/A @ T8F Ignition Coil 6	-	P0300, P0356	-	P0300, P0356

Circuit/System Description

For an overview of the component/system, refer to [Electronic Ignition System Description](#)

Circuit	Description
Control	The output circuit is switched to ground to activate the component.
Ground	Chassis Ground

Component	Description
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.
T8 Ignition Coil	The ignition system on this engine uses ignition coils with integrated power transistors.

The ECM controls the spark event for each cylinder through individual ignition coil control circuits. When the ECM commands the ignition control circuit On, electrical current flows through the primary winding of the ignition coil, creating a magnetic field. When a spark event is requested, the ECM commands the ignition control circuit Off, interrupting current flow through the primary winding. The collapsing magnetic field created by the primary winding induces a high voltage in the secondary winding, which is connected to the spark plugs.

Conditions for Running the DTC

- Engine = Cranking or Running
- Ignition Voltage = Greater than 11 V

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

Control Circuit = Commanded state does not match the actual state

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type A DTC - Exceptions listed below

DTC P0355, P0356, P2312, P2313, P2315, P2316 = Type B DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC - Exceptions listed below

DTC P0355, P0356, P2312, P2313, P2315, P2316 = Type B DTC

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

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

Special Tools

<special tool><special tool-no>J-26792</special tool-no><special tool-desc>Ignition Spark Tester</special tool-desc></special tool>

Equivalent regional tools: Special Tools (Mechanical Tools)

Circuit/System Verification

1. Engine - Running

2. Verify the scan tool parameter:

- Ignition Coil 1 - 6 Control Circuit High Voltage Test Status = OK or Not Run
- Ignition Coil 1 - 6 Control Circuit Low Voltage Test Status = OK or Not Run
- Ignition Coil 1 - 6 Control Circuit Open Test Status = OK or Not Run
- **If not the specified state**

Refer to: Circuit/System Testing

- **Go to next step: If the specified state**

3. Verify the scan tool parameter:

- Ignition Coil 1 - 6 Control Circuit High Voltage Test Status = OK or Not Run
- Ignition Coil 1 - 6 Control Circuit Low Voltage Test Status = OK or Not Run
- Ignition Coil 1 - 6 Control Circuit Open Test Status = OK or Not Run
- Perform the action while monitoring the parameter:
- Wiggle the harness and connector: T8 Ignition Coil
- Wiggle the harness and connector: K20 Engine Control Module
- **If not the specified state**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If the specified state**

4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

5. 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 appropriate electrical connector: T8 Ignition Coil
3. Test for less than 10 ohms between the test points: Ground circuit terminal 1/A & Ground
 - **If 10 ohms or greater**
 1. Disconnect the ground connection: Ground terminal
 2. Test for less than 2 ohms between the test points: Ground circuit terminal 1/A @ Component harness & The other end of the circuit @ Ground terminal
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Repair the open/high resistance in the ground connection.
 - **Go to next step: If less than 10 ohms**
4. Ignition - On / Vehicle - In Service Mode
5. Verify a test lamp does not turn On between the test points: Control circuit terminal 3/C & B+
 - **If the test lamp turns On**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Disconnect the electrical connector: K20 Engine Control Module
 3. Test for infinite resistance between the test points: Control circuit terminal 3/C @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module
 - **Go to next step: If the test lamp does not turn On**
6. Remove - Test Lamp
7. Engine - Running
8. Verify the scan tool parameter: Ignition Coil 1 - 6 Control Circuit High Voltage Test Status = OK or Not Run
 - **If not the specified state**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K20 Engine Control Module
 3. Test for less than 1 V between the test points: Control circuit terminal 3/C @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module
 - **Go to next step: If the specified state**
9. Ignition/Vehicle - Off
10. Connect a 3 A fused jumper wire between the test points: Control circuit terminal 3/C & Ignition circuit terminal 4/D

11. Engine - Running

12. Verify the scan tool parameter: Ignition Coil 1 - 6 Control Circuit High Voltage Test Status = OK or Not Run

- **If the specified state**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)

2. Disconnect the electrical connector: K20 Engine Control Module

3. Test for less than 2 ohms between the test points: Control circuit terminal 3/C @ Component harness & The other end of the circuit @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.

- If less than 2 ohms - Replace the component: K20 Engine Control Module

- **Go to next step: If not the specified state**

13. Test or replace the component: T8 Ignition Coil

Component Testing

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

1. Ignition/Vehicle - Off

2. Remove the appropriate component: T8 Ignition Coil - Leave the electrical connector connected.

3. Install the special tool:<special tool><special tool-no>J-26792</special tool-no><special tool-desc>Ignition Spark Tester</special tool-desc></special tool>

4. Engine - Running

NOTE: **An erratic or weak spark is considered a no spark condition.**

5. Verify there is spark at the tool.

- **If there is no spark**

Replace the component: T8 Ignition Coil

- **Go to next step: If there is spark**

6. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Ignition Coil Replacement - Bank 1](#)

- [Ignition Coil Replacement - Bank 2](#)

- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0420 OR P0430

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 P0420

Catalyst System Low Efficiency Bank 1

DTC P0430

Catalyst System Low Efficiency Bank 2

Circuit/System Description

For an overview of the component/system, refer to [Catalytic Converter Description and Operation](#)

Conditions for Running the DTC

P0420, P0430

- {P0420} DTC P013A, P013B, P013E, P013F, P2270, P2271 = Not set
- {P0430} DTC P013C, P013D, P014A, P014B, P2272, P2273 = Not set
- DTCs related to the following system/component = Not Set
 - B34 Engine Coolant Temperature Sensor
 - B52 Heated Oxygen Sensor
 - B74 Manifold Absolute Pressure Sensor
 - B75C Multifunction Intake Air Sensor
 - B198 Fuel Composition Sensor
 - Q17 Fuel Injector
 - Q38 Throttle Body
 - Engine Misfire
 - Fuel Trim System
- Accelerator Pedal Position = Less than 3%
- Catalytic Converter = 550 to 910B°C (1, 022 to 1, 670B°F)
- Deceleration Fuel Cut-Off = Active
- Engine Speed = 1, 150 to 3, 500 RPM
- EVAP Purge Solenoid Valve = OFF
- Fuel Control Loop Status = Closed Loop
- Fuel level = Greater than 10%
- HO2S Heater Resistance Learn Status = Valid
- Ignition Voltage = Greater than 10 V
- MAF Sensor = 1.7 to 20 g/s
- Vehicle Speed = 64 to 125 km/h (40 to 78 MPH)

Frequency the DTC runs = Once - After the running conditions are met - 3 Attempts per drive cycle

Conditions for Setting the DTC

Oxygen storage capacity of the catalyst = Less than a predefined threshold

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type A DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC

Reference Information

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode

2. Verify there are no DTCs set related to the following component/system:

- B34 Engine Coolant Temperature Sensor
- B52 Heated Oxygen Sensor
- B74 Manifold Absolute Pressure Sensor
- B75C Multifunction Intake Air Sensor
- B198 Fuel Composition Sensor
- Q17 Fuel Injector
- Q38 Throttle Body
- Engine Misfire
- Fuel Trim System
- **If a related DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **Go to next step: If a related DTC is not set**

3. Verify the following conditions do not exist:

- Coolant consumption - Refer to [Loss of Coolant](#)
- Oil consumption - Refer to [Oil Consumption Diagnosis](#)
- **If a condition exists**

Repair or replace as necessary

- **Go to next step: If no condition exists**

4. Verify a condition does not exist with the component: B52 Heated Oxygen Sensor - Loose/Poor Connection/Visible Damage

- **If a condition exists**

Repair or replace as necessary

- **Go to next step: If no condition exists**

5. Verify a condition does not exist with the component: Exhaust System & Three-Way Catalytic Converter

- Cracked
- Internal component rattle
- Leaking - Refer to [Exhaust Leakage](#)
- Loose Clamps
- Missing components
- Restrictions - Refer to [Restricted Exhaust](#)
- Severe discoloration caused by excessive temperatures
- Visible Damage
- **If a condition exists**

Repair or replace as necessary

- **Go to next step: If no condition exists**

6. All OK.

Repair Instructions

- Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)
 - [Heated Oxygen Sensor Replacement - Bank 1 Sensor 2](#)
 - [Heated Oxygen Sensor Replacement - Bank 2 Sensor 2](#)
 - [Warm Up Three-Way Catalytic Converter Replacement \(Right Side, LGZ\)](#) , or [Warm Up Three-Way Catalytic Converter Replacement \(Left Side, LGZ 2WD\)](#) , or [Warm Up Three-Way Catalytic Converter Replacement \(Left Side, LGZ 4WD\)](#)
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2021 ENGINE PERFORMANCE

Engine Controls And Fuel - 3.6L (LGZ) - Diagnostic Information And Procedures (2 Of 2) - Canyon, Colorado

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P0442 OR P0455

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 P0442

Evaporative Emission (EVAP) System Small Leak Detected

DTC P0455

Evaporative Emission (EVAP) System Large Leak Detected

Circuit/System Testing

For an overview of the component/system, refer to [Evaporative Emission Control System Description](#)

P0442

This diagnostic tests the Evaporative Emission (EVAP) System for a small leak when the ignition is off and the Conditions for Running the DTC are met. When the ignition is turned off and the EVAP system is sealed, a change in the fuel tank vapor temperature occurs which results in a corresponding pressure change in the fuel tank vapor space. This change is monitored by the control module using the fuel tank pressure (FTP) sensor. With a leak in the system, the amount of pressure change will be less than that of a sealed system.

P0455

This diagnostic tests the Evaporative Emission (EVAP) System for a large leak or restrictions to the purge path in the EVAP system. When the Conditions for Running the DTC are met the control module commands the EVAP canister vent solenoid valve and EVAP purge solenoid valve on, allowing vacuum into the EVAP system. The control module monitors the fuel tank pressure (FTP) sensor voltage to verify that the system is able to reach a predetermined level of vacuum before a calibrated amount of purge volume has passed through the system.

Conditions for Running the DTC

P0442

- DTCs related to the following system/component = Not Set
 - B9 Ambient Air Temperature Sensor
 - B34 Engine Coolant Temperature Sensor
 - B46 Fuel Level Sensor
 - B66 Intake Air Temperature Sensor
 - B75B Mass Air Flow/Intake Air Temperature Sensor

- B115 Vehicle Speed Sensor
- B150 Fuel Tank Pressure Sensor
- Q12 Evaporative Emission Purge Solenoid Valve
- Q13 Evaporative Emission Vent Solenoid Valve
- Evaporative Emission (EVAP) Purge System
- Fuel Pump
- Ignition Off Time
- Output Speed Sensor
- Ambient Air Temperature Sensor = 0 to 34B°C (32 to 93B°F)
- Barometric Pressure Sensor = Greater than 70 kPa (10.1 PSI)
- Engine Coolant Temperature Sensor = Greater than 63B°C (145B°F)
- Engine Run Time = Greater than 10 min - Before ignition off
- Fuel Level Sensor = 10 to 90%
- Ignition = Off
- Start-Up Engine Coolant Temperature Sensor & Start-Up Intake Air Temperature Sensor = Within 8B°C (14B°F) of each other
- Time since diagnostic ran last Greater than 8 h = Test Passed or Greater than 8 h = Test Failed
- Vehicle Distance Traveled During Drive Cycle = Greater than 16.0 km (10.0 mi) - Before ignition off

Frequency the DTC runs = Once - Per hot soak @ Ignition Off - DTC test could take 40 min to complete

P0455

- DTCs related to the following system/component = Not Set
 - B9 Ambient Air Temperature Sensor
 - B34 Engine Coolant Temperature Sensor
 - B46 Fuel Level Sensor
 - B66 Intake Air Temperature Sensor
 - B74 Manifold Absolute Pressure Sensor
 - B75B Mass Air Flow/Intake Air Temperature Sensor
 - B115 Vehicle Speed Sensor
 - B150 Fuel Tank Pressure Sensor
 - G58 Evaporative Emission Purge Pump
 - Q12 Evaporative Emission Purge Solenoid Valve
 - Q13 Evaporative Emission Vent Solenoid Valve
 - Q38 Throttle Body
 - Evaporative Emission (EVAP) Purge System
 - Fuel Pump
 - Ignition Off Time
 - Output Speed Sensor
 - Reduced Engine Power
 - Throttle Position Sensor
- Q12 Evaporative Emission Purge Solenoid Valve - Flow = Greater than 2.0%
- Barometric Pressure Sensor = Greater than 70 kPa (10.1 PSI)
- Fuel Level Sensor = 10 to 90%
- Ignition Voltage = Greater than 10.0 V

- Start-Up Engine Coolant Temperature Sensor & Start-Up Intake Air Temperature Sensor = Within 8B°C (14B°F) of each other
- Start-Up Engine Coolant Temperature Sensor = Less than 35B°C (95B°F)
- Start-Up Intake Air Temperature Sensor = 4 to 35B°C (39 to 95B°F)

Frequency the DTC runs = Once - Per cold start-up

Conditions for Setting the DTC

Evaporative Emission (EVAP) Purge System = Leaking - Greater than a predefined threshold

Actions Taken When the DTC Sets

DTC P0442 = Type A DTC

DTC P0455 = Type B DTC

Conditions for Clearing the DTC

DTC P0442 = Type A DTC

DTC P0455 = Type B DTC

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or **Inline Harness Connector End Views - Index** or **Component Connector End Views - Index**

Component View Reference

Powertrain Component Views

Description and Operation

Evaporative Emission Control System Description

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

Special Tools

- CH-48096 EVAP Service Port Access Tool

- GE-41413-A / B Evaporative Emissions System Tester (EEST)
- GE-41413-SPT High Intensity White Light
- GE-41413-300 EVAP Cap and Plug Kit
- EN-41413-VLV EVAP Service Port Vent Fitting

Equivalent regional tools: **Special Tools (Mechanical Tools)**

Circuit/System Verification

WARNING: Refer to **Fuel and Evaporative Emission Pipe Warning** .

CAUTION: Refer to **Clean, Dry, Low Pressure Gas Source Caution** .

1. Verify the following conditions do not exist:

- {If equipped} G58 Evaporative Emission Purge Pump - Disconnected/Incorrect connection/Leaking/Loose/Visible Damage
- Q12 Evaporative Emission Purge Solenoid Valve - Disconnected/Incorrect connection/Leaking/Loose/Visible Damage
- Q13 Evaporative Emission Vent Solenoid Valve - Disconnected/Incorrect connection/Leaking/Loose/Visible Damage
- Evaporative Emission Canister - Disconnected/Incorrect connection/Leaking/Visible Damage
- Evaporative Emission Hose & Evaporative Emission Pipe - Defective/Disconnected/Incorrect connection/Kinked/Leaking/Loose/Restricted/Visible Damage
- {Cap Type Fuel Fill} Fuel Tank Filler Cap - Defective/Leaking/Loose/Missing/Visible Damage
- {Capless Type Fuel Fill} Door @ Fuel Tank Filler Pipe - Defective/Leaking/Loose/Visible Damage
 - **If a condition exists**
Repair or replace as necessary
 - **Go to next step: If no condition exists**

NOTE:

- **Before proceeding with this test, review the tool user manual for Safety Information and Instructions: GE-41413-A / B Evaporative Emissions System Tester (EEST)**
- **The user manual that is supplied with the tool, is also available online, refer to: GM Special Service Tools**
- **Make sure the underbody temperature of the vehicle and the tester temperature are similar.**
- **Completely unwind the nitrogen/smoke hose from the bracket to optimize the tester's performance.**

2. Perform the following action:

1. Install - Hose @ Test Orifice - 0.51 mm (0.020 in) @ GE-41413-A / B Evaporative Emissions System Tester (EEST)
2. Select - Nitrogen @ GE-41413-A / B Evaporative Emissions System Tester (EEST)
3. Press and release the switch: Remote Switch @ GE-41413-A / B Evaporative Emissions System Tester (EEST) - Special Tool = On or Activated
4. Align - Sliding Red Flag @ Floating Indicator
5. Press and release the switch: Remote Switch @ GE-41413-A / B Evaporative Emissions System Tester (EEST) - Special Tool = Off or Deactivated

3. Remove - Hose @ Test Orifice

4. Disconnect the component: Quick Connect Fitting @ Q12 Evaporative Emission Purge Solenoid Valve
5. Install - CH-48096 EVAP Service Port Access Tool - Between: Evaporative Emission Canister Purge Tube & Q12 Evaporative Emission Purge Solenoid Valve
6. Install - GE-41413-A / B Evaporative Emissions System Tester (EEST) - Hose @ CH-48096 EVAP Service Port Access Tool
7. Ignition - On / Vehicle - In Service Mode
8. Perform the scan tool function: EVAP Purge/Seal - Not Venting

NOTE:

- **The pressure must not exceed 13 in H2O (0.5 PSI) as pressure in excess of this could cause system components to perform inaccurately.**
- **Larger volume fuel tanks, and/or those with lower fuel levels may require several minutes for the floating indicator to stabilize or produce smoke from a leak.**

9. Press and release the switch: Remote Switch @ GE-41413-A / B Evaporative Emissions System Tester (EEST) - Special Tool = On or Activated

Verify the tool reading: Floating Indicator = Below: Sliding Red Flag

- **If not below the Sliding Red Flag**

1. Press and release the switch: Remote Switch @ GE-41413-A / B Evaporative Emissions System Tester (EEST) - Special Tool = Off or Deactivated
2. Select - Smoke @ GE-41413-A / B Evaporative Emissions System Tester (EEST)

NOTE:

- **When injecting smoke in to the system, remove the fuel fill cap or temporarily leave the EVAP vent valve open, until smoke is observed. Then close the system.**
- **Verify smoke has filled the system by opening the system opposite the end where smoke is injected.**
- **To help locate intermittent leaks move related components while applying smoke to the system.**

3. Press and release the switch: Remote Switch @ GE-41413-A / B Evaporative Emissions System Tester (EEST) - Special Tool = On or Activated
4. Use the special tool: GE-41413-SPT High Intensity White Light - Illuminate the area(s) of concern - Evaporative Emission (EVAP) System

Verify the condition does not exist: Smoke exiting the system

- If a condition exists - Repair or replace as necessary
- Go to next step: If no condition exists

5. Repeat the procedure starting at step 1

- **Go to next step: If below the Sliding Red Flag**

10. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Repeat the procedure starting at step 1

- **Go to next step: If the DTC does not set**

11. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Evaporative Emission Canister Replacement](#)
- [Evaporative Emission Canister Vent Solenoid Valve Replacement](#)
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0443, P0458, OR P0459

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 P0443

Evaporative Emission (EVAP) Purge Solenoid Valve Control Circuit

DTC P0458

Evaporative Emission (EVAP) Purge Solenoid Valve Control Circuit Low Voltage

DTC P0459

Evaporative Emission (EVAP) Purge Solenoid Valve Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P0443, P0458	P0443	P0690	-
Control	P0443, P0458	P0443, P0458	P0459, P0690	-

Circuit/System Description

For an overview of the component/system, refer to [Evaporative Emission Control System Description](#)

Circuit	Description
Ignition	Supplied from a fuse.
Control	The output circuit is switched to ground to activate the component.

Component	Description
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.
Q12 Evaporative Emission Purge Solenoid Valve	A solenoid valve is an electro-mechanically operated valve. The valve is controlled by an electric current through the

Component	Description
	solenoid.

Conditions for Running the DTC

Ignition Voltage = Greater than 11 V

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

Control Circuit = Commanded state does not match the actual state - For greater than 5 s

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

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

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. Perform the scan tool control function: EVAP Purge Solenoid Valve - From 0 to 50% and back to 0%.

Verify the scan tool parameter:

- EVAP Purge Solenoid Valve Control Circuit Open Test Status = OK or Not Run
- EVAP Purge Solenoid Valve Control Circuit Low Voltage Test Status = OK or Not Run
- EVAP Purge Solenoid Valve Control Circuit High Voltage Test Status = OK or Not Run
- **If not the specified state**

Refer to: Circuit/System Testing

- **Go to next step: If the specified state**

3. Perform the scan tool control function: EVAP Purge Solenoid Valve - From 0 to 50% and back to 0%.

Verify a click can be heard or felt at the following component(s) when the scan tool control function was commanded: Q12 Evaporative Emission Purge Solenoid Valve

- **If a click cannot be heard or felt**

Refer to: Circuit/System Testing

- **Go to next step: If a click can be heard or felt**

4. Verify the scan tool parameter:

- EVAP Purge Solenoid Valve Control Circuit Open Test Status = OK or Not Run
- EVAP Purge Solenoid Valve Control Circuit Low Voltage Test Status = OK or Not Run
- EVAP Purge Solenoid Valve Control Circuit High Voltage Test Status = OK or Not Run
- Perform the action while monitoring the parameter:
- Wiggle the harness and connector: Q12 Evaporative Emission Purge Solenoid Valve
- Wiggle the harness and connector: K20 Engine Control Module
- **If not the specified state**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If the specified state**

5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

6. All OK.

Circuit/System Testing

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: Q12 Evaporative Emission Purge Solenoid Valve
3. Ignition - On / Vehicle - In Service Mode
4. Verify a test lamp turns On between the test points: Ignition circuit terminal 1/A & Ground
 - **If the test lamp does not turn On and the circuit fuse is OK**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Test for less than 2 ohms between the test points: Ignition circuit terminal 1/A & Output terminal @ Fuse
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not turn On and the circuit fuse is open**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Connect the electrical connector: Q12 Evaporative Emission Purge Solenoid Valve
 3. Ignition - On / Vehicle - In Service Mode

4. Replace the component: Fuse

5. Verify the fuse does not open.

- If the fuse opens and there are components connected to the circuit - Disconnect a component and repeat procedure starting at step 4.4
- If the fuse opens with all components disconnected from the circuit - Repair the short to ground on the circuit.
- If the fuse does not open after disconnecting a component from the circuit - Replace the component disconnected last.
- Go to next step: If the fuse does not open with all components connected.

NOTE: It may be necessary to use a scan tool control function to operate a component.

6. Operate the component: Each component on the circuit - One at a time

Verify the fuse does not open when any of the components are activated.

- If the fuse opens - Replace the component that caused the fuse to open when activated.
- Go to next step: If the fuse does not open.

7. All OK.

• **Go to next step: If the test lamp turns On**

5. Verify a test lamp does not turn On between the test points: Control circuit terminal 2/B & B+

• **If the test lamp turns On**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Disconnect the electrical connector: K20 Engine Control Module
3. Test for infinite resistance between the test points: Control circuit terminal 2/B @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module

• **Go to next step: If the test lamp does not turn On**

6. Remove - Test Lamp

7. Perform the scan tool control function: EVAP Purge Solenoid Valve - From 0 to 50% and back to 0%.

Verify the scan tool parameter: EVAP Purge Solenoid Valve Control Circuit High Voltage Test Status = OK

• **If not the specified state**

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: K20 Engine Control Module
3. Ignition - On / Vehicle - In Service Mode
4. Test for less than 1 V between the test points: Control circuit terminal 2/B @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module

• **Go to next step: If the specified state**

8. Connect a 3 A fused jumper wire between the test points: Control circuit terminal 2/B & Ignition circuit terminal 1/A

9. Perform the scan tool control function: EVAP Purge Solenoid Valve - From 0 to 50% and back to 0%.

Verify the scan tool parameter: EVAP Purge Solenoid Valve Control Circuit High Voltage Test Status = Malfunction

- **If not the specified state**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
2. Disconnect the electrical connector: K20 Engine Control Module
3. Test for less than 2 ohms between the test points: Control circuit terminal 2/B & The other end of the circuit
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module

- **Go to next step: If the specified state**

10. Test or replace the component: Q12 Evaporative Emission Purge Solenoid Valve

Component Testing

Static Test

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: Q12 Evaporative Emission Purge Solenoid Valve
3. Test for 10 to 30 ohms between the test points: Control terminal 2/B & Ignition terminal 1/A
 - **If not between 10 and 30 ohms**

Replace the component: Q12 Evaporative Emission Purge Solenoid Valve
 - **Go to next step: If between 10 and 30 ohms**
4. Test for infinite resistance between the test points: Each terminal of the component & The component's housing
 - **If less than infinite resistance**

Replace the component: Q12 Evaporative Emission Purge Solenoid Valve
 - **Go to next step: If infinite resistance**
5. All OK.

Dynamic Test

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: Q12 Evaporative Emission Purge Solenoid Valve
3. Connect a 3 A fused jumper wire between the test points: Ignition terminal 1/A & 12 V

CAUTION: Complete the testing as quickly as possible in order to prevent overheating and damaging the component.

4. Momentarily connect a jumper wire between the test points: Control terminal 2/B & Ground

Verify the component turns On and Off when connecting and disconnecting the jumper wire: Q12 Evaporative Emission Purge Solenoid Valve

- **If the component does not turn On and Off**

Replace the component: Q12 Evaporative Emission Purge Solenoid Valve

- **Go to next step: If the component turns On and Off**

5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Evaporative Emission Canister Purge Solenoid Valve Replacement](#)
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0446

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 P0446

Evaporative Emission (EVAP) Vent System Performance

Typical Scan Tool Data

Fuel Tank Pressure Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition = On & Engine = Off Parameter Normal Range: 1.3 to 1.7 V			
5 V Reference	0.0 V	0.0 V	4.2 to 5.0 V
Signal	0.0 V	0.0 V	5.0 V
Low Reference	-	4.96 V	-

Circuit/System Description

For an overview of the component/system, refer to [Evaporative Emission Control System Description](#)

Component	Description
B150 Fuel Tank Pressure Sensor	The pressure sensor is a 3 wire piezoelectric pressure transducer.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

This diagnostic tests the Evaporative Emission (EVAP) System for a restricted or blocked EVAP vent path that would cause excess amounts of vacuum to develop in the EVAP system.

Conditions for Running the DTC

- DTCs related to the following system/component = Not Set
 - B34 Engine Coolant Temperature Sensor
 - B46 Fuel Level Sensor
 - B66 Intake Air Temperature Sensor
 - B74 Manifold Absolute Pressure Sensor
 - B75B Mass Air Flow/Intake Air Temperature Sensor
 - B115 Vehicle Speed Sensor
 - B150 Fuel Tank Pressure Sensor
 - Q12 Evaporative Emission Purge Solenoid Valve
 - Q13 Evaporative Emission Vent Solenoid Valve

- Q38 Throttle Body
- Evaporative Emission (EVAP) Purge System
- Fuel Pump
- Output Speed Sensor
- Reduced Engine Power
- Throttle Position Sensor
- Barometric Pressure Sensor = Greater than 70 kPa (10.15 PSI)
- Fuel Level Sensor = 10 to 90%
- Start-Up Engine Coolant Temperature Sensor = Less than 35B°C (95B°F)
- Start-Up Intake Air Temperature Sensor = 4 to 35B°C (39 to 95B°F)
- System Voltage = Greater than 10.0 V

Frequency the DTC runs = Once - Per cold start-up - After the running conditions are met

Conditions for Setting the DTC

Fuel Tank Pressure Sensor = Greater than 4.65 mmHg (2.5 in. H2O) or Less than -1.24 mmHg (-5.0 in. H2O) - For greater than 60 s

or

Fuel Tank Pressure Sensor = Less than -22.5 mmHg (-12.0 in. H2O) - For greater than 5 s - Before 6.0 L (1.6 gal) of vapor have been purged through the EVAP system.

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

The following conditions could cause DTC P0446 to set:

- Cold Regions = Ice / Snow @ Evaporative Emission Vent Filter or Evaporative Emission Canister Air Inlet Hose
- Dry Regions = Dirt / Dust / Sand @ Evaporative Emission Vent Filter or Evaporative Emission Canister Air Inlet Hose
- Wet Regions = Mud @ Evaporative Emission Vent Filter or Evaporative Emission Canister Air Inlet Hose

Reference Information

Connector End View Reference

[Master Electrical Component List](#) , or [Inline Harness Connector End Views - Index](#) or [Component Connector End Views - Index](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#)

Special Tools

- CH-41415-30 Fuel Tank Cap Adapter
- GE-41413-A / B Evaporative Emissions System Tester (EEST)
- GE-41415-60 Engine Induction System Leak Test Adapter/Capless Fuel Fill Adapter

Equivalent regional tools: [Special Tools \(Mechanical Tools\)](#).

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC P0449, P0498, P0499, P0451 - P0454 is not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **Go to next step: If none of the DTCs are set**

3. Ignition/Vehicle - Off
 4. Perform the following action:
 - {Cap Type Fuel Fill} Remove - Fuel Tank Filler Cap
 - {Capless Type Fuel Fill} Install - GE-41415-60 Engine Induction System Leak Test Adapter/Capless Fuel Fill Adapter @ Door @ Fuel Tank Filler Pipe
 5. Ignition - On / Vehicle - In Service Mode
 6. Verify the scan tool parameter: Fuel Tank Pressure Sensor = 1.3 to 1.7 V
 - **If not between 1.3 and 1.7 V**
- Refer to [DTC P0451-P0454](#).
- **Go to next step: If between 1.3 and 1.7 V**
7. Perform the following action:
 - {Cap Type Fuel Fill} Install - Fuel Tank Filler Cap
 - {Capless Type Fuel Fill} Remove - GE-41415-60 Engine Induction System Leak Test Adapter/Capless Fuel Fill Adapter @ Door @ Fuel Tank Filler Pipe
 8. Engine - Idling - At normal operating temperature
 9. Perform the scan tool function: EVAP Purge Solenoid Valve - 50%

Verify the scan tool parameter: Fuel Tank Pressure Sensor = Less than 2.5 V

- **If 2.5 V or greater**

Refer to: Circuit/System Testing

- **Go to next step: If less than 2.5 V**

10. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC does not set**

11. All OK.

WARNING: Refer to Fuel and Evaporative Emission Pipe Warning

CAUTION: Refer to Clean, Dry, Low Pressure Gas Source Caution

1. Verify the following conditions do not exist:

- Q13 Evaporative Emission Vent Solenoid Valve - Blocked/Restricted/Visible Damage
- Evaporative Emission Canister - Blocked/Defective/Restricted/Visible Damage
- Evaporative Emission Canister Purge Hose - Blocked/Defective/Incorrect connection/Kinked/Restricted/Visible Damage
- Evaporative Emission Canister Vent Hose - Blocked/Defective/Incorrect connection/Kinked/Restricted/Visible Damage
- Evaporative Emission Canister Vent Pipe - Blocked/Defective/Incorrect connection/Kinked/Restricted/Visible Damage
- Evaporative Emission Vent Filter - Blocked/Dirty/Restricted/Visible Damage
- **If a condition exists**

Repair or replace as necessary

- **Go to next step: If no condition exists**

2. Install any previously removed components.

3. Perform the following action:

- {Cap Type Fuel Fill} Remove - Fuel Tank Filler Cap

Install - CH-41415-30 Fuel Tank Cap Adapter

- {Capless Type Fuel Fill} Install - GE-41415-60 Engine Induction System Leak Test Adapter/Capless Fuel Fill Adapter @ Door @ Fuel Tank Filler Pipe

4. Perform the following action:

- {Cap Type Fuel Fill} Install - GE-41413-A / B Evaporative Emissions System Tester (EEST) - Hose @ CH-41415-30 Fuel Tank Cap Adapter
- {Capless Type Fuel Fill} Install - GE-41413-A / B Evaporative Emissions System Tester (EEST) - Hose @ GE-41415-60 Engine Induction System Leak Test Adapter/Capless Fuel Fill Adapter

5. Ignition - On / Vehicle - In Service Mode

NOTE:

- **Before proceeding with this test, review the tool user manual for Safety Information and Instructions: GE-41413-A / B Evaporative Emissions System Tester (EEST)**
- **The user manual that is supplied with the tool, is also available online, refer to: GM Special Service Tools**
- **Make sure the underbody temperature of the vehicle and the tester temperature are similar.**
- **Completely unwind the nitrogen/smoke hose from the bracket to optimize the tester's performance.**

6. Perform the following action:

1. Select - Nitrogen @ GE-41413-A / B Evaporative Emissions System Tester (EEST)
2. Perform the scan tool function: EVAP Vent Solenoid Valve - Not Venting
3. Press and release the switch: Remote Switch @ GE-41413-A / B Evaporative Emissions System Tester (EEST) - Special Tool = On or Activated

NOTE: Do NOT exceed the specified value or incorrect test results may occur.

Use the tool to achieve a gauge reading of 9.3 mmHg (5.0 in H₂O)

7. Perform the scan tool function: EVAP Vent Solenoid Valve - Venting

Verify the scan tool parameter: Fuel Tank Pressure Sensor = 0.0 mmHg (0.0 in. H₂O)

- **If not the specified value**

1. Ignition/Vehicle - Off

2. Verify the following conditions do not exist:

- Q13 Evaporative Emission Vent Solenoid Valve - Blocked/Restricted/Visible Damage
- Evaporative Emission Canister - Blocked/Defective/Restricted/Visible Damage
- Evaporative Emission Canister Purge Hose - Blocked/Defective/Incorrect connection/Kinked/Restricted/Visible Damage
- Evaporative Emission Canister Vent Hose - Blocked/Defective/Incorrect connection/Kinked/Restricted/Visible Damage
- Evaporative Emission Canister Vent Pipe - Blocked/Defective/Incorrect connection/Kinked/Restricted/Visible Damage
- Evaporative Emission Vent Filter - Blocked/Dirty/Restricted/Visible Damage
- If a condition exists - Repair or replace as necessary
- Go to next step: If no condition exists

3. Replace the component: Q13 Evaporative Emission Vent Solenoid Valve

- **Go to next step: If the specified value**

8. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Repeat the procedure starting at step 1

- **Go to next step: If the DTC does not set**

9. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Evaporative Emission Canister Replacement](#)
- [Evaporative Emission Canister Vent Solenoid Valve Replacement](#) - Q13 Evaporative Emission Vent Solenoid Valve

DTC P0449, P0498, OR P0499

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 P0449

Evaporative Emission (EVAP) Vent Solenoid Valve Control Circuit

DTC P0498

Evaporative Emission (EVAP) Vent Solenoid Valve Control Circuit Low Voltage

DTC P0499

Evaporative Emission (EVAP) Vent Solenoid Valve Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	P0449, P0498	P0449	-	-
Control	P0449, P0498	P0449	P0499	-

Circuit/System Description

For an overview of the component/system, refer to [Evaporative Emission Control System Description](#)

Circuit	Description
B+	Supplied from a fuse.
Control	The output circuit is switched to ground to activate the component.

Component	Description
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.
Q13 Evaporative Emission Vent Solenoid Valve	A solenoid valve is an electro-mechanically operated valve. The valve is controlled by an electric current through the solenoid.

Conditions for Running the DTC

Ignition = On or Engine = Running

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

Control Circuit = Commanded state does not match the actual state - For greater than 5 s

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

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

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. Perform the scan tool control function: EVAP Vent Solenoid Valve - Venting & Not Venting

Verify the scan tool parameter:

- EVAP Vent Solenoid Valve Control Circuit High Voltage Test Status = Not Run or OK
- EVAP Vent Solenoid Valve Control Circuit Low Voltage Test Status = Not Run or OK
- EVAP Vent Solenoid Valve Control Circuit Open Test Status = Not Run or OK
- **If not the specified state**

Refer to: Circuit/System Testing

- **Go to next step: If the specified state**

3. Perform the scan tool control function: EVAP Vent Solenoid Valve - Venting & Not Venting

Verify a click can be heard or felt at the following component(s) when the scan tool control function was commanded: Q13 Evaporative Emission Vent Solenoid Valve

- **If a click cannot be heard or felt**

Refer to: Circuit/System Testing

- **Go to next step: If a click can be heard or felt**

4. Verify the scan tool parameter:

- EVAP Vent Solenoid Valve Control Circuit High Voltage Test Status = Not Run or OK
- EVAP Vent Solenoid Valve Control Circuit Low Voltage Test Status = Not Run or OK
- EVAP Vent Solenoid Valve Control Circuit Open Test Status = Not Run or OK
- Perform the action while monitoring the parameter:
- Wiggle the harness and connector: Q13 Evaporative Emission Vent Solenoid Valve
- Wiggle the harness and connector: K20 Engine Control Module
- **If not the specified state**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If the specified state**

5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

6. All OK.

Circuit/System Testing

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: Q13 Evaporative Emission Vent Solenoid Valve
3. Ignition - On / Vehicle - In Service Mode
4. Verify a test lamp turns On between the test points: B+ circuit terminal 2/B & Ground
 - **If the test lamp does not turn On and the circuit fuse is OK**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Test for less than 2 ohms between the test points: B+ circuit terminal 2/B & Output terminal @ Fuse
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not turn On and the circuit fuse is open**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Test for infinite resistance between the test points: B+ circuit terminal 2/B & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: Q13 Evaporative Emission Vent Solenoid Valve
 - **Go to next step: If the test lamp turns On**
5. Verify a test lamp does not turn On between the test points: Control circuit terminal 1/A & B+
 - **If the test lamp turns On**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Test for infinite resistance between the test points: Control circuit terminal 1/A @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module
 - **Go to next step: If the test lamp does not turn On**
6. Remove - Test Lamp
7. Perform the scan tool control function: EVAP Vent Solenoid Valve - Not Venting

Verify the scan tool parameter: EVAP Vent Solenoid Valve Control Circuit High Voltage Test Status = OK

- **If not the specified state**

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: K20 Engine Control Module

3. Ignition - On / Vehicle - In Service Mode

4. Test for less than 1 V between the test points: Control circuit terminal 1/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: K20 Engine Control Module

• **Go to next step: If the specified state**

8. Connect a 3 A fused jumper wire between the test points: Control circuit terminal 1/A & B+ circuit terminal 2/B

9. Perform the scan tool control function: EVAP Vent Solenoid Valve - Not Venting

Verify the scan tool parameter: EVAP Vent Solenoid Valve Control Circuit High Voltage Test Status = Malfunction

• **If not the specified state**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)

2. Disconnect the appropriate electrical connector: K20 Engine Control Module

3. Test for less than 2 ohms between the test points: Control circuit terminal 1/A @ Component harness & The other end of the circuit @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

• **Go to next step: If the specified state**

10. Test or replace the component: Q13 Evaporative Emission Vent Solenoid Valve

Component Testing

Static Test

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: Q13 Evaporative Emission Vent Solenoid Valve

3. Test for 10 to 30 ohms between the test points: Control terminal 1/A & B+ terminal 2/B

• **If not between 10 and 30 ohms**

Replace the component: Q13 Evaporative Emission Vent Solenoid Valve

• **Go to next step: If between 10 and 30 ohms**

4. All OK.

Dynamic Test

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: Q13 Evaporative Emission Vent Solenoid Valve

3. Connect a 3 A fused jumper wire between the test points: B+ terminal 2/B & 12 V

CAUTION: Complete the testing as quickly as possible in order to prevent overheating and damaging the component.

4. Momentarily connect a jumper wire between the test points: Control terminal 1/A & Ground

Verify the component turns On and Off when connecting and disconnecting the jumper wire: Q13 Evaporative Emission Vent Solenoid Valve

• **If the component does not turn On and Off**

Replace the component: Q13 Evaporative Emission Vent Solenoid Valve

- **Go to next step: If the component turns On and Off**

5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Evaporative Emission Canister Vent Solenoid Valve Replacement](#)
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0451-P0454

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 P0451

Fuel Tank Pressure Sensor Performance

DTC P0452

Fuel Tank Pressure Sensor Circuit Low Voltage

DTC P0453

Fuel Tank Pressure Sensor Circuit High Voltage

DTC P0454

Fuel Tank Pressure Sensor Circuit Intermittent

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0641*	P0446, P0451, P0452	P0641*	-
Signal	P0452	P0451, P0452, P0453	P0453	P0451, P0454
Low Reference	-	P0446, P0451, P0453, P0463	-	P0451

*Additional DTCs may set.

Typical Scan Tool Data

Fuel Tank Pressure Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition = On & Engine = Off			
Parameter Normal Range: 1.3 to 1.7 V			
5 V Reference	0.0 V	0.0 V	4.2 to 5.0 V
Signal	0.0 V	0.0 V	5.0 V

Circuit	Short to Ground	Open	Short to Voltage
Low Reference	-	4.96 V	-

Circuit/System Description

For an overview of the component/system, refer to [Evaporative Emission Control System Description](#)

Circuit	Description
5 V Reference	Regulated voltage supplied by the control module.
Signal	The control module input circuit has an internal resistance connected to ground.
Low Reference	Grounded through the control module.

Component	Description
B150 Fuel Tank Pressure Sensor	The pressure sensor is a 3 wire piezoelectric pressure transducer. The sensor measures the pressure in the component: Fuel Tank
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Conditions for Running the DTC

P0451

- DTC P0442 = Running
- Ignition = Off

Frequency the DTC runs = 2 times - After the running conditions are met

P0452, P0453

- DTC P1001, P1005, U18A2 = Not set
- Ignition = On

Frequency the DTC runs = Continuously - After the running conditions are met

P0454

- DTC P0442 = Running
- Ignition = Off
- Refueling Event Detected = No - For greater than 10 min

Frequency the DTC runs = Once - After the running conditions are met

Conditions for Setting the DTC

P0451

Fuel Tank Pressure Sensor = Not within a calibrated range

P0452

Fuel Tank Pressure Sensor = Less than 0.15 V - For greater than 10 s

P0453

Fuel Tank Pressure Sensor = Greater than 4.85 V - For greater than 10 s

P0454

Fuel Tank Pressure Sensor = Signal Erratic

Actions Taken When the DTC Sets

- DTC P0451, P0454 = Type A DTC
- DTC P0452, P0453 = Type B DTC

Conditions for Clearing the DTC

- DTC P0451, P0454 = Type A DTC
- DTC P0452, P0453 = Type B DTC

Diagnostic Aids

P0451, P0454

- A restriction in the vent system could prevent fuel vapor pressure from bleeding off fast enough. If the pressure cannot bleed off fast enough a DTC sets.
- Ensure that the fresh air inlet, reference port, or vent of the component is clean, dry, and unobstructed: B150 Fuel Tank Pressure Sensor

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

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

Special Tools

- CH-48096 EVAP Service Port Access Tool
- GE-41413-A / B Evaporative Emissions System Tester (EEST)
- GE-41415-60 Engine Induction System Leak Test Adapter/Capless Fuel Fill Adapter

Equivalent regional tools: Special Tools (Mechanical Tools)

Circuit/System Verification

WARNING: Refer to Fuel and Evaporative Emission Pipe Warning

CAUTION: Refer to Clean, Dry, Low Pressure Gas Source Caution

1. Ignition - On / Vehicle - In Service Mode

2. Verify DTC P0641 is not set.

- **If the DTC is set**

Refer to DTC P0641, P0651, P0697, or P06A3

- **Go to next step: If the DTC is not set**

3. Verify with the customer the following did not exist: Poor fuel fill quality

- **If a condition exists**

1. Ignition/Vehicle - Off

2. Verify the condition does not exist with the component and repair as necessary:

1. Evaporative Emission Vent Filter or Evaporative Emission Canister Air Inlet Hose - Blocked/Dirty/Ice/Restricted/Visible Damage
2. Q13 Evaporative Emission Vent Solenoid Valve - Blocked/Restricted/Visible Damage
3. Evaporative Emission Canister Vent Hose or Pipe - Blocked/Kinked/Restricted/Visible Damage
4. Evaporative Emission Canister - Restricted/Visible Damage
5. Evaporative Emission Hose - Kinked/Restricted/Visible Damage
6. Evaporative Emission Pipe - Kinked/Restricted/Visible Damage

- **Go to next step: If no condition exists**

4. Verify the following conditions do not exist:

- Evaporative Emission Canister - Restricted/Visible Damage
- Evaporative Emission Hose - Kinked/Restricted/Visible Damage
- Evaporative Emission Pipe - Kinked/Restricted/Visible Damage
- **If a condition exists**

Repair or replace as necessary

- **Go to next step: If no condition exists**

5. Disconnect the component: Quick Connect Fitting @ Q12 Evaporative Emission Purge Solenoid Valve

6. Install - CH-48096 EVAP Service Port Access Tool - Between: Evaporative Emission Canister Purge Tube & Q12 Evaporative Emission Purge Solenoid Valve

7. Install - GE-41413-A / B Evaporative Emissions System Tester (EEST) - Hose @ CH-48096 EVAP Service Port Access Tool

8. Ignition - On / Vehicle - In Service Mode

9. Perform the following action:

1. Perform the scan tool function: Evaporative Emission Canister Vent Valve - Not Venting
2. Select - Nitrogen @ GE-41413-A / B Evaporative Emissions System Tester (EEST)
3. Press and release the switch: Remote Switch @ GE-41413-A / B Evaporative Emissions System Tester (EEST) - Special Tool = On or Activated

Use the tool to achieve a gauge reading of 9.3 mmHg (5.0 in H₂O)

4. Verify the scan tool parameter: Fuel Tank Pressure Sensor & Gauge @ GE-41413-A / B
Evaporative Emissions System Tester (EEST) = Within 1.9 mmHg (1.0 in H₂O) of each other
 - **If not within 1.9 mmHg (1.0 in H₂O) of each other**

Replace the component: B150 Fuel Tank Pressure Sensor

- **Go to next step: If within 1.9 mmHg (1.0 in H₂O) of each other**

10. Perform the scan tool function: Evaporative Emission Canister Vent Valve - Venting

Verify the scan tool parameter: Fuel Tank Pressure Sensor = -1.9 to 1.9 mmHg (-1.0 to 1.0 in. H₂O) - Within 3 s

- **If not between -1.9 to 1.9 mmHg (-1.0 to 1.0 in. H₂O) or Does not decrease within the specified time**

1. Ignition/Vehicle - Off

2. Verify the condition does not exist with the component and repair as necessary:

- Evaporative Emission Canister - Incorrect connection/Restricted/Visible Damage
- Evaporative Emission Hose - Defective/Incorrect connection/Kinked/Restricted/Visible Damage
- Evaporative Emission Pipe - Defective/Incorrect connection/Kinked/Restricted/Visible Damage
- **Go to next step: If between -1.9 to 1.9 mmHg (-1.0 to 1.0 in. H₂O) & Decreases within the specified time**

11. Perform the following action:

- {Cap Type Fuel Fill} Remove - Fuel Tank Filler Cap
- {Capless Type Fuel Fill} Install - GE-41415-60 Engine Induction System Leak Test Adapter/Capless Fuel Fill Adapter @ Door @ Fuel Tank Filler Pipe

12. Ignition - On / Vehicle - In Service Mode

13. Verify the scan tool parameter: Fuel Tank Pressure Sensor = 1.3 to 1.7 V

- **If not between 1.3 and 1.7 V**

Refer to: Circuit/System Testing

- **Go to next step: If between 1.3 and 1.7 V**

14. Verify the scan tool parameter: Fuel Tank Pressure Sensor = The parameter value should not change.

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: B150 Fuel Tank Pressure Sensor
- Wiggle the harness and connector: K20 Engine Control Module
- **If the parameter value changes**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If the parameter value does not change**

15. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

16. All OK.

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: B150 Fuel Tank Pressure Sensor
3. Test for less than 5 ohms between the test points: Low Reference circuit terminal 2 & Ground
 - **If 5 ohms or greater**
 1. Disconnect the appropriate electrical connector: K20 Engine Control Module
 2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 2 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **Go to next step: If less than 5 ohms**
4. Ignition - On / Vehicle - In Service Mode
5. Test for 4.8 to 5.2 V between the test points: 5 V Reference circuit terminal 3 & Low Reference circuit terminal 2
 - **If less than 4.8 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Test for infinite resistance between the test points: 5 V Reference circuit terminal 3 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
 4. Test for less than 2 ohms between the test points: 5 V Reference circuit terminal 3 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **If greater than 5.2 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: 5 V Reference circuit terminal 3 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module
 - **Go to next step: If between 4.8 and 5.2 V**
6. Verify the scan tool parameter: Fuel Tank Pressure Sensor = Less than 0.2 V
 - **If 0.2 V or greater**
 1. Ignition/Vehicle - Off
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1.0 V between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If 1.0 V or greater - Repair the short to voltage on the circuit.
 - If less than 1.0 V - Replace the component: K20 Engine Control Module
 - **Go to next step: If less than 0.2 V**

7. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & 5 V Reference circuit terminal 3
8. Verify the scan tool parameter: Fuel Tank Pressure Sensor = Greater than 4.7 V
 - **If 4.7 V or less**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Test for infinite resistance between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
 4. Test for less than 2 ohms between the test points: Signal circuit terminal 1 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **Go to next step: If greater than 4.7 V**
9. Test or replace the component: B150 Fuel Tank Pressure Sensor

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Fuel Tank Pressure Sensor Replacement](#)
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0496

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 P0496

Evaporative Emission (EVAP) System Flow During Non-Purge

Circuit/System Description

For an overview of the component/system, refer to [Evaporative Emission Control System Description](#)

Component	Description
B150 Fuel Tank Pressure Sensor	The pressure sensor is a 3 wire piezoelectric pressure transducer. The sensor measures the pressure in the component: Fuel Tank
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

This diagnostic tests for undesired intake manifold vacuum flow to the Evaporative Emission (EVAP) System. The control module seals the EVAP system by commanding the EVAP purge solenoid valve off and the EVAP

canister vent solenoid valve on. The control module monitors the fuel tank pressure (FTP) sensor to determine if a vacuum is being drawn on the EVAP system. If vacuum in the EVAP system is more than a predetermined value within a predetermined time, this DTC sets.

Conditions for Running the DTC

- DTCs related to the following system/component = Not Set
 - B34 Engine Coolant Temperature Sensor
 - B66 Intake Air Temperature Sensor
 - B74 Manifold Absolute Pressure Sensor
 - B75B Mass Air Flow/Intake Air Temperature Sensor
 - B115 Vehicle Speed Sensor
 - B150 Fuel Tank Pressure Sensor
 - K111 Fuel Pump Driver Control Module
 - Q12 Evaporative Emission Purge Solenoid Valve
 - Q13 Evaporative Emission Vent Solenoid Valve
 - Evaporative Emission (EVAP) Purge System
 - LIN Bus Communication Error
 - Ignition On/Start Switch 1 Circuit
 - Output Speed Sensor
 - Reduced Engine Power
 - Throttle Position Sensor
 - Fuel Pump Control Module
- Barometric Pressure = Greater than 70 kPa (10.15 PSI)
- Engine Off Time = Greater than 8 h

Engine Run Time = Less than 1,400 s

- Fuel level = 10 to 90%
- Ignition Voltage = Greater than 10 V
- Start-Up ECT = Less than 35B°C (95B°F)
- Start-Up IAT = 4 to 35B°C (39 to 95B°F)

Frequency the DTC runs = Once - Per cold start-up - After the running conditions are met

Conditions for Setting the DTC

Fuel Tank Pressure Sensor = Greater than 2.5 kPa (0.36 PSI) - During Non-Purge

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition/Vehicle - Off
2. Verify the following conditions do not exist:
 - Q12 Evaporative Emission Purge Solenoid Valve - Incorrect connection/Incorrect installation/Leaking/Visible Damage
 - Vacuum Hoses @ Q12 Evaporative Emission Purge Solenoid Valve - Incorrect connection / Incorrect installation/Incorrect routing
 - **If a condition exists**

Repair or replace as necessary
 - **Go to next step: If no condition exists**
3. Ignition - On / Vehicle - In Service Mode
4. Verify DTC P0451 - P0454 is not set.
 - **If any of the DTCs are set**

Refer to [DTC P0451-P0454](#)
 - **Go to next step: If none of the DTCs are set**
5. Engine - Idling
6. Perform the scan tool control function: EVAP Purge/Seal - Not Venting
7. Verify the scan tool parameter: Fuel Tank Pressure Sensor = Less than 9.3 mmHg (5.0 in. H2O) - After 60 s
 - **If 9.3 mmHg (5.0 in. H2O) or greater**

Test or replace the component: Q12 Evaporative Emission Purge Solenoid Valve
 - **Go to next step: If less than 9.3 mmHg (5.0 in. H2O)**
8. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.
 - **If the DTC sets**

Repeat the procedure starting at step 2
 - **Go to next step: If the DTC does not set**
9. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

Evaporative Emission Canister Purge Solenoid Valve Replacement

DTC P0506 OR P0507

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 P0506

Idle Speed Low

DTC P0507

Idle Speed High

Circuit/System Description

For an overview of the component/system, refer to [Throttle Actuator Control \(TAC\) System Description](#)

Conditions for Running the DTC

- DTC P0068, P0101, P0102, P0103, P0112, P0113, P0116, P0117, P0118, P0121, P0122, P0123, P0128, P0171, P0172, P0174, P0175, P0201-P0208, P0222, P0223, P0300 - P0308, P0351 - P0358, P0461 - P0463, P0496, P0502, P0503, P0606, P0722, P0723, P0806-P0808, P1101, P1516, P2066 - P2068, P2101, P2135 = Not set
- Barometric Pressure = Greater than 70 kPa (10 PSI)
- {If equipped} Clutch Pedal = Not Pressed
- {If equipped} Clutch Pedal = Engaged Less than 25%
- {If equipped} Clutch Pedal = Engaged Greater than 88%
- Engine = Running - For greater than 1 min
- Engine = Idling - For greater than 5 s
- Engine Coolant Temperature = Greater than 60B°C (140B°F)
- Engine speed varies less than +/-25 RPM
- Ignition and Start Signal = 11 to 32 V
- Intake Air Temperature Sensor = Greater than -20B°C (-4B°F)
- Scan Tool Control Function = Inactive
- Torque Converter Clutch = Inactive
- Transmission = Not Shifting
- Vehicle Speed = Less than 1.6 km/h (1 MPH)

Frequency the DTC runs = Continuously - After the running conditions are met - For greater than 10 s

Conditions for Setting the DTC

P0506

Engine Speed = 94 RPM Less than desired - For greater than 10 s

P0507

Engine Speed = 188 RPM Greater than desired - For greater than 10 s

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

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

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 no other DTCs are set.

- **If any other DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle

- **Go to next step: If no other DTCs are set**

3. Verify the scan tool parameter: Throttle Body Idle Air Flow Compensation = Less than 90%

- **If 90% or greater**

Refer to Throttle Body Inspection and Cleaning

- **Go to next step: If less than 90%**

4. Engine - Idling - At normal operating temperature.

5. Verify the scan tool parameter: Engine Speed = -100 to +200 RPM of the Desired Idle Speed

- **Go to next step: If not the specified state**

Go to next step: Refer to: Circuit/System Testing

- **Go to next step: If the specified state**

6. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

7. Verify the DTC does not set.

- **Go to next step: If the DTC sets**

Go to next step: Refer to: Circuit/System Testing

- **Go to next step: If the DTC does not set**

8. All OK.

Circuit/System Testing

P0506

1. Verify the following conditions do not exist:

- Exhaust System - Restricted
- Mechanical Condition - Engine Speed = Limited
- Engine - Parasitic Load
- **If a condition exists**

Repair as necessary

- **Go to next step: If no conditions exist**

2. All OK.

P0507

1. Verify the following conditions do not exist:

- Vacuum leak @ Engine/Intake Manifold
- Q38 Throttle Body - Binding or Sticking @ Closed
- Positive Crankcase Ventilation System - Leaking/Incorrect connection/Restricted
- **If a condition exists**

Repair as necessary

- **Go to next step: If no conditions exist**

2. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

[Throttle Body Assembly Replacement](#) - Q38 Throttle Body

DTC P050D

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 P050D

Cold Start Rough Idle

Circuit/System Description

For an overview of the component/system, refer to [Fuel System Description](#)

During a cold start, the engine control module (ECM) commands dual-pulse mode during Open Loop operation to improve cold start emissions. In dual-pulse mode, the fuel injectors are energized twice during each injection

event. As with misfire diagnosis, in dual-pulse mode the ECM monitors the crankshaft position sensor and the camshaft position sensors to calculate crankshaft rotation speed. In normal operation, optimum fuel delivery during dual-pulse mode produces a steady crankshaft rotation speed. If the variations exceed a calibrated value, the DTC sets.

Conditions for Running the DTC

- DTC P0010, P0011, P0013, P0014, P0016, P0017, P0018, P0019, P0020, P0021, P0023, P0024, P0089, P0090 - P0092, P00C6, P00C8, P00C9, P00CA, P0101 - P0103, P0106 - P0108, P0112 - P0114, P0116 - P0118, P0121 - P0123, P0128, P0192, P0193, P0201 - P0206, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0315, P0335, P0336, P0351 - P0356, P0627 - P0629, P069E, P0716, P0717, P0722, P0723, P0850 - P0852, P1248, P1249, P124A, P124B, P124C, P124D, P1258, P135A, P135B, P150C, P163A, P1762, P1763, P1915, P2122, P2123, P2127, P2128, P2135, P2138, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216B, P216C, P216E, P216F, P228C, P228D, U0109 = Not set
- Accelerator Pedal Position = Less than 1%
- Catalyst temperature = Less than 500B°C (932B°F)
- Barometric Pressure = Greater than 70 kPa (10.2 PSI)
- Engine = Cold Start-Up
- Engine Coolant Temperature = 6 to 66B°C (43 to 151B°F)
- Engine Speed = 550 to 2000 RPM

Frequency the DTC runs = Once - Per cold start-up - After the running conditions are met

Conditions for Setting the DTC

This DTC sets if the engine control module detects variations in crankshaft rotation speed caused by the lack of adequate fuel delivery during dual-pulse mode.

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC

Dual pulse = Disabled

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Diagnostic Aids

This DTC has a higher priority over any misfire DTC. Diagnose the fuel system, not the ignition system.

Verify the condition did not cause the DTC to set:

- Q17 Fuel Injector = Blocked / Restricted
- Q17 Fuel Injector / Circuit = High Resistance
- System Voltage = Low - Cold Start-Up

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

[Master Electrical Component List](#) , or [Inline Harness Connector End Views - Index](#) or [Component Connector End Views - Index](#)

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](#)

NOTE: Cold Start-Up = Required

1. Engine - Idling
2. Verify the scan tool parameter: Cylinder 1 - 8 Current Misfire Counter = Less than 1
 - **If 1 or greater**
 1. Ignition - On / Vehicle - In Service Mode & Engine - Off
 2. Verify the following conditions do not exist:
 - Fuel Pressure - Low / High - Refer to [Fuel System Diagnosis](#).
 - Fuel - Contaminated / Poor Quality - Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#)
 - If a condition exists - Repair or replace as necessary
 - If no condition exists - Replace the component: Q17 Fuel Injector
 - **Go to next step: If less than 1**
3. All OK.

[Repair Instructions](#)

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

[Fuel Injector Replacement](#)

DTC P057B-P057E

[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 P057B

Brake Pedal Position Sensor Performance

DTC P057C

Brake Pedal Position Sensor Circuit Low Voltage

DTC P057D

Brake Pedal Position Sensor Circuit High Voltage

DTC P057E

Brake Pedal Position Sensor Circuit Erratic

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P057C, P0651*	P057C	P0651*	-
Signal	P057C	P057C	P057D	P057B
Low Reference	-	P057D	-	-
*Additional DTCs may set.				

Typical Scan Tool Data

Brake Pedal Position Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition = On Parameter Normal Range: 0.25 to 4.75 V			
5 V Reference	0 V	0 V	2.2 V
Signal	0 V	0 V	5 V
Low Reference	-	5 V	-

Circuit/System Description

Circuit	Description
5 V Reference	Regulated voltage supplied by the control module.
Signal	The control module input circuit has an internal resistance connected to ground.
Low Reference	Grounded through the control module.

Component	Description
B22 Brake Pedal Position Sensor	The input voltage varies depending on the position of the sensor.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

The pedal assembly contains 2 potentiometer-type brake pedal position sensors. When the pedal is pressed, the voltage of one sensor goes up and the voltage of the other sensor goes down.

Conditions for Running the DTC

P057B

- DTC P057C, P057D = Not set
- Ignition Voltage = Greater than 10 V
- Shift Lever = Park - At least 1 time(s) during the ignition cycle

- Shift Lever = Not in Park
- Vehicle Speed = Greater than 8 km/h (5 MPH)
- Accelerator Pedal Position = Less than 5%

Frequency the DTC runs = Once - After the running conditions are met

P057C, P057D, P057E

Ignition Voltage = Greater than 10 V

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

P057B

Brake Pedal Position Sensor = Stuck in range - For greater than 1 s

P057C

Brake Pedal Position Sensor = Less than 0.25 V - For greater than 1 s

P057D

Brake Pedal Position Sensor = Greater than 4.75 V - For greater than 1 s

P057E

Brake Pedal Position Sensor = Signal noisy or erratic

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type A DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or **Inline Harness Connector End Views - Index** or **Component Connector End Views - Index**

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

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify the scan tool parameter: Brake Pedal Position Sensor = 0.26 to 4.74 V
 - **If not between 0.26 and 4.74 V**

Refer to: Circuit/System Testing
 - **Go to next step: If between 0.26 and 4.74 V**
3. Verify the scan tool parameter: Brake Pedal Position Sensor = The value should change while moving the sensor through the entire range.
 - **If the value does not change**

Refer to: Circuit/System Testing
 - **Go to next step: If the value changes**
4. Verify the scan tool parameter: Brake Pedal Position Sensor = The value should not spike or drop out.

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: B22 Brake Pedal Position Sensor
 - Wiggle the harness and connector: K20 Engine Control Module
 - **If the value spikes or drops out**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)
 - **Go to next step: If the value does not spike or drop out**
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing
 - **Go to next step: If the DTC is not set**
6. 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: B22 Brake Pedal Position Sensor
3. Test for less than 10 ohms between the test points: Low Reference circuit terminal 5 & Ground
 - **If 10 ohms or greater**
 1. Disconnect the appropriate electrical connector: K20 Engine Control Module
 2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 5 @ Component harness & The other end of the circuit @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

• **Go to next step: If less than 10 ohms**

4. Ignition - On / Vehicle - In Service Mode

5. Test for 4.8 to 5.2 V between the test points: 5 V Reference circuit terminal 6 & Low Reference circuit terminal 5

• **If less than 4.8 V**

1. Ignition/Vehicle - Off

2. Disconnect the appropriate electrical connector: K20 Engine Control Module

3. Test for infinite resistance between the test points: 5 V Reference circuit terminal 6 @ Component harness & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- Go to next step: If infinite resistance

4. Test for less than 2 ohms between the test points: 5 V Reference circuit terminal 6 @ Component harness & The other end of the circuit @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

• **If greater than 5.2 V**

1. Ignition/Vehicle - Off

2. Disconnect the appropriate electrical connector: K20 Engine Control Module

3. Ignition - On / Vehicle - In Service Mode

4. Test for less than 1 V between the test points: 5 V Reference circuit terminal 6 @ Component harness & Ground

- If 1 V or greater - Repair the short to voltage on the circuit.
- If less than 1 V - Replace the component: K20 Engine Control Module

• **Go to next step: If between 4.8 and 5.2 V**

6. Verify the scan tool parameter: Brake Pedal Position Sensor = Less than 0.25 V

• **If 0.25 or greater**

1. Ignition/Vehicle - Off

2. Disconnect the appropriate electrical connector: K20 Engine Control Module

3. Ignition - On / Vehicle - In Service Mode

4. Test for less than 1 V between the test points: Signal circuit terminal 4 @ Component harness & Ground

- If 1 V or greater - Repair the short to voltage on the circuit.
- If less than 1 V - Replace the component: K20 Engine Control Module

• **Go to next step: If less than 0.25 V**

7. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 4 & 5 V Reference circuit terminal 6

8. Verify the scan tool parameter: Brake Pedal Position Sensor = Greater than 4.8 V

• **If 4.8 V or less**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)

2. Disconnect the appropriate electrical connector: K20 Engine Control Module

3. Test for infinite resistance between the test points: Signal circuit terminal 4 @ Component harness & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- Go to next step: If infinite resistance

4. Test for less than 2 ohms between the test points: Signal circuit terminal 4 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
- **Go to next step: If greater than 4.8 V**
9. Test or replace the component: B22 Brake Pedal Position Sensor

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Brake Pedal Position Sensor Replacement](#)
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0627-P0629 OR P12A6

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 P0627

Fuel Pump Enable Circuit

DTC P0628

Fuel Pump Enable Circuit Low Voltage

DTC P0629

Fuel Pump Enable Circuit High Voltage

DTC P12A6

Fuel Pump Driver Control Module Enable Circuit Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	P0171, P0506, P0628, P12A6	P0171, P0269, P0506, P0627, P12A6	P0629, P12A6	P12A6

Circuit/System Description

For an overview of the component/system, refer to [Fuel System Description](#)

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

Component	Description
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.
K111 Fuel Pump Driver Control Module	The control module K111 supplies the fuel pump with a PWM signal in order to achieve the desired fuel line pressure.

When the ignition is turned On, the ECM sends a 12 V signal to the control module K111 to enable the fuel pump. If the engine is not started, the control module K111 turns the fuel pump Off after 6 s.

Conditions for Running the DTC

- Engine Speed = Greater than 0 RPM
- Ignition Voltage = Greater than 11 V
- Fuel Pump Enable Circuit = On

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

P0627-P0629

Control Circuit = Commanded state does not match the actual state - For greater than 2 s

P12A6

Control Circuit = Commanded state does not match the actual state - For greater than 1 s

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC - Exceptions listed below

DTC P12A6 = Type A DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC - Exceptions listed below

DTC P12A6 = Type A DTC

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

Electrical Information Reference

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

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify the scan tool parameter:
 - Fuel Pump Enable Circuit High Voltage Test Status = OK or Not Run
 - Fuel Pump Enable Circuit Low Voltage Test Status = OK or Not Run
 - Fuel Pump Enable Circuit Open Test Status = OK or Not Run
 - **If not the specified state**

Refer to: Circuit/System Testing
 - **Go to next step: If the specified state**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 - **If the DTC sets**

Refer to: Circuit/System Testing
 - **Go to next step: If the DTC is not set**
5. All OK.

Circuit/System Testing

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: K111 Fuel Pump Driver Control Module
3. Ignition - On / Vehicle - In Service Mode
4. Perform the scan tool control function: Fuel Pump Enable - Off

Verify a test lamp does not turn On between the test points: Control circuit terminal 2 & Ground

- **If the test lamp turns On**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Disconnect the electrical connector: X1 @ K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Control circuit terminal 2 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module
 - **Go to next step: If the test lamp does not turn On**
- 5. Remove - Test Lamp
- 6. Perform the scan tool control function: Fuel Pump Enable - On

Verify the scan tool parameter: Fuel Pump Enable Circuit Low Voltage Test Status = OK

- **If not the specified state**

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: X1 @ K20 Engine Control Module
3. Test for infinite resistance between the test points: Control circuit terminal 2 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module

• **Go to next step: If the specified state**

7. Connect a 3 A fused jumper wire between the test points: Control circuit terminal 2 & Ground
8. Perform the scan tool control function: Fuel Pump Enable - On

Verify the scan tool parameter: Fuel Pump Enable Circuit Low Voltage Test Status = Malfunction

• **If not the specified state**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
2. Disconnect the electrical connector: X1 @ K20 Engine Control Module
3. Test for less than 2 ohms between the test points: Control circuit terminal 2 @ Component harness & Terminal 64 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module

• **Go to next step: If the specified state**

9. Test or replace the component: K111 Fuel Pump Driver 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 P0641, P0651, P0697, OR P06A3

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 P0641

5V Reference 1 Circuit

DTC P0651

5V Reference 2 Circuit

DTC P0697

5V Reference 3 Circuit

DTC P06A3

5V Reference 4 Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5V Reference 1	P0641	-	P0641	-
5V Reference 2	P0651	-	P0651	-
5V Reference 3	P0697	-	P0697	-
5V Reference 4	P06A3	-	P06A3	-

Typical Scan Tool Data

5V Reference 1 - 4

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition = On Parameter Normal Range: OK			
5 V Reference	Malfunction	OK	Malfunction

Circuit/System Description

Circuit	Description
5 V Reference	Regulated voltage supplied by the control module.

Component	Description
K20 Engine Control Module	The control module contains a microprocessor used to process input data to control outputs. The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

The control module consists of 4 internal 5 V reference circuits. The 5 V reference circuit provides 5 V for one or more sensors. All sensors will be affected when a short to ground or voltage is on a shared 5 V reference circuit.

Conditions for Running the DTC

- Ignition - On / Vehicle - In Service Mode
- Ignition Voltage = Greater than 6.4 V

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

Condition 1

5V Reference Circuit = Less than 4.88 V

Condition 2

5V Reference Circuit = Greater than 5.13 V

Condition 3

The following parameters are not within 0.05 V of each other:

- 5V Reference 1
- 5V Reference 2

- 5V Reference 3
- 5V Reference 4

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type A DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or **Inline Harness Connector End Views - Index** or **Component Connector End Views - Index**

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 the scan tool parameter: 5V Reference 1 - 4 Circuit Status = OK

- **If not the specified state**

Refer to: Circuit/System Testing

- **Go to next step: If the specified state**

3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

4. All OK.

Circuit/System Testing

1. Ignition/Vehicle - Off

NOTE: Additional DTCs will set when disconnecting the components.

2. Disconnect the electrical connector at one of the following components, depending on the DTC that is set:

P0641

- B1 A/C Refrigerant Pressure Sensor
- B23A Camshaft Position Sensor - Bank 1 Exhaust
- B23B Camshaft Position Sensor - Bank 1 Intake
- B23C Camshaft Position Sensor - Bank 2 Exhaust
- B23D Camshaft Position Sensor - Bank 2 Intake
- B37B Engine Oil Pressure Sensor
- B75C Multifunction Intake Air Sensor
- B150 Fuel Tank Pressure Sensor
- B310 Fuel Pressure/Temperature Sensor

P0651

- B14A Transmission Output Shaft Speed Sensor - {If equipped}
- B22 Brake Pedal Position Sensor
- B26 Crankshaft Position Sensor

P0697

- B74 Manifold Absolute Pressure Sensor
- B107 Accelerator Pedal Position Sensor2

P06A3

- B107 Accelerator Pedal Position Sensor1
- Q38 Throttle Body2

3. Ignition - On / Vehicle - In Service Mode

4. Verify the scan tool parameter: 5V Reference 1 - 4 Circuit Status = Malfunction - For the circuit that set the DTC.

- **If not the specified state after disconnecting a component from the circuit**

Test or replace the component: The component that was disconnected last.

- **If the specified state and there are components connected to the circuit**

Disconnect a component and repeat step 4.

- **Go to next step: If the specified state with all components disconnected from the circuit**

5. Test for 4.8 to 5.2 V between the test points:

P0641 - 5V Reference 1 Circuit

- 5 V Reference circuit terminal 2 @ B1 A/C Refrigerant Pressure Sensor & Ground
- 5 V Reference circuit terminal 1 @ B23A Camshaft Position Sensor - Bank 1 Exhaust & Ground
- 5 V Reference circuit terminal 1 @ B23B Camshaft Position Sensor - Bank 1 Intake & Ground

- 5 V Reference circuit terminal 1 @ B23C Camshaft Position Sensor - Bank 2 Exhaust & Ground
- 5 V Reference circuit terminal 1 @ B23D Camshaft Position Sensor - Bank 2 Intake & Ground
- 5 V Reference circuit terminal 3 @ B37B Engine Oil Pressure Sensor & Ground
- 5 V Reference circuit terminal 2 @ B75C Multifunction Intake Air Sensor & Ground
- 5 V Reference circuit terminal 3 @ B150 Fuel Tank Pressure Sensor & Ground
- 5 V Reference circuit terminal 3 @ B310 Fuel Pressure/Temperature Sensor & Ground

P0651 - 5V Reference 2 Circuit

- 5 V Reference circuit terminal 3 @ B14A Transmission Output Shaft Speed Sensor & Ground - {If equipped}
- 5 V Reference circuit terminal 6 @ B22 Brake Pedal Position Sensor & Ground
- 5 V Reference circuit terminal 1 @ B26 Crankshaft Position Sensor & Ground

P0697 - 5V Reference 3 Circuit

- 5 V Reference circuit terminal 1 @ B74 Manifold Absolute Pressure Sensor & Ground
- 5 V Reference circuit terminal 1 @ B107 Accelerator Pedal Position Sensor - Sensor 2 & Ground

P06A3 - 5V Reference 4 Circuit

- 5 V Reference circuit terminal 2 @ B107 Accelerator Pedal Position Sensor - Sensor 1 & Ground
- 5 V Reference circuit terminal 5 @ Q38 Throttle Body & Ground
- **If less than 4.8 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K20 Engine Control Module
 3. Test for infinite resistance between the test points:

P0641

- 5 V Reference circuit terminal 47 X1 @ Control module harness & Ground
- 5 V Reference circuit terminal 27 X2 @ Control module harness & Ground
- 5 V Reference circuit terminal 43 X2 @ Control module harness & Ground
- 5 V Reference circuit terminal 46 X2 @ Control module harness & Ground
- 5 V Reference circuit terminal 3 X3 @ Control module harness & Ground
- 5 V Reference circuit terminal 5 X3 @ Control module harness & Ground
- 5 V Reference circuit terminal 35 X3 @ Control module harness & Ground
- 5 V Reference circuit terminal 40 X3 @ Control module harness & Ground
- 5 V Reference circuit terminal 55 X3 @ Control module harness & Ground

P0651

- 5 V Reference circuit terminal 25 X1 @ Control module harness & Ground
- 5 V Reference circuit terminal 45 X2 @ Control module harness & Ground
- 5 V Reference circuit terminal 6 X3 @ Control module harness & Ground

P0697

- 5 V Reference circuit terminal 21 X1 @ Control module harness & Ground
- 5 V Reference circuit terminal 47 X2 @ Control module harness & Ground - {If equipped}

P06A3

- 5 V Reference circuit terminal 8 X3 @ Control module harness & Ground
 - 5 V Reference circuit terminal 23 X1 @ Control module harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module
- **If greater than 5.2 V**
1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points:

P0641

- 5 V Reference circuit terminal 47 X1 @ Control module harness & Ground
- 5 V Reference circuit terminal 27 X2 @ Control module harness & Ground
- 5 V Reference circuit terminal 43 X2 @ Control module harness & Ground
- 5 V Reference circuit terminal 46 X2 @ Control module harness & Ground
- 5 V Reference circuit terminal 3 X3 @ Control module harness & Ground
- 5 V Reference circuit terminal 5 X3 @ Control module harness & Ground
- 5 V Reference circuit terminal 35 X3 @ Control module harness & Ground
- 5 V Reference circuit terminal 40 X3 @ Control module harness & Ground
- 5 V Reference circuit terminal 55 X3 @ Control module harness & Ground

P0651

- 5 V Reference circuit terminal 25 X1 @ Control module harness & Ground
- 5 V Reference circuit terminal 45 X2 @ Control module harness & Ground
- 5 V Reference circuit terminal 6 X3 @ Control module harness & Ground

P0697

- 5 V Reference circuit terminal 21 X1 @ Control module harness & Ground
- 5 V Reference circuit terminal 47 X2 @ Control module harness & Ground - {If equipped}

P06A3

- 5 V Reference circuit terminal 8 X3 @ Control module harness & Ground
 - 5 V Reference circuit terminal 23 X1 @ Control module harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module
- **Go to next step: If between 4.8 and 5.2 V**

6. All OK.

Repair Instructions

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

- **Accelerator Pedal Position Sensor Replacement**
- **Air Conditioning Refrigerant Pressure Sensor Replacement (LCV, LWN)**, or **Air Conditioning Refrigerant Pressure Sensor Replacement (LGZ)**
- **Brake Pedal Position Sensor Replacement**
- **Camshaft Position Sensor Replacement - Bank 1 (Right Side) Exhaust**

- [Camshaft Position Sensor Replacement - Bank 1 \(Right Side\) Intake](#)
- [Camshaft Position Sensor Replacement - Bank 2 \(Left Side\) Exhaust](#)
- [Camshaft Position Sensor Replacement - Bank 2 \(Left Side\) Intake](#)
- [Crankshaft Position Sensor Replacement](#)
- [Fuel Pressure Sensor Replacement - Fuel Injection Fuel Rail](#)
- [Fuel Tank Pressure Sensor Replacement](#)
- [Manifold Absolute Pressure Sensor Replacement](#)
- [Mass Airflow Sensor with Intake Air Temperature Sensor Replacement](#)
- [Throttle Body Assembly Replacement](#)
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0650, P263A, OR P263B - MALFUNCTION INDICATOR LAMP (MIL) 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](#)

DTC Descriptor

DTC P0650

Malfunction Indicator Lamp (MIL) Control Circuit

DTC P263A

Malfunction Indicator Lamp (MIL) Control Circuit Low Voltage

DTC P263B

Malfunction Indicator Lamp (MIL) Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition @ P16 Instrument Cluster	P0650	P0650	-	-
Control @ K20 Engine Control Module	P0650, P263A*	P0650, P263A	P263B	-
*Malfunction Indicator Lamp (MIL) = Always On				

Circuit/System Description

Circuit	Description
Ignition @ P16 Instrument Cluster	Supplied from a fuse.
Control @ K20 Engine Control Module	The output circuit is switched to ground to activate the component.

Component	Description
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this

Component	Description
	by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.
P16 Instrument Cluster	The instrument cluster houses several displays and gauges to inform the driver about various parameters of the vehicle.

Conditions for Running the DTC

- Ignition = On
- Ignition Voltage = Greater than 11 V
- Remote Vehicle Start = Inactive

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

Control Circuit = Commanded state does not match the actual state - For greater than 1 s

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

- [Engine Controls Wiring Schematics](#)
- [Instrument Cluster Wiring Schematics](#)

Connector End View Reference

[Master Electrical Component List](#) , or [Inline Harness Connector End Views - Index](#) or [Component Connector End Views - Index](#)

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. Perform the scan tool control function: Malfunction Indicator Lamp (MIL) - On and Off

Verify the scan tool parameter:

- MIL Control Circuit High Voltage Test Status = Not Run or OK
- MIL Control Circuit Low Voltage Test Status = Not Run or OK
- MIL Control Circuit Open Test Status = Not Run or OK
- **If not the specified state**

Refer to: Circuit/System Testing

- **Go to next step: If the specified state**

3. Perform the scan tool control function: Malfunction Indicator Lamp (MIL) - On and Off

Verify the component turns On and Off: Malfunction Indicator Lamp (MIL) @ P16 Instrument Cluster

- **If the component does not turn On and Off**

Refer to: Circuit/System Testing

- **Go to next step: If the component turns On and Off**

4. Verify a condition does not exist with the component: Malfunction Indicator Lamp (MIL) @ P16 Instrument Cluster - Turns Off

Perform the action while monitoring the component: Wiggle the harness and connector: X1 @ K20 Engine Control Module

- **If a condition exists**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If no condition exists**

5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify that no DTCs are set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC does not set**

6. All OK.

Circuit/System Testing

1. Verify the ignition fuse that supplies voltage to the component is not open: P16 Instrument Cluster

- **If the fuse is open**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: P16 Instrument Cluster

3. Test for infinite resistance between the test points: Ignition circuit terminal 8 & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- If infinite resistance - Replace the component: P16 Instrument Cluster

- **Go to next step: If the fuse is not open**

2. Ignition/Vehicle - Off

3. Disconnect the appropriate electrical connector: K20 Engine Control Module

4. Ignition - On / Vehicle - In Service Mode

5. Verify the component works as specified: Malfunction Indicator Lamp (MIL) = Off

- **If the component does not work as specified**

1. Ignition/Vehicle - Off

2. Test for infinite resistance between the test points: Control circuit terminal 16 X1 & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- If infinite resistance - Replace the component: P16 Instrument Cluster

- **Go to next step: If the component works as specified**

6. Ignition/Vehicle - Off

7. Connect a 3 A fused jumper wire between the test points: Control circuit terminal 16 X1 & Ground

8. Ignition - On / Vehicle - In Service Mode

9. Verify the component works as specified: Malfunction Indicator Lamp (MIL) = On

- **If the component does not work as specified**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)

2. Disconnect the appropriate electrical connector: P16 Instrument Cluster

3. Ignition - On / Vehicle - In Service Mode

4. Test for less than 1 V between the test points: Control circuit terminal 16 X1 @ Control module harness & Ground

- If 1 V or greater - Repair the short to voltage on the circuit.
- Go to next step: If less than 1 V

5. Ignition/Vehicle - Off

6. Test for less than 2 ohms between the test points: Control circuit terminal 16 @ Component harness & The other end of the circuit @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- Go to next step: If less than 2 ohms

1. Test for less than 2 ohms between the test points: Ignition circuit terminal 8 @ Component harness & Output terminal @ Fuse

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: P16 Instrument Cluster

- **Go to next step: If the component works as specified**

10. Replace the component: K20 Engine Control Module

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Instrument Cluster Replacement](#)

- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0685-P0687, P0689, P0690, P1682, P16A7, P16AF, OR P16B3

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 P0685

Engine Controls Ignition Relay Control Circuit

DTC P0686

Engine Controls Ignition Relay Control Circuit Low Voltage

DTC P0687

Engine Controls Ignition Relay Control Circuit High Voltage

DTC P0689

Engine Controls Ignition Relay Feedback Circuit Low Voltage

DTC P0690

Engine Controls Ignition Relay Feedback Circuit High Voltage

DTC P1682

Ignition 1 Switch Circuit 2

DTC P16A7

Engine Controls Ignition Relay Feedback Circuit 2

DTC P16AF

Engine Controls Ignition Relay Feedback Circuit 2 Low Voltage

DTC P16B3

Engine Controls Ignition Relay Feedback Circuit 2 High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ - Relay Coil	P0689, P1682	P0685, P0689, P1682, P16A7, P16AF	-	-
B+ - Relay Switch	P0689, P1682	P0685, P0689, P1682, P16A7, P16AF	-	-
Ignition - Component - Terminal 87	P0689, P1682	P0685, P0689, P1682, P16A7, P16AF	P0690, P16B3, P16BF	-
Control - Relay Coil	P0686, P0690	P0685, P0689, P1682, P16A7, P16AF	P0685, P0687, P0689, P1682*	-

*Internal control module or component damage may occur if the circuit shorts to B+.

Circuit/System Description

Circuit	Description
B+ - Relay Coil	Supplied directly from the battery.
B+ - Relay Switch	Supplied directly from the battery.
Ignition - Component - Terminal 87	Supplied from a relay.

Circuit	Description
Control - Relay Coil	The output circuit is switched to ground to activate the component.

Component	Description
K20 Engine Control Module	The control module contains a microprocessor used to process input data to control outputs. The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.
KR75 Engine Controls Ignition Relay	Relays are used to control a high power circuit with a low power signal.

2 ignition voltage circuits supply the ECM. The 2 circuits are supplied by 1 relay(s):KR75 Engine Controls Ignition Relay

The ECM monitors and compares the voltages supplied by the relay(s).

Conditions for Running the DTC

P0685, P0686, P0687, P16A7

- Ignition Voltage = Greater than 11 V

Frequency the DTC runs = Continuously - After the running conditions are met

P0689, P16AF

- Ignition Voltage = Greater than 9 V
- Engine Controls Ignition Relay Command = On

Frequency the DTC runs = Continuously - After the running conditions are met

P0690, P16B3

- DTC P0685 = Not set
- Engine Controls Ignition Relay Command = Off - For greater than 2 s

Frequency the DTC runs = Continuously - After the running conditions are met

P1682

- Engine Controls Ignition Relay Command = On
- Ignition Voltage = Greater than 5.5 V

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

P0685, P0686, P0687, P16A7

Control Circuit = Commanded state does not match the actual state - Greater than 2 s

P0689, P16AF

Engine Controls Ignition Relay Feedback Signal = Commanded state does not match the actual state - Greater than 5 s

P0690, P16B3

Engine Controls Ignition Relay Feedback Signal = Commanded state does not match the actual state - Greater than 5 s

P1682

The following parameters are not within 3 V of each other:

- Ignition 1 Signal
- Engine Controls Ignition Relay Feedback Signal
- Engine Controls Ignition Relay Feedback 2 Signal

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC - Exceptions listed below

DTC P0689, P16AF = Type C DTC

DTC P1682 = Type A DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC - Exceptions listed below

DTC P0689, P16AF = Type C DTC

DTC P1682 = Type A DTC

Diagnostic Aids

If the condition is intermittent, wiggle the related wiring harnesses and connectors, with the ignition/vehicle on or engine running, while monitoring the scan tool circuit status parameters for the component. The parameters will display if there is a condition with the circuit or a connection.

Reference Information

Schematic Reference

- [Engine Controls Wiring Schematics](#)
- [Power Distribution Wiring Schematics](#)

Connector End View Reference

[Master Electrical Component List](#) , or [Inline Harness Connector End Views - Index](#) or [Component Connector End Views - Index](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Electrical Center Identification Views](#)
- [Electrical Relay Replacement \(Attached to Wire Harness\)](#) , or [Electrical Relay Replacement \(Within an Electrical Center\)](#)
- [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 no other DTCs are set.

- **If other DTCs are set**

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

- **Go to next step: If no other DTCs are set**

3. Ignition - Cycle Off and On & Cycle On and Off

Verify a click can be heard or felt at the following component(s) when the scan tool control function was commanded: KR75 Engine Controls Ignition Relay

- **If a click cannot be heard or felt**

Refer to: Circuit/System Testing

- **Go to next step: If a click can be heard or felt**

4. Verify the following parameters are within 3 V of each other:

- Ignition 1 Signal
- Engine Controls Ignition Relay Feedback Signal
- **If not within 3 V of each other**

Refer to: Circuit/System Testing

- **Go to next step: If within 3 V of each other**

5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC does not set**

6. All OK.

Circuit/System Testing

1. Ignition/Vehicle - Off

2. Remove the component: KR75 Engine Controls Ignition Relay

3. Verify a test lamp turns On between the test points:

- B+ circuit terminal 30 & Ground
- B+ circuit terminal 85 & Ground
- **If the test lamp does not turn On**

Replace the component: X50A Fuse Block - Underhood

- **Go to next step: If the test lamp turns On**

4. Ignition - On / Vehicle - In Service Mode

5. Connect a test lamp between the test points: B+ circuit terminal 85 & Control circuit terminal 86

6. Perform the scan tool control function: Engine Controls Ignition Relay - 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 appropriate electrical connector: K20 Engine Control Module

3. Ignition - On / Vehicle - In Service Mode

4. Test for less than 1 V between the test points: Control circuit terminal 86 @ Relay Socket & Ground

- If 1 V or greater - Repair the short to voltage on the circuit.

- Go to next step: If less than 1 V

5. Ignition/Vehicle - Off

6. Test for less than 2 ohms between the test points: Control circuit terminal 86 @ Relay Socket & The other end of the circuit @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.

- If less than 2 ohms - Replace the component: K20 Engine Control Module

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

1. Ignition/Vehicle - Off & Remove - Test lamp

2. Disconnect the appropriate electrical connector: K20 Engine Control Module

3. Test for infinite resistance between the test points: Control circuit terminal 86 @ Relay Socket & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.

- If infinite resistance - Replace the component: K20 Engine Control Module

- **Go to next step: If the test lamp turns On and Off**

7. Verify the fuse is not open: F10UA Fuse

- **If the fuse is open**

1. Ignition/Vehicle & All vehicle systems - Off

2. Disconnect the appropriate electrical connector: K20 Engine Control Module

3. Test for infinite resistance between the test points: Output terminal @ Fuse & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.

- If infinite resistance - Replace the component: K20 Engine Control Module

- **Go to next step: If the fuse is not open**

8. Ignition - On / Vehicle - In Service Mode

9. Verify a test lamp does not turn On between the test points: Ignition circuit terminal 87 @ Relay Socket & Ground

- **Go to next step: If the test lamp turns On**

10. Ignition/Vehicle & All vehicle systems - Off

11. Disconnect the appropriate electrical connector: K20 Engine Control Module

12. Test for less than 1 V between the test points: Ignition circuit terminal 73 X1 @ Control module harness & Ground

- If 1 V or greater - Repair the short to voltage on the circuit.

- **Go to next step: If the test lamp does not turn On**

13. Ignition/Vehicle - Off

CAUTION:

Complete the testing as quickly as possible in order to prevent overheating and damaging the component.

14. Connect a 30 A fused jumper wire between the test points: Ignition circuit terminal 87 & B+ circuit terminal 30
15. Ignition - On / Vehicle - In Service Mode
16. Verify the scan tool parameter: Engine Controls Ignition Relay Feedback Signal = Within 1 V of the battery voltage
 - **If not within 1 V of the battery voltage**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Test for less than 2 ohms between the test points: Ignition circuit terminal 87 @ Relay Socket & Ignition circuit terminal 73 X1 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **Go to next step: If within 1 V of the battery voltage**
17. Test or replace the component: KR75 Engine Controls Ignition Relay

Component Testing

Relay Test

1. Ignition/Vehicle - Off
2. Remove the component: KR75 Engine Controls Ignition Relay
3. Test for 70 to 110 ohms between the test points: Component terminal 85 & 86
 - **If not between 70 and 110 ohms**

Replace the component: KR75 Engine Controls Ignition Relay
 - **Go to next step: If between 70 and 110 ohms**
4. Test for infinite resistance between the test points:
 - Component terminal 30 & 85
 - Component terminal 30 & 86
 - Component terminal 30 & 87
 - Component terminal 85 & 87
 - **If less than infinite resistance**

Replace the component: KR75 Engine Controls Ignition Relay
 - **Go to next step: If infinite resistance**
5. Connect a 3 A fused jumper wire between the test points: Component terminal 86 & B+

Connect a jumper wire between the test points: Component terminal 85 & Ground
6. Test for less than 2 ohms between the test points: Component terminal 30 & 87
 - **If 2 ohms or greater**

Replace the component: KR75 Engine Controls Ignition Relay
 - **Go to next step: If less than 2 ohms**
7. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Fuse Block Replacement](#)
- [Electrical Relay Replacement \(Attached to Wire Harness\)](#) , or [Electrical Relay Replacement \(Within an Electrical Center\)](#)
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P0700

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 P0700

Transmission Control Module Requested MIL Illumination

Circuit/System Description

The DTC is an informational DTC. The DTC indicates an emission related DTC set in the following control module: K71 Transmission Control Module

The control module K20 turns on the malfunction indicator lamp (MIL) when the requesting control module sends a message over serial data.

Conditions for Running the DTC

Ignition = On or Engine = Running - For greater than 3 s

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

An emission related DTC set in the following control module: K71 Transmission Control Module

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type A DTC

Malfunction Indicator Lamp (MIL) = On

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

NOTE:

- Do NOT replace the control module if DTC P0700 is set.
- DTC P0700 is an informational DTC.
- Correct any Engine Controls and Serial Data DTCs before diagnosing the following system/component DTCs: Transmission

1. Verify there are no DTCs set related to the following component/system:

- Engine Controls and Fuel
- Serial Data
- If a related DTC is set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- Go to next step: If a related DTC is not set

2. Verify there are no DTCs set related to the following component/system: Transmission

- If a related DTC is set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- Go to next step: If a related DTC is not set

3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify no other DTCs are set.

- If other DTCs are set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- Go to next step: If no other DTCs are set

4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

DTC P1000, P1001, P1003, P1009, P10C6, P10F5, P1100, P1103, P11FF, P1200, P128C, P128D, P128F, P129E, P12A8, P130F, P139A, P139B, P14CD, P14CE, P14D4-P14D6, P15F9, P15FB, P165C, P167E, P16FF, P175F, P1772, P30DE, P314E, OR P316B

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 P1000**

Fuel Pump Driver Control Module Reset Count Message Counter Incorrect

DTC P1001

Evaporative Emission (EVAP) System Signals Message Counter Incorrect

DTC P1003

Fuel Composition Signals Message Counter Incorrect

DTC P1009

Fuel Pump Driver Control Module Temperature High Signal Message Counter Incorrect

DTC P10C6

Engine Diagnostic Status Signal Message Counter Incorrect

DTC P10F5

EVAP Purge Pump Status Message Counter Incorrect

DTC P1100

Fuel Level Sensor 2 Signal Message Counter Incorrect

DTC P1103

Water in Fuel Signal Message Counter Incorrect

DTC P11FF

Fuel Pump Command Signal Message Counter Incorrect

DTC P1200

Fuel Level Sensor 1 Signal Message Counter Incorrect

DTC P128C

Fuel Rail Temperature Sensor 1 Signal Message Counter Incorrect

DTC P128D

Fuel Rail Temperature Sensor 2 Signal Message Counter Incorrect

DTC P128F

Fuel Rail Pressure Sensors 1 and 2 Signals Message Counter Incorrect

DTC P129E

Fuel Level Sensor Control Module Signal Message Counter Incorrect or Fuel Pump Driver Control Module Signal Message Counter Incorrect

DTC P12A8

Fuel Pump Control Status Signal Message Counter Incorrect

DTC P130F

Ignition On/Start Voltage Signal Message Counter Incorrect

DTC P139A

Glow Plug Control Module Diagnostic Status Signal 1 Message Counter Incorrect

DTC P139B

Glow Plug Control Module Diagnostic Status Signal 2 Message Counter Incorrect

DTC P14CD

Fuel Pump Driver Control Module Configuration Command Signal 1 Message Counter Incorrect

DTC P14CE

Fuel Pump Driver Control Module Configuration Status Signal Message Counter Incorrect

DTC P14D4

Fuel Pump Driver Control Module Configuration Command Signal 2 Message Counter Incorrect

DTC P14D5

Fuel Pump Driver Control Module Configuration Command Signal 3 Message Counter Incorrect

DTC P14D6

Fuel Pump Driver Control Module Configuration Command Signal 5 Message Counter Incorrect

DTC P15F9

Hybrid/EV System Engine Speed Control Intervention Request Type Signal Message Counter Incorrect

DTC P15FB

Brake Pedal Position Sensor Signal Message Counter Incorrect

DTC P165C

Sensor Reference Voltage Status Message Counter Incorrect

DTC P167F

Battery Voltage Signal Message Counter Incorrect

DTC P16FF

Engine Controls Ignition Relay Request Signal Message Counter Incorrect

DTC P175F

Acceleration Sensor Signal Message Counter Incorrect

DTC P1772

Powerflow Engaged Signal Message Counter Incorrect

DTC P30DE

Fuel Rail Pressure Sensor 2 Signal Message Counter Incorrect

DTC P314E

Fuel Heater Control Module Status Signal Message Counter Incorrect

DTC P316B

Secondary Fuel System Requests Signal Message Counter Incorrect

Circuit/System Description

Control modules connected to the serial data circuits monitor the communication during normal vehicle operation. Operating information and commands are exchanged among the control modules. Each module on the serial data circuit maintains a transmit error counter and a receive error counter. The counter values increase with detected errors and decrease with error-free messages.

Conditions for Running the DTC

- Ignition = On - For greater than 3 s
- Serial Data = Enabled

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

Serial Data = Message Counter Incorrect - Component

The above condition(s) must occur 5 times.

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC - Exceptions listed below

- DTC P10C6, P128F, P14CE, P15F2, P30DE, P316B = Type A DTC
- DTC P1103, P155D, P15FB, P175F = Type C DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC - Exceptions listed below

- DTC P10C6, P128F, P14CE, P15F2, P30DE, P316B = Type A DTC
- DTC P1103, P155D, P15FB, P175F = Type C DTC

Reference Information

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 there are no DTCs set related to the following component/system: Serial Data
 - **If a related DTC is set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**
 - **Go to next step: If a related DTC is not set**
3. Clear the DTCs.
4. Operate the vehicle within the Conditions for Running the DTC.

Verify the DTC does not set.

- **If the DTC sets**

1. Ignition/Vehicle - Off
2. Replace the component: Transmitting Component - Refer to [Transmitting and Receiving Components](#)
3. Operate the vehicle within the Conditions for Running the DTC.

Verify the DTC does not set.

- If the DTC sets

Replace the component: Receiving Component - Refer to [Transmitting and Receiving Components](#)

- Go to next step: If the DTC does not set

4. All OK.

- **Go to next step: If the DTC does 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 P1008, P103D, P103E, P10C7, P10C8, P117A, P1436, P143A, P143B, P30B4, P30B5, P30BC, OR P30D5

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 P1008

Engine Coolant Bypass Valve Command Signal Message Counter Incorrect

DTC P103D

Engine Coolant Pump Control Signal Message Counter Incorrect

DTC P103E

Auxiliary Coolant Pump Control Signal Message Counter Incorrect

DTC P10C7

Reductant Control System Signal Message Counter Incorrect

DTC P10C8

Reductant Temperature Signal Message Counter Incorrect

DTC P117A

Engine Block Coolant Valve Signal Message Counter Incorrect

DTC P1436

Particulate Matter Sensor Control Module Temperature Signal Message Counter Incorrect

DTC P143A

Reductant Control System Diagnostic Signal Message Counter Incorrect

DTC P143B

Reductant Control System Information Signal Message Counter Incorrect

DTC P30B4

NOx Sensor 1 Signal Message Counter Incorrect

DTC P30B5

NOx Sensor 2 Signal Message Counter Incorrect

DTC P30BC

Particulate Matter Sensor Control Module Status Signal Message Counter Incorrect

DTC P30D5

NOx Sensor 3 Signal Message Counter Incorrect

Circuit/System Description

Control modules connected to the serial data circuits monitor the communication during normal vehicle operation. Operating information and commands are exchanged among the control modules. Each module on the serial data circuit maintains a transmit error counter and a receive error counter. The counter values increase with detected errors and decrease with error-free messages.

Conditions for Running the DTC

- Ignition = On - For greater than 3 s
- Serial Data = Enabled

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

Serial Data = Message Counter Incorrect - Component

The above condition(s) must occur 5 times.

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC - Exceptions listed below

- DTC P103D, P117A, P143B = Type A DTC
- DTC P10C8 = Type C DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC - Exceptions listed below

- DTC P103D, P117A, P143B = Type A DTC
- DTC P10C8 = Type C DTC

Reference Information

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 there are no DTCs set related to the following component/system: Serial Data
 - **If a related DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **Go to next step: If a related DTC is not set**
3. Clear the DTCs.
 4. Operate the vehicle within the Conditions for Running the DTC.

Verify the DTC does not set.

- **If the DTC sets**
 1. Ignition/Vehicle - Off
 2. Replace the component: Transmitting Component - Refer to [Transmitting and Receiving Components](#)
 3. Operate the vehicle within the Conditions for Running the DTC.

Verify the DTC does not set.

- If the DTC sets

Replace the component: Receiving Component - Refer to [Transmitting and Receiving Components](#)

 - Go to next step: If the DTC does not set
- 4. All OK.
 - **Go to next step: If the DTC does 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 P100A, P135C-P135E, P14A0, OR P14B6

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 P100A

Turbocharger Boost Control Signal Message Counter Incorrect

DTC P135C

Cooling Fan 1 Status Signals Message Counter Incorrect

DTC P135D

Cooling Fan 2 Status Signals Message Counter Incorrect

DTC P135E

Cooling Fan 3 Status Signals Message Counter Incorrect

DTC P14A0

Charge Air Cooler Coolant Pump Status Signal Message Counter Incorrect

DTC P14B6

Mass Air Flow Sensor Signal Message Counter Incorrect

Circuit/System Description

Control modules connected to the serial data circuits monitor the communication during normal vehicle operation. Operating information and commands are exchanged among the control modules. Each module on the serial data circuit maintains a transmit error counter and a receive error counter. The counter values increase with detected errors and decrease with error-free messages.

Conditions for Running the DTC

- Ignition = On - For greater than 3 s
- Serial Data = Enabled

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

Serial Data = Message Counter Incorrect - Component

The above condition(s) must occur 5 times.

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC - Exceptions listed below

- DTC P100A = Type A DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC - Exceptions listed below

- DTC P100A = Type A DTC

Reference Information

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 there are no DTCs set related to the following component/system: Serial Data
 - **If a related DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **Go to next step: If a related DTC is not set**
3. Clear the DTCs.
 4. Operate the vehicle within the Conditions for Running the DTC.

Verify the DTC does not set.

- **If the DTC sets**
 1. Ignition/Vehicle - Off
 2. Replace the component: Transmitting Component - Refer to [Transmitting and Receiving Components](#)
 3. Operate the vehicle within the Conditions for Running the DTC.

Verify the DTC does not set.

- If the DTC sets

Replace the component: Receiving Component - Refer to [Transmitting and Receiving Components](#)

- Go to next step: If the DTC does not set
4. All OK.
 - **Go to next step: If the DTC does 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 P1248-P124D

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 P1248

Cylinder 1 Injector High Control Circuit Shorted to Control Circuit

DTC P1249

Cylinder 2 Injector High Control Circuit Shorted to Control Circuit

DTC P124A

Cylinder 3 Injector High Control Circuit Shorted to Control Circuit

DTC P124B

Cylinder 4 Injector High Control Circuit Shorted to Control Circuit

DTC P124C

Cylinder 5 Injector High Control Circuit Shorted to Control Circuit

DTC P124D

Cylinder 6 Injector High Control Circuit Shorted to Control Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Short Between Circuits
Control circuit terminal 2 @ Q17A Fuel Injector 1	P2147	P0201	P2148	P1248
Control circuit terminal 1 @ Q17A Fuel Injector 1	P0261	P0201	P0262	P1248
Control circuit terminal 2 @ Q17B Fuel Injector 2	P2150	P0202	P2151	P1249
Control circuit terminal 1 @ Q17B Fuel Injector 2	P0264	P0202	P0265	P1249
Control circuit terminal 2 @ Q17C Fuel Injector 3	P2153	P0203	P2154	P124A
Control circuit terminal 1 @ Q17C Fuel Injector 3	P0267	P0203	P0268	P124A
Control circuit terminal 2 @ Q17D Fuel Injector 4	P2156	P0204	P0270, P2157	P124B
Control circuit terminal 1 @ Q17D Fuel Injector 4	P0270, P2156	P0204	P0271, P2157	P124B
Control circuit terminal 2 @ Q17E Fuel Injector 5	P216B	P0205	P216C	P124C
Control circuit terminal 1 @ Q17E Fuel Injector 5	P0273	P0205	P0274	P124C
Control circuit terminal 2 @ Q17F Fuel Injector 6	P216E	P0206	P216F	P124D
Control circuit terminal 1 @ Q17F Fuel Injector 6	P0276	P0206	P0277	P124D

Typical Scan Tool Data

Fuel Injector Control Circuit Test Status

Circuit	Short to Ground	Open	Short to Voltage	Short between the circuits
Operating Conditions: Engine at Idle Parameter Normal Range: OK or Not Run				
Control circuit terminal 2	High Control Circuit Low Voltage	Open	High Control Circuit High Voltage	High Control Circuit Shorted to Control Circuit
Control circuit terminal 1	Control Circuit Low Voltage	Open	Control Circuit High Voltage	High Control Circuit Shorted to Control Circuit

Circuit/System Description

Circuit	Description
Control circuit terminal 2	Regulated voltage supplied by the control module.
Control circuit terminal 1	The output circuit is switched to ground to activate the component.

Component	Description
Q17 Fuel Injector	Fuel injectors are solenoid valves that inject fuel either into the intake system or directly into the cylinder. The amount of fuel injected depends on the length of the electrical pulse that is applied. The fuel injectors of this system have an operating voltage range of 50 to 90 V.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Conditions for Running the DTC

- DTC P062B = Not set
- Engine is Running
- Battery Voltage = Greater than 11 V

DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

P1248, P1249, P124A, P124B, P124C, P124D

Control Circuit Shorted to Control Circuit - For greater than 1 s

Actions Taken When the DTC Sets

DTCs P1248, P1249, P124A, P124B, P124C, P124D are Type A DTCs.

Conditions for Clearing the DTC

DTCs P1248, P1249, P124A, P124B, P124C, P124D are Type A DTCs.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

Description and Operation

Fuel System Description

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. Engine running.
2. Verify the scan tool parameter:
 - Cylinder 1 Injector Control Circuit Status = OK
 - Cylinder 2 Injector Control Circuit Status = OK
 - Cylinder 3 Injector Control Circuit Status = OK
 - Cylinder 4 Injector Control Circuit Status = OK
 - Cylinder 5 Injector Control Circuit Status = OK
 - Cylinder 6 Injector Control Circuit Status = OK
 - **If not the specified state**

Refer to: Circuit/System Testing

- **Go to next step: If the specified state**

3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

4. Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

5. All OK.

Circuit/System Testing

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: X160 X161

3. Ignition - On / Vehicle - In Service Mode

4. Verify the scan tool parameter:

X160

- Cylinder 1 Injector Control Circuit Status = OK
- Cylinder 3 Injector Control Circuit Status = OK
- Cylinder 5 Injector Control Circuit Status = OK

X161

- Cylinder 2 Injector Control Circuit Status = OK
- Cylinder 4 Injector Control Circuit Status = OK
- Cylinder 6 Injector Control Circuit Status = OK

- **If not the specified state**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: X3 @ K20 Engine Control Module

3. Test for infinite resistance between the test points:

- {Q17A Fuel Injector 1} Terminal 72 & Terminal 52 @ Control module harness
- {Q17B Fuel Injector 2} Terminal 68 & Terminal 48 @ Control module harness
- {Q17C Fuel Injector 3} Terminal 70 & Terminal 50 @ Control module harness
- {Q17D Fuel Injector 4} Terminal 66 & Terminal 46 @ Control module harness
- {Q17E Fuel Injector 5} Terminal 67 & Terminal 47 @ Control module harness
- {Q17F Fuel Injector 6} Terminal 71 & Terminal 51 @ Control module harness
- If less than infinite resistance - Repair the short between the circuits.
- If infinite resistance - Replace the component: K20 Engine Control Module

- **Go to next step: If the specified state**

5. Ignition/Vehicle - Off

6. Disconnect the appropriate electrical connector: Q17 Fuel Injector

7. Test for infinite resistance between the test points: Q17 Fuel Injector Terminal 1 & Terminal 2 @ Component harness

- **If less than infinite resistance**

Repair the short between the circuits: High Control & Low Control

- **If infinite resistance**

Test or replace the component: Q17 Fuel Injector

Component Testing

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: Q17 Fuel Injector

NOTE: The specified resistances are valid for components at room temperature.

3. Test for 1 to 3 ohms between the test points: Control circuit terminal 2 & Control circuit terminal 1

- **If not between 1 and 3 ohms**

Replace the component: Q17 Fuel Injector

- **Go to next step: If between 1 and 3 ohms**

4. Test for infinite resistance between the test points: Each terminal of the component & The component's housing

- **If less than infinite resistance**

Replace the component: Q17 Fuel Injector

- **Go to next step: If infinite resistance**

5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Fuel Injector Replacement](#)
- Fuel Rail Pressure Sensor or Fuel Rail Learn
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P1255

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

NOTE: This procedure may also diagnose malfunctions that are not detected by a DTC.

DTC P1255

Fuel Pump Control Module Driver High Temperature

Circuit/System Description

For an overview of the component/system, refer to [Fuel System Description](#)

Component	Description
K111 Fuel Pump Driver Control Module	The control module K111 monitors the fuel system for any condition which may adversely affect emissions. If a condition is detected it sets a DTC and sends a serial data message to the engine control module which then sets DTC P069E.

When the ignition is turned On, the ECM sends a 12 V signal to the control module K111 to enable the fuel pump. If the engine is not started, the control module K111 turns the fuel pump Off after 6 s.

Conditions for Running the DTC

- Ignition Voltage = Greater than 9 V
- Engine = Cranking or running.
- Fuel Pump Enable Command = On

DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

K111 Fuel Pump Driver Control Module = Greater than 150B°C (302B°F) - For greater than 1 s

Actions Taken When the DTC Sets

DTC P1255 is a Type A DTC.

Conditions for Clearing the DTC

DTC P1255 is a Type A DTC.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or **Inline Harness Connector End Views - Index** or **Component Connector End Views - Index**

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 P0231, P0232, P023F is not set.

- **If any of the DTCs are set**

Refer to **DTC P0231, P0232, or P023F**

- **Go to next step: If none of the DTCs are set**

3. Verify the component location is free of debris, clutter or any obstruction that may reduce airflow which could cause an overheat condition: K111 Fuel Pump Driver Control Module

- **If a condition exists**

1. Repair as necessary
2. Clear the DTCs.
3. Test drive the vehicle.
4. Verify DTC P1255 is not set.

- If the DTC sets - Replace the component: K111 Fuel Pump Driver Control Module
- Go to next step: If the DTC is not set

5. All OK.

- **Go to next step: If no condition exists**

4. Clear the DTCs.

5. Test drive the vehicle.

6. Verify DTC P1255 is not set.

- **If the DTC is set**

Replace the component: K111 Fuel Pump Driver Control Module

- **Go to next step: If the DTC is not set**

7. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

[Fuel Pump Power Control Module Replacement](#) - K111 Fuel Pump Driver Control Module

DTC P129D

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 P129D

Fuel Pump Driver Control Module Ignition On/Start Switch Circuit Low Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P129D	P129D	P129D	-

Circuit/System Description

For an overview of the component/system, refer to [Fuel System Description](#)

Component	Description
K111 Fuel Pump Driver Control Module	The control module K111 supplies the fuel pump with a PWM signal in order to achieve the desired fuel line pressure.

When the ignition is turned On, the ECM sends a 12 V signal to the control module K111 to enable the fuel pump. If the engine is not started, the control module K111 turns the fuel pump Off after 6 s.

Conditions for Running the DTC

Control Module Power Moding = Enabled

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

Ignition circuit = Commanded state does not match the actual state - For greater than 1 s

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type A DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or **Inline Harness Connector End Views - Index** or **Component Connector End Views - Index**

Description and Operation

Fuel System Description

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 P0562 is not set.

- **If the DTC is set**

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

- **Go to next step: If the DTC is not set**

3. Verify DTC P129D is not set.

- **If the DTC is set**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
5. Verify DTC P129D is not set.

- **If the DTC is set**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

6. 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: K111 Fuel Pump Driver Control Module
3. Ignition - On / Vehicle - In Service Mode
4. Verify a test lamp turns On between the test points: Ignition circuit terminal 6 & Ground
 - **If the test lamp does not turn On and the circuit fuse is OK**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Test for less than 2 ohms between the test points: Ignition circuit terminal 6 & Output terminal @ X50A Fuse Block - Underhood F15UA Fuse
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not turn On and the circuit fuse is open**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Test for infinite resistance between the test points: Ignition circuit terminal 6 & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K111 Fuel Pump Driver Control Module
 - **Go to next step: If the test lamp turns On**
5. Ignition/Vehicle & All vehicle systems - Off
6. Verify a test lamp does not turn On between the test points: Ignition circuit terminal 6 & Ground
 - **If the test lamp turns On**

Repair the short to voltage on the circuit.
 - **Go to next step: If the test lamp does not turn On**
7. Test or replace the component: K111 Fuel Pump Driver 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 P135A OR P135B

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 P135A

Ignition Coil Supply Voltage Circuit Bank 1

DTC P135B

Ignition Coil Supply Voltage Circuit Bank 2

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P135A, P135B*	P135A, P135B*	-	-
*Additional DTCs may set.				

Circuit/System Description

For an overview of the component/system, refer to [Electronic Ignition System Description](#)

Circuit	Description
Ignition	Supplied from a fuse.

Component	Description
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.
T8 Ignition Coil	The ignition system on this engine uses ignition coils with integrated power transistors.

The ECM monitors and compares the voltages supplied by the relay(s).

Conditions for Running the DTC

- Delayed starting = Greater than 5 engine revolutions
- KR75 Engine Controls Ignition Relay = Greater than 11 V
- Run/Crank Relay = Greater than 5 V

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

Ignition Coil Supply Voltage = Less than 2.5 V

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type A DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC

Reference Information

Schematic Reference

[Engine Controls Wiring Schematics](#)

Connector End View Reference

[Master Electrical Component List](#) , or [Inline Harness Connector End Views - Index](#) or [Component Connector End Views - Index](#)

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 the scan tool parameter: Ignition Coil Supply Voltage = On
 - **If not the specified state**
Refer to: Circuit/System Testing
 - **Go to next step: If the specified state**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**
Refer to: Circuit/System Testing
- **Go to next step: If the DTC is not set**

4. All OK.

[Circuit/System Testing](#)

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: X1 @ K20 Engine Control Module
3. Connect a 3 A fused jumper wire between the test points: Control circuit terminal X1-15 & Ground
4. Ignition - On / Vehicle - In Service Mode
5. Verify a test lamp turns On between the test points:
 - {P135B} Ignition circuit terminal 49 & Ground
 - {P135A} Ignition circuit terminal 50 & Ground
 - **If the test lamp does not turn On and the circuit fuse is OK**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Test for less than 2 ohms between the test points: Ignition circuit terminal 50 @ Control module harness & Output terminal @ Fuse
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not turn On and the circuit fuse is open**

1. Ignition/Vehicle - Off

2. Replace the component: Fuse

3. Ignition - On / Vehicle - In Service Mode

4. Verify the fuse does not open.

- If the fuse opens and there are components connected to the circuit - Disconnect a component and repeat procedure starting at step 5.1
- If the fuse opens with all components disconnected from the circuit - Repair the short to ground on the circuit.
- If the fuse does not open after disconnecting a component from the circuit - Replace the component disconnected last.
- Go to next step: If the fuse does not open with all components connected, except the following component: K20 Engine Control Module

5. Ignition/Vehicle - Off

6. Connect the electrical connector: K20 Engine Control Module

7. Replace the component: Fuse

8. Ignition - On / Vehicle - In Service Mode

9. Verify the fuse does not open.

- If the fuse is open - Replace the component: K20 Engine Control Module
- Go to next step: If the fuse does not open.

10. Verify the fuse does not open when any of the components are activated.

- If the fuse opens - Replace the component that caused the fuse to open when activated.
- Go to next step: If the fuse does not open.

11. All OK.

- **Go to next step: If the test lamp turns On**

6. Replace the component: K20 Engine Control Module

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Ignition Coil Replacement - Bank 1](#)
- [Ignition Coil Replacement - Bank 2](#)
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P1400

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 P1400

Cold Start Emission Reduction Control System

Circuit/System Description

For an overview of the component/system, refer to [Catalytic Converter Description and Operation](#)

Conditions for Running the DTC

- DTCs related to the following system/component = Not Set
 - 5V Reference Circuit
 - B14A Transmission Output Shaft Speed Sensor/Vehicle Speed Sensor
 - B15 Transmission Internal Mode Switch
 - B26 Crankshaft Position Sensor
 - B34 Engine Coolant Temperature Sensor
 - B74 Manifold Absolute Pressure Sensor
 - B75C Multifunction Intake Air Sensor
 - B107 Accelerator Pedal Position Sensor
 - Q17 Fuel Injector
 - Q38 Throttle Body
 - T8 Ignition Coil
 - Engine Misfire
 - Fuel Trim System
- Accelerator pedal not pressed.
- Calculated Catalyst Temperature = 350 to 662B°C (900 to 1, 652B°F)
- {Cold Start-Up} BARO Sensor = Less than 76 kPa (11 PSI)
- Engine = Running - For greater than 45 s
- Engine Coolant Temperature = -10 to 66B°C (14 to 150B°F)
- Vehicle Speed = Less than 2 km/h (1.25 MPH)

Frequency the DTC runs = Once - Per cold start-up - Within 15 s

Conditions for Setting the DTC

Catalyst System = Not within a calibrated range

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type A DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC

Diagnostic Aids

Modifications to the intake air systems may cause this DTC to set.

Reference Information

Description and Operation

[Engine Control Module Description](#)

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 there are no DTCs set related to the following component/system:

- 5V Reference Circuit
- B14A Transmission Output Shaft Speed Sensor/Vehicle Speed Sensor
- B15 Transmission Internal Mode Switch
- B26 Crankshaft Position Sensor
- B34 Engine Coolant Temperature Sensor
- B74 Manifold Absolute Pressure Sensor
- B75C Multifunction Intake Air Sensor
- B107 Accelerator Pedal Position Sensor
- Q17 Fuel Injector
- Q38 Throttle Body
- T8 Ignition Coil
- Engine Misfire
- Fuel Trim System
- **If a related DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **Go to next step: If a related DTC is not set**

3. Verify the condition does not exist:

- Air Cleaner Element - Dirty/Water intrusion/Visible Damage
- Intake Air Duct - Loose/Poor Connection/Visible Damage
- Intake Manifold - Leaking
- Positive Crankcase Ventilation System - Dirty/Poor Connection/Restricted - Refer to [Crankcase Ventilation System Inspection/Diagnosis](#)
- Vacuum Hoses - Incorrect connection/Kinked/Leaking/Restricted
- **If a condition exists**

Repair or replace as necessary

- **Go to next step: If no condition exists**

4. Verify a condition does not exist with the component: Exhaust System

- Leaking - Refer to [Exhaust Leakage](#)
- Loose Clamps
- Missing components
- Restrictions - Refer to [Restricted Exhaust](#)
- Visible Damage
- **If a condition exists**

Repair or replace as necessary

- **Go to next step: If no condition exists**

5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify DTC P1400 is not set.

- **If the DTC sets**

Refer to [Symptoms - Engine Mechanical](#)

- **Go to next step: If no DTC is set**

6. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

DTC P150C, P155D, P15F2, P1762, P1773, P1775, P188B, P18EF, P1919, OR P2544

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 P150C

Transmission Control Module Engine Speed Request Signal Message Counter Incorrect

DTC P155D

Hill Descent Control Message Counter Incorrect

DTC P15F2

Engine Torque Command Signal Message Counter Incorrect

DTC P1762

Transmission Mode Switch Signal Message Counter Incorrect

DTC P1773

Internal Mode Switch State Signal Message Counter Incorrect

DTC P1775

Transmission Range Request Signal Message Counter Incorrect

DTC P188B

Transmission Range Signal Message Counter Incorrect

DTC P18EF

Continuously Variable Transmission Torque Ratio Signal Message Counter Incorrect

DTC P1919

Transmission Neutral Locked Turbine Signal Message Counter Incorrect

DTC P2544

Transmission Torque Request Signal Message Counter Incorrect

Circuit/System Description

Control modules connected to the serial data circuits monitor the communication during normal vehicle operation. Operating information and commands are exchanged among the control modules. Each module on the serial data circuit maintains a transmit error counter and a receive error counter. The counter values increase with detected errors and decrease with error-free messages.

Conditions for Running the DTC

- Ignition = On - For greater than 3 s
- Serial Data = Enabled

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

Serial Data = Message Counter Incorrect - Component

The above condition(s) must occur 5 times.

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC - Exceptions listed below

- DTC P15F2, P188B, P18EF = Type A DTC
- DTC P155D = Type C DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC - Exceptions listed below

- DTC P15F2, P188B, P18EF = Type A DTC
- DTC P155D = Type C DTC

Reference Information

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 there are no DTCs set related to the following component/system: Serial Data
 - **If a related DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **Go to next step: If a related DTC is not set**
3. Clear the DTCs.
 4. Operate the vehicle within the Conditions for Running the DTC.

Verify the DTC does not set.

- **If the DTC sets**

1. Ignition/Vehicle - Off
2. Replace the component: Transmitting Component - Refer to [Transmitting and Receiving Components](#)
3. Operate the vehicle within the Conditions for Running the DTC.

Verify the DTC does not set.

- If the DTC sets

Replace the component: Receiving Component - Refer to [Transmitting and Receiving Components](#)

- Go to next step: If the DTC does not set

4. All OK.

- **Go to next step: If the DTC does 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 P1516, P2101, P2119, OR P2176

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 P1516

Throttle Actuator Control Module Throttle Actuator Position Performance

DTC P2101

Throttle Actuator Position Performance

DTC P2119

Throttle Closed Position Performance

DTC P2176

Minimum Throttle Position Not Learned

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - Terminal 1	P1516, P2101, P2119	P1516, P2101	P1516, P2101	P1516, P2101, P2176
Control - Terminal 2	P1516, P2101	P1516, P2101	P1516, P2101	P1516, P2101, P2176

Circuit/System Description

For an overview of the component/system, refer to [Throttle Actuator Control \(TAC\) System Description](#)

Circuit	Description
Control - Terminal 1	The output circuit is switched from ground to 12 V to activate the component. The output is PWM controlled.
Control - Terminal 2	The output circuit is switched from ground to 12 V to activate the component. The output is PWM controlled.

Component	Description
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.
Q38 Throttle Body	The throttle valve is actuated by a bidirectional DC motor. A spring pulls the valve to a rest or default position, in which the valve is almost closed. The throttle actuator motor can push against the force of the spring to open or close the valve. The more current flow through the motor, the more the valve moves.

Conditions for Running the DTC

P1516

- DTC P1682 = Not set
- Desired Throttle Position = Stable - Greater than 4 s
- Ignition Voltage = Greater than 6.4 V
- Throttle Position Learn = Not Activated

Frequency the DTC runs = Continuously - After the running conditions are met

P2101 Condition 1

- DTC P1682 = Not set
- Engine = Running - Ignition Voltage = Greater than 5.5 V
- Ignition = On - Ignition Voltage = Greater than 8.4 V
- Throttle Position Learn = Not Activated

Condition 2

- DTC P1682 = Not set
- Throttle Position Learn = Active

Frequency the DTC runs = Continuously - After the running conditions are met

P2119

- DTC P0122, P0123, P0222, P0223, P06A3 = Not set
- Engine = Not Running
- Ignition Voltage = Greater than 5.4 V

Frequency the DTC runs = Continuously - After the running conditions are met

P2176

- Ignition Voltage = Greater than 6.4 V
- Throttle Position Learn = Active

Frequency the DTC runs = Continuously - After the running conditions are met - For greater than 2 s

Conditions for Setting the DTC

P1516

The following parameters are not within 2% of each other:

- Desired Throttle Position
- Throttle Position

P2101 Condition 1

The following parameters are not within 10% of each other:

- Desired Throttle Position
- Throttle Position

Condition 2

- Throttle Position Learn = Active
- Throttle Position = Greater than 36%

P2119

Blade @ Q38 Throttle Body Closed @ Engine Off

P2176

Minimum Throttle Position Not Learned = Exceeded Number of Attempts - 10

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC - Exceptions listed below - Additional actions taken:

DTC P2101, P2176 = Type A DTC

DTC P2119 = Type C DTC

- Reduced Engine Power = Active
- Warning Message = Reduced Engine Power
- Under certain conditions, the control module commands the engine Off.

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC - Exceptions listed below

- DTC P2101, P2176 = Type A DTC
- DTC P2119 = Type C DTC

Diagnostic Aids

- A high resistance condition on the throttle position and throttle actuator control circuits could cause a DTC to set.
- A weak battery may cause this DTC to set.
- If the throttle blade becomes stuck, a DTC will set. Depending on the position of the throttle blade, the engine control module (ECM) may enter Engine Shutdown Mode. The ECM will disable fuel and de-energize the throttle actuator. If the condition remains present during the next ignition cycle, the ECM may disable engine cranking. Inspect the throttle body assembly for a stuck throttle blade if a throttle actuator DTC is current and the engine won't crank.
- Inspect for a condition in which the throttle blade may have been held open. For example, ice may have formed in the throttle bore causing the throttle blade not to close.
- Under cold start conditions, it might happen briefly that the desired and the actual throttle blade position do not match.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or **Inline Harness Connector End Views - Index** or **Component Connector End Views - Index**

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

Special Tools

EL-44603 Injector Test Lamp

Equivalent regional tools: **Special Tools (Mechanical Tools)**

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC P0121, P0122, P0123, P0222, P0223, P0562, P0606, P0607, P0621, P0622, P2135, U0606, U0607 is not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **Go to next step: If none of the DTCs are set**

3. Verify the scan tool parameter: Throttle Body Idle Air Flow Compensation = Less than 90%

- **If 90% or greater**

Refer to [Throttle Body Inspection and Cleaning](#)

- **Go to next step: If less than 90%**

4. Perform the following action: Clear the DTCs.

5. Ignition/Vehicle - Off

6. Ignition - On / Vehicle - In Service Mode

7. Perform the scan tool control function: Throttle Sweep - Start

Verify the scan tool parameter: Throttle Actuator Control Valve = Enabled

- **If not the specified state**

Test or replace the component: Q38 Throttle Body

- **Go to next step: If the specified state**

8. Engine - Idling

9. Verify the scan tool parameter: Throttle Actuator Control Valve = Enabled

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: Q38 Throttle Body
- Wiggle the harness and connector: K20 Engine Control Module
- **If not the specified state**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If the specified state**

10. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC does not set**

11. All OK.

Circuit/System Testing

1. Ignition/Vehicle - Off

2. Verify a condition does not exist with the component: Blade @ Q38 Throttle Body

WARNING: Turn OFF the ignition before inserting fingers into the throttle bore. Unexpected movement of the throttle blade could cause personal injury.

- Binding or Sticking @ Open/Closed - Position
- Open @ Engine Off
- Closed - Without spring pressure
- **If a condition exists**

Replace the component: Q38 Throttle Body

- **Go to next step: If no condition exists**

NOTE: **Disconnecting the component electrical connector causes additional DTCs to set.**

3. Disconnect the electrical connector: Q38 Throttle Body
4. Ignition - On / Vehicle - In Service Mode
5. Test for 8.5 to 9.5 V between the test points:
 - Control circuit terminal 1 & Ground
 - Control circuit terminal 2 & Ground
 - **If less than 8.5 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Test for infinite resistance between the test points:
 - Control circuit terminal 1 @ Component harness & Ground
 - Control circuit terminal 2 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
 4. Test for less than 2 ohms between the test points:
 - Control circuit terminal 1 @ Component harness & The other end of the circuit @ Control module harness
 - Control circuit terminal 2 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **If greater than 9.5 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the appropriate electrical connector: K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points:
 - Control circuit terminal 1 @ Component harness & Ground
 - Control circuit terminal 2 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module
 - **Go to next step: If between 8.5 and 9.5 V**
6. Ignition/Vehicle & All vehicle systems - Off - It may take up to 2 min for all vehicle systems to power down before an accurate test can be performed.
7. Use the special tool: EL-44603 Injector Test Lamp
8. Connect the tool between the test points: Control circuit terminal 1 & Control circuit terminal 2
9. Ignition - On / Vehicle - In Service Mode
10. Verify the test lamp flashes - Once

- **If the test lamp does not flash**

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: K20 Engine Control Module
3. Test for less than 2 ohms between the test points:
 - Control circuit terminal 1 @ Component harness & The other end of the circuit @ Control module harness
 - Control circuit terminal 2 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module

- **Go to next step: If the test lamp flashes**

11. Test or replace the component: Q38 Throttle Body

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Throttle Body Assembly Replacement](#) - Q38 Throttle Body
- For control module replacement, programming, and setup refer to [Control Module References](#)

Additional Procedures

[Throttle Body Idle Air Flow Compensation Reset](#) - Perform only when the following component/system is replaced or serviced:

- K20 Engine Control Module - Replaced
- Q38 Throttle Body - Cleaned/Replaced

DTC P2096-P2099

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 P2096

Post Catalyst Fuel Trim System Low Limit Bank 1

DTC P2097

Post Catalyst Fuel Trim System High Limit Bank 1

DTC P2098

Post Catalyst Fuel Trim System Low Limit Bank 2

DTC P2099

Post Catalyst Fuel Trim System High Limit Bank 2

Circuit/System Description

For an overview of the component/system, refer to [Catalytic Converter Description and Operation](#)

Conditions for Running the DTC

- DTCs related to the following system/component = Not Set
 - B23 Camshaft Position Sensor
 - B34 Engine Coolant Temperature Sensor
 - B52 Heated Oxygen Sensor
 - B74 Manifold Absolute Pressure Sensor
 - B75C Multifunction Intake Air Sensor
 - B150 Fuel Tank Pressure Sensor
 - B198 Fuel Composition Sensor
 - Q12 Evaporative Emission Purge Solenoid Valve
 - Q17 Fuel Injector
 - Evaporative Emission (EVAP) System
 - Engine Misfire
- BARO Sensor = Greater than 70 kPa (10.2 PSI)
- Engine Coolant Temperature @ Cold Start-Up = Greater than -20B°C (-4B°F)
- Evaporative Emission (EVAP) Purge System = Inactive
- HO2S Heater Resistance Learn Status = Valid
- IAT Sensor = -20 to 150B°C (-4 to 302B°F)
- MAF Sensor = 0 to 10, 000 g/s
- {P2096, P2097} MAP Sensor = 10 to 255 kPa (1.5 to 37 PSI)
- {P2098, P2099} MAP Sensor = 0 to 200 kPa (0 to 29 PSI)

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

Fuel Trim System = Not within a calibrated range

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

Engine Controls Wiring Schematics

Connector End View Reference

[Master Electrical Component List](#) , or [Inline Harness Connector End Views - Index](#) or [Component Connector End Views - Index](#)

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 there are no DTCs set related to the following component/system:

- B23 Camshaft Position Sensor
- B34 Engine Coolant Temperature Sensor
- B52 Heated Oxygen Sensor
- B74 Manifold Absolute Pressure Sensor
- B75C Multifunction Intake Air Sensor
- B150 Fuel Tank Pressure Sensor
- B198 Fuel Composition Sensor
- Q12 Evaporative Emission Purge Solenoid Valve
- Q17 Fuel Injector
- Evaporative Emission (EVAP) System
- Engine Misfire
- **If a related DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **Go to next step: If a related DTC is not set**

3. Verify the following conditions do not exist:

- Coolant consumption - Refer to [Loss of Coolant](#)
- Exhaust System - Leaking/Missing components/Restricted - Refer to [Symptoms - Engine Exhaust](#)
- Fuel - Contaminated/Poor Quality - Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#)
- Fuel System - Leaking - Refer to [Fuel System Diagnosis](#)
- Oil consumption - Refer to [Oil Consumption Diagnosis](#)
- Positive Crankcase Ventilation System - Refer to [Crankcase Ventilation System Inspection/Diagnosis](#)
- Rich fuel mixture. - Refer to [Fuel System Diagnosis](#)
- **If a condition exists**

Repair or replace as necessary

- **Go to next step: If no condition exists**

4. Verify a condition does not exist with the component: B52 Heated Oxygen Sensor

Loose/Poor Connection/Visible Damage

- **If a condition exists**

Repair or replace as necessary

- **Go to next step: If no condition exists**

5. Verify a condition does not exist with the component: Exhaust System

Leaking/Loose Clamps/Missing components/Restrictions/Visible Damage

- **If a condition exists**

Repair or replace as necessary

- **Go to next step: If no condition exists**

6. Verify a condition does not exist with the component: Warm Up Three-Way Catalytic Converter

- A rattling sound indicates internal damage.
- Cracks or holes in the catalytic converter housing.
- Restrictions/Visible Damage
- Severe discoloration caused by excessive temperatures
- **If a condition exists**

Replace the component: Warm Up Three-Way Catalytic Converter

- **Go to next step: If no condition exists**

7. All OK.

Repair Instructions

- Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)
- [Warm Up Three-Way Catalytic Converter Replacement \(Right Side, LGZ\)](#) , or [Warm Up Three-Way Catalytic Converter Replacement \(Left Side, LGZ 2WD\)](#) , or [Warm Up Three-Way Catalytic Converter Replacement \(Left Side, LGZ 4WD\)](#).

DTC P2122, P2123, P2127, P2128, OR P2138

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 P2122

Accelerator Pedal Position (APP) Sensor 1 Circuit Low Voltage

DTC P2123

Accelerator Pedal Position (APP) Sensor 1 Circuit High Voltage

DTC P2127

Accelerator Pedal Position (APP) Sensor 2 Circuit Low Voltage

DTC P2128

Accelerator Pedal Position (APP) Sensor 2 Circuit High Voltage

DTC P2138

Accelerator Pedal Position (APP) Sensors 1-2 Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
12V Reference - APP Sensor 1	P06A3	P2122, P2138	P06A3	P2138
Signal - APP Sensor 1	P2122	P2122, P2138	P2123	P2138
Low Reference - APP Sensor 1	-	P2123, P2138	-	P2138
12V Reference - APP Sensor 2	P0106, P0107, P0108, P0697	P2127, P2138	P0106, P0108, P0697	P2138
Signal - APP Sensor 2	P2127	P2127, P2138	P2128	P2138
Low Reference - APP Sensor 2	-	P2128, P2138	-	P2138

Typical Scan Tool Data

APP Sensor 1

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine idling. Parameter Normal Range: 0.88 to 1.08 V			
5 V Reference	0 V	0 V	2 to 3 V
Signal	0 V	0 V	4 to 5 V
Low Reference	-	4 to 5 V	-

APP Sensor 2

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine idling. Parameter Normal Range: 0.39 to 0.59 V			
5 V Reference	0 V	0 V	1 to 3 V
Signal	0 V	0 V	2 to 5 V
Low Reference	-	4 to 5 V	-

Circuit/System Description

Circuit	Description
5 V Reference	Regulated voltage supplied by the control module.
Signal	The control module input circuit has an internal resistance connected to ground.
Low Reference	Grounded through the control module.

Component	Description
B107 Accelerator Pedal Position Sensor	The sensor is an input to the control module. The input voltage varies depending on the position of the sensor.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

The pedal assembly contains 2 potentiometer-type accelerator pedal position sensors, which are not serviceable. When the accelerator pedal is pressed, the voltages of both sensors goes up. This redundant design enables the ECM to detect if the 2 signals indicate the same accelerator pedal position.

Conditions for Running the DTC

DTC P2122, P2123, P2127, P2128

- DTC P0697, P06A3 = Not set
- Ignition = On or Engine Running
- Ignition Voltage = Greater than 6.4 V

DTC runs continuously when the above conditions are met.

P2138

- DTC P0697, P06A3, P2122, P2123, P2127, P2128 = Not set
- Ignition Voltage = Greater than 6.4 V
- Reduced Engine Power = Inactive

DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

P2122

APP Sensor 1 = Less than 0.46 V - For greater than 175 ms

P2123

APP Sensor 1 = Greater than 4.75 V - For greater than 175 ms

P2127

APP Sensor 2 = Less than 0.33 V - For greater than 175 ms

P2128

APP Sensor 2 = Greater than 2.6 V - For greater than 175 ms

P2138

APP Sensor 1 and 2 = Not within a calibrated range - For greater than 188 ms

Action Taken When the DTC Sets

- DTCs P2122, P2123, P2127, P2128, 2138 are Type A DTCs.
- ECM commands the throttle actuator control (TAC) system to operate in a Reduced Engine Power mode.
- A message and/or warning indicator may be displayed to the driver.
- Under certain conditions, the control module commands the engine Off.

Conditions for Clearing the DTC

DTCs P2122, P2123, P2127, P2128, 2138 are Type A DTCs.

Diagnostic Aids

- A high resistance condition on the component circuits may cause the DTC to set.
- Ensure that the inline harness connector seals are installed correctly. Incorrect installation could result in water intrusion into the connector and may cause a DTC to set.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

Description and Operation

Throttle Actuator Control (TAC) System Description

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 P0697, P06A3 is not set.

- **If any of the DTCs are set**

Refer to DTC P0641, P0651, P0697, or P06A3

- **Go to next step: If none of the DTCs are set**

3. Verify the scan tool parameter:

- APP Sensor 1 Circuit Status = OK
- APP Sensor 2 Circuit Status = OK
- **If not the specified state**

Refer to: Circuit/System Testing

- **Go to next step: If the specified state**

4. Verify the scan tool parameter:

- APP Sensor 1 = 0.8 to 4.5 V - The value should not spike or drop out while moving the sensor through the entire range.
- APP Sensor 2 = 0.4 to 2.5 V - The value should not spike or drop out while moving the sensor through the entire range.
- **If not in the specified range or does not change**

Refer to: Circuit/System Testing

- **Go to next step: If in the specified range and changes**

5. Verify the scan tool parameter: APP Sensor 1 and 2 = Agree

- **If not the specified state**

Refer to: Circuit/System Testing

- **Go to next step: If the specified state**

6. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

7. Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC does not set**

8. 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: B107 Accelerator Pedal Position Sensor

3. Test for less than 5 ohms between the test points:

- {APP Sensor 1} Low Reference circuit terminal 4 & Ground
- {APP Sensor 2} Low Reference circuit terminal 3 & Ground
- **If 5 ohms or greater**

1. Disconnect the electrical connector: K20 Engine Control Module

2. Test for less than 2 ohms between the test points:

- {APP Sensor 1} Low Reference circuit terminal 4 @ Component harness & The other end of the circuit @ Control module harness
- {APP Sensor 2} Low Reference circuit terminal 3 @ Component harness & The other end of the circuit @ Control module harness
- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

- **Go to next step: If less than 5 ohms**

4. Ignition - On / Vehicle - In Service Mode

5. Test for 4.8 to 5.2 V between the test points:

- {APP Sensor 1} 5 V Reference circuit terminal 6 & Low Reference circuit terminal 4
- {APP Sensor 2} 5 V Reference circuit terminal 1 & Low Reference circuit terminal 3
- **If less than 4.8 V**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: K20 Engine Control Module

3. Test for infinite resistance between the test points:

- 5 V Reference circuit terminal 6 @ Component harness & Ground
- 5 V Reference circuit terminal 1 @ Component harness & Ground
- If less than infinite resistance - Repair the short to ground on the circuit.
- Go to next step: If infinite resistance

4. Test for less than 2 ohms between the test points:

- 5 V Reference circuit terminal 6 @ Component harness & The other end of the circuit @ Control module harness
- 5 V Reference circuit terminal 1 @ Component harness & The other end of the circuit @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

• **If greater than 5.2 V**

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: K20 Engine Control Module
3. Ignition - On / Vehicle - In Service Mode
4. Test for less than 1 V between the test points:
 - 5 V Reference circuit terminal 6 @ Component harness & Ground
 - 5 V Reference circuit terminal 1 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module

• **Go to next step: If between 4.8 and 5.2 V**

6. Verify the scan tool parameter:

- APP Sensor 1 = Less than 0.2 V
- APP Sensor 2 = Less than 0.2 V

• **If 0.2 V or greater**

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: K20 Engine Control Module
3. Ignition - On / Vehicle - In Service Mode
4. Test for less than 1 V between the test points:
 - {APP Sensor 1} Signal circuit terminal 5 @ Component harness & Ground
 - {APP Sensor 2} Signal circuit terminal 2 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module

• **Go to next step: If less than 0.2 V**

7. Connect a 3 A fused jumper wire between the test points:

- {APP Sensor 1} Signal circuit terminal 5 & 5 V Reference circuit terminal 6
- {APP Sensor 2} Signal circuit terminal 2 & 5 V Reference circuit terminal 1

8. Verify the scan tool parameter: = Greater than 4.8 V

• **If 4.8 V or less**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
2. Disconnect the electrical connector: K20 Engine Control Module
3. Test for infinite resistance between the test points:
 - {APP Sensor 1} Signal circuit terminal 5 @ Component harness & Ground
 - {APP Sensor 2} Signal circuit terminal 2 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - Go to next step: If infinite resistance
4. Test for less than 2 ohms between the test points:
 - {APP Sensor 1} Signal circuit terminal 5 @ Component harness & The other end of the circuit @ Control module harness
 - {APP Sensor 2} Signal circuit terminal 2 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module

• **Go to next step: If greater than 4.8 V**

9. Test or replace the component: B107 Accelerator Pedal Position Sensor

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- Refer to [ACCELERATOR PEDAL POSITION SENSOR REPLACEMENT](#)
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P2199

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 P2199

Intake Air Temperature (IAT) Sensors 1-2 Not Plausible

Diagnostic Fault Information

IAT Sensor 1

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0112, P0114, P2199	P0111, P0113, P0114, P2199	P0113, P0114, P2199*	P0111, P2199
Low Reference	-	P0111, P0113, P0114, P2199, P2227, P2228, P2229	P0113, P0114, P2199, P2227, P2229*	-
Internal control module or component damage may occur if the circuit shorts to B+.				

IAT Sensor 2

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P0096, P0097, P00F4, P0102, P0178, P2199	P0096, P0097, P00F4, P0101, P0102, P2199, P2230	P0690	P0096, P0101, P0103
Signal	P0096, P0097, P00F5, P2199	P0096, P0097, P00F4, P2199	P0096, P0097, P00F4, P2199*	P0096
Ground	-	P0096, P0097, P00F4, P0102, P2199, P2130	-	P0096, P0102
Internal control module or component damage may occur if the circuit shorts to B+.				

Typical Scan Tool Data

IAT Sensor 1

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine = Idling			
Parameter Normal Range: -39 to 149B°C (-38 to 300B°F)			

Circuit	Short to Ground	Open	Short to Voltage
Signal	150B°C (302B°F)	-40B°C (-40B°F)	-40B°C (-40B°F)
Low Reference	-	-40B°C (-40B°F)	-40B°C (-40B°F)

IAT Sensor 2

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine = Idling Parameter Normal Range: -39 to 149B°C (-38 to 300B°F)			
Signal	150B°C (302B°F)	-40B°C (-40B°F)	-40B°C (-40B°F)
Ground	-	-40B°C (-40B°F)	-40B°C (-40B°F)

Circuit/System Description

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 5 V.
Low Reference	Grounded through the control module.

Component	Description
B75C Multifunction Intake Air Sensor	The assembly has several functions: - The mass air flow sensor is a hot film type sensor that measures the mass of air (not the volume) entering the engine. The signal varies with engine load and is displayed by the scan tool in Hertz (Hz) and grams per second (g/s). - The intake air humidity sensor uses the same signal circuit as the intake air temperature sensor 2. The intake air humidity sensor modulates the pulse width of the signal. The intake air temperature sensor 2 modulates the frequency of the signal. That means the signal is both, PWM and FM modulated. - The barometric pressure sensor generates an analog voltage that is proportional to the ambient air pressure. - The intake air temperature sensor 1 varies its resistance depending on the temperature. - Low temperature produces a high resistance: 1, 166 ohms @ 40B°C (104B°F) - High temperature produces a low resistance: 97 ohms @ 130B°C (266B°F)
K20 Engine Control Module	The control module contains a microprocessor used to process input data to control outputs. The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Conditions for Running the DTC

- DTC 1682 = Not set
- Ignition = On
- Battery Voltage = Greater than 11 V

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

The following parameters are not within 55B°C (99B°F) of each other: - For greater than 5 s

- IAT Sensor 1
- IAT Sensor 2

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

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

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

Special Tools

EL-38522 Variable Signal Generator

Equivalent regional tools: Special Tools (Mechanical Tools)

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC P0097, P0098, P0099, P00F4, P00F5, P00F6, P0102, P0103, P0112, P0113, P0114, P0641, P0651, P0697, P06A3 is not set.

- **If any of the DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle

- **Go to next step: If none of the DTCs are set**

NOTE: To minimize the effects of residual engine heat and heating elements inside the sensor, perform step 3 of this procedure only if the ignition has been Off for longer than 8 h.

3. Verify the following parameters are within 25B°C (45B°F) of each other:

- Start-Up IAT Sensor 1
- Start-Up IAT Sensor 2
- Start-Up ECT
- **If not in the specified range**

Refer to: Circuit/System Testing

- **Go to next step: If in the specified range**

4. Engine - Idling

5. Verify the scan tool parameter: = -39 to 149B°C (-38 to 300B°F) and changes

- IAT Sensor 1
- IAT Sensor 2
- Start-Up ECT
- **If not in the specified range or does not change**

Refer to: Circuit/System Testing

- **Go to next step: If in the specified range and changes**

6. Verify the appropriate scan tool parameter:

- IAT Sensor 1
- IAT Sensor 2
- Wiggle the harness and connector: B75C Multifunction Intake Air Sensor
- Wiggle the harness and connector: K20 Engine Control Module
- **If the value spikes or drops out**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If the value does not spike or drop out**

7. All OK.

Circuit/System Testing

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

1. Verify the following conditions do not exist:

- B75C Multifunction Intake Air Sensor - Contamination of the measuring element/Cracked/Visible Damage/Water intrusion
- Intake Air Duct - Cracked/Incorrect connection/Restricted/Visible Damage
- **If a condition exists**

Repair or replace as necessary

- **Go to next step: If no condition exists**

1. Ignition/Vehicle & All vehicle systems - Off

2. Disconnect the electrical connector: B75C Multifunction Intake Air Sensor

3. Test for less than 5 ohms between the test points: Ground circuit terminal 7 & Ground
 - **If 5 ohms or greater**
4. Disconnect the electrical connector: B75C Multifunction Intake Air Sensor
5. Test for less than 5 ohms between the test points: Low Reference circuit terminal 3 & Ground
 - **If 5 ohms or greater**
 1. Disconnect the appropriate electrical connector: @ K20 Engine Control Module
 2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 3 @ Component harness & The other end of the circuit
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **Go to next step: If less than 5 ohms**
6. Ignition - On / Vehicle - In Service Mode
7. Verify a test lamp turns On between the test points: Ignition circuit terminal 5 & Ground
 - **If the test lamp does not turn On and the circuit fuse is OK**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Test for less than 2 ohms between the test points: Ignition circuit terminal 5 @ Control module harness & Output terminal @ Fuse
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not turn On and the circuit fuse is open**
 1. Ignition/Vehicle - Off
 2. Replace the component: Fuse
 3. Ignition - On / Vehicle - In Service Mode
 4. Verify the fuse does not open.
 - If the fuse opens and there are components connected to the circuit - Disconnect a component and repeat procedure starting at step 5.1
 - If the fuse opens with all components disconnected from the circuit - Repair the short to ground on the circuit.
 - If the fuse does not open after disconnecting a component from the circuit - Replace the component disconnected last.
 - Go to next step: If the fuse does not open with all components connected, except the following component: K20 Engine Control Module
 5. Ignition/Vehicle - Off
 6. Connect the electrical connector: K20 Engine Control Module
 7. Replace the component: Fuse
 8. Ignition - On / Vehicle - In Service Mode
 9. Verify the fuse does not open.
 - If the fuse is open - Replace the component: K20 Engine Control Module
 - Go to next step: If the fuse does not open.

NOTE: It may be necessary to use a scan tool control function to operate a component.

10. Operate the component: Each component on the circuit - One at a time

Verify the fuse does not open when any of the components are activated.

- If the fuse opens - Replace the component that caused the fuse to open when activated.
- Go to next step: If the fuse does not open.

11. All OK.

- **Go to next step: If the test lamp turns On**

8. Verify the scan tool parameter: IAT Sensor 1 = Colder than -39B°C (-38B°F)

- **If -39B°C (-38B°F) or warmer**

1. Ignition/Vehicle - Off

2. Disconnect the appropriate electrical connector: K20 Engine Control Module

3. Test for infinite resistance between the test points: Signal circuit terminal 1 @ Component harness & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- If infinite resistance - Replace the component: K20 Engine Control Module

- **Go to next step: If colder than -39B°C (-38B°F)**

9. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Low Reference circuit terminal 3

10. Verify the scan tool parameter: IAT Sensor 1 = Warmer than 149B°C (300B°F)

- **If 149B°C (300B°F) or colder**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)

2. Disconnect the appropriate electrical connector: K20 Engine Control Module

3. Ignition - On / Vehicle - In Service Mode

4. Test for less than 1 V between the test points: Signal circuit terminal 1 @ Component harness & Ground

- If 1 V or greater - Repair the short to voltage on the circuit.
- Go to next step: If less than 1 V

5. Ignition/Vehicle - Off

6. Test for less than 2 ohms between the test points: Signal circuit terminal 1 @ Component harness & The other end of the circuit @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

- **Go to next step: If warmer than 149B°C (300B°F)**

11. Verify the scan tool parameter: Intake Air Humidity Sensor = Less than 1%

- **If 1% or greater**

1. Ignition/Vehicle - Off

2. Disconnect the appropriate electrical connector: K20 Engine Control Module

3. Test for infinite resistance between the test points: Signal circuit terminal 8 & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.
- If infinite resistance - Replace the component: K20 Engine Control Module

- **Go to next step: If less than 1%**

12. Ignition/Vehicle - Off

13. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 8 @ Component harness & Low Reference circuit terminal 3

14. Ignition - On / Vehicle - In Service Mode

15. Verify the scan tool parameter: Intake Air Humidity Sensor = Greater than 99%

- **If less than 99%**

NOTE: Internal control module or component damage may occur if the circuit shorts to B+.

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)

2. Disconnect the appropriate electrical connector: K20 Engine Control Module
3. Ignition - On / Vehicle - In Service Mode
4. Test for less than 1 V between the test points: Signal circuit terminal 8 & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - Go to next step: If less than 1 V
5. Ignition/Vehicle - Off
6. Test for less than 2 ohms between the test points: Signal circuit terminal 8 & The other end of the circuit
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **If greater than 99%**
16. Test or replace the component: B75C Multifunction Intake Air Sensor

Component Testing

IAT Sensor 1

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: B75C Multifunction Intake Air Sensor
3. Test for 49 to 49, 882 ohms between the test points: Signal terminal 1 & Low Reference terminal 3
 - **If not between 49 and 49, 882 ohms**

Replace the component: B75C Multifunction Intake Air Sensor

 - **Go to next step: If between 49 and 49, 882 ohms**
4. Verify the value is within the range listed in the table: Temperature Versus Resistance - Intake Air Temperature Sensor
 - **If not in the specified range**

Replace the component: B75C Multifunction Intake Air Sensor

 - **Go to next step: If in the specified range**
5. Test for infinite resistance between the test points: Each terminal of the component & The component's housing
 - **If less than infinite resistance**

Replace the component: B75C Multifunction Intake Air Sensor

 - **Go to next step: If infinite resistance**
6. All OK.

IAT Sensor 2

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

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: B75C Multifunction Intake Air Sensor
3. Install the special tool: EL-38522 Variable Signal Generator
 - Black lead @ Ground
 - Battery Cable Clip @ Battery
 - Red lead @ Signal circuit terminal 8

- Set the voltage to 5 V
- Set the frequency to 250 Hz
- Set the duty cycle to 50%

4. Ignition - On / Vehicle - In Service Mode

5. Verify the scan tool parameter:

- IAT Sensor 2 = 248 to 252 Hz
- IAT Sensor 2 = 70 to 76B°C (160 to 166B°F)
- Intake Air Humidity Sensor = 48 to 52%
- **If not in the specified range or does not change**

1. Ignition/Vehicle - Off

2. Disconnect the appropriate electrical connector: @ K20 Engine Control Module

3. Test for less than 2 ohms between the test points: Signal circuit terminal 8 @ B75C Multifunction Intake Air Sensor & Circuit terminal 60 X1 @ K20 Engine Control Module

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

- **Go to next step: If in the specified range and changes**

6. Replace the component: B75C Multifunction Intake Air Sensor

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- Refer to [MASS AIRFLOW SENSOR WITH INTAKE AIR TEMPERATURE SENSOR REPLACEMENT](#) - B75C Multifunction Intake Air Sensor
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P219A OR P219B

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 P219A

Fuel Trim Cylinder Balance Bank 1

DTC P219B

Fuel Trim Cylinder Balance Bank 2

Circuit/System Description

For an overview of the component/system, refer to [Fuel System Description](#)

Conditions for Running the DTC

- DTCs related to the following system/component = Not Set
 - B23 Camshaft Position Sensor
 - B34 Engine Coolant Temperature Sensor

- B52 Heated Oxygen Sensor
- B74 Manifold Absolute Pressure Sensor
- B75C Multifunction Intake Air Sensor
- B150 Fuel Tank Pressure Sensor
- Q12 Evaporative Emission Purge Solenoid Valve
- Q17 Fuel Injector
- Q38 Throttle Body
- Engine Misfire
- Fuel Trim System
- Device controls are not active.
- Engine Coolant Temperature = Warmer than -20B°C (-4B°F)
- Engine Overspeed = Inactive
- Engine Run Time = Greater than 10 min
- Engine Speed = 1, 700 to 4, 279 RPM
- Evaporative Emission (EVAP) Purge System = Inactive
- Fuel Control Loop Status = Closed Loop
- Fuel level = Greater than 10%
- HO2S Heater Resistance Learn Status = Valid
- Ignition Voltage = Greater than 10 V
- MAF Sensor = 0 to 1, 000 g/s

Frequency the DTC runs = Once - Per ignition cycle - After the running conditions are met

Conditions for Setting the DTC

HO2S Data = Greater than a predefined threshold

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type A DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC

Diagnostic Aids

- Inspect for aftermarket devices which may affect the operation of the system.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

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 there are no DTCs set related to the following component/system:

- B23 Camshaft Position Sensor
- B34 Engine Coolant Temperature Sensor
- B52 Heated Oxygen Sensor
- B74 Manifold Absolute Pressure Sensor
- B75C Multifunction Intake Air Sensor
- B150 Fuel Tank Pressure Sensor
- Q12 Evaporative Emission Purge Solenoid Valve
- Q17 Fuel Injector
- Q38 Throttle Body
- Engine Misfire
- Fuel Trim System
- **If a related DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **Go to next step: If a related DTC is not set**

3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify DTC P219A, P219B is not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If no DTC is set**

4. All OK.

[Circuit/System Testing](#)

1. Ignition - On / Vehicle - In Service Mode
2. Verify the scan tool parameter: MAP Sensor = 20 to 48 kPa (2.9 to 7 PSI)

- **If not in the specified range**

Refer to [DTC P0106, P0107, or P0108](#)

- **Go to next step: If in the specified range**

3. Verify the following conditions do not exist:

- Q17 Fuel Injector - Restricted - Refer to [Fuel System Diagnosis](#)

- Q38 Throttle Body - Vacuum leak
- Exhaust System - Cracked/Leaking/Loose Clamps/Missing components/Restricted - Refer to [Symptoms - Engine Exhaust](#)
- Fuel - Contaminated/Poor Quality - Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#)
- Fuel injectors which do not close completely. - Refer to [Fuel Injector Diagnosis](#)
- Ignition System = Malfunction - Refer to [Electronic Ignition System Diagnosis](#)
- Intake Air Duct - Blocked/Collapsed/Loose Clamps/Visible Damage
- MAF Sensor = Contamination of the measuring element
- Mechanical Condition @ Engine - Altered air flow

For example:

- Cylinder Head @ Intake Port or Exhaust Port - Restrictions/Casting Flash
- Intake Manifold - Restrictions/Casting Flash/Vacuum leak
- Intake Valve or Exhaust Valve - Stuck/Leaking
- Lock Pin @ Valve Rocker Switching Arm - Broken/Stuck
- Valve Rocker Switching Arm - Binding or Sticking/Mechanically stuck/Visible Damage/Worn
- Positive Crankcase Ventilation System - Leaking/Restricted - Refer to [Crankcase Ventilation System Inspection/Diagnosis](#)
- Vacuum Hoses - Kinked/Leaking/Incorrect connection
- **If a condition exists - Repair or replace as necessary**
- **Go to next step: If no condition exists**

4. Refer to [Symptoms - Engine Mechanical](#)

Repair Instructions

- Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)
- Perform the special tool function: Fuel Trim Reset

DTC P2227-P2230

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

NOTE: This procedure may also diagnose malfunctions that are not detected by a DTC.

DTC P2227

Barometric Pressure (BARO) Sensor Performance

DTC P2228

Barometric Pressure (BARO) Sensor Circuit Low Voltage

DTC P2229

Barometric Pressure (BARO) Sensor Circuit High Voltage

DTC P2230

Barometric Pressure (BARO) Sensor Circuit Erratic

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0651, P2228	P2227, P2228	P0651, P2227, P2229	P2227
Signal	P2227, P2228	P2227, P2229	P2227, P2229	P2227
Low Reference	-	P0113, P2199, P2227, P2229	-	P2227

Typical Scan Tool Data

BARO

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition - On / Vehicle - In Service Mode & Engine - Off Parameter Normal Range: 56 to 105 kPa (8.1 to 15.2 PSI)			
5 V Reference	0 kPa (0.0 PSI)	0 kPa (0.0 PSI)	127 kPa (18.4 PSI)
Signal	0 kPa (0.0 PSI)	127 kPa (18.4 PSI)	127 kPa (18.4 PSI)
Low Reference	-	127 kPa (18.4 PSI)	-

Circuit/System Description

Circuit	Description
5 V Reference	Regulated voltage supplied by the control module.
Signal	The control module input circuit has an internal resistance connected to 5 V.
Low Reference	Grounded through the control module.

Component	Description
B75C Multifunction Intake Air Sensor	The assembly has several functions: - The mass air flow sensor is a hot film type sensor that measures the mass of air (not the volume) entering the engine. The signal varies with engine load and is displayed by the scan tool in Hertz (Hz) and grams per second (g/s). - The intake air humidity sensor uses the same signal circuit as the intake air temperature sensor 2. The intake air humidity sensor modulates the pulse width of the signal. The intake air temperature sensor 2 modulates the frequency of the signal. That means the signal is both, PWM and FM modulated. - The barometric pressure sensor generates an analog voltage that is proportional to the ambient air pressure. - The intake air temperature sensor 1 varies its resistance depending on the temperature. - Low temperature produces a high resistance: 5.6 kohms @ 0B°C (32B°F)

Component	Description
	High temperature produces a low resistance: 187 ohms @ 100B°C (212B°F)
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Conditions for Running the DTC

P2227Condition 1

- DTC P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0117, P0118, P0119, P0121, P0122, P0123, P0222, P0223, P1516, P2101, P2135, P2228, P2229 = Not set
- Engine Running = For greater than 30 s

Condition 2

- DTC P0106, P0107, P0108, P2228, P2229, P2230, P2610 = Not set
- Ignition = On
- Engine Off = For greater than 6 min

Frequency the DTC runs = Continuously - After the running conditions are met

P2228, P2229

Engine Running = For greater than 30 s

Frequency the DTC runs = Continuously - After the running conditions are met

P2230

- DTC P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0117, P0118, P0119, P0121, P0122, P0123, P0222, P0223, P1516, P2101, P2135, P2228, P2229 = Not set
- Ignition = On

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

P2227Condition 1

BARO & Calculated BARO = Not within 15 kPa (2.2 PSI) of each other.

Condition 2

BARO & Calculated BARO = Not within 20 kPa (3.0 PSI) of each other.

P2228

BARO = Less than 2 V - For greater than 5 s

P2229

BARO = Greater than 4.5 V - For greater than 5 s

P2230

BARO = Signal noisy or erratic - For greater than 5 s

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

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or **Inline Harness Connector End Views - Index** or **Component Connector End Views - Index**

Description and Operation

Engine Control Module Description

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 P0106, P0107, P0108, P0641, P0651, P0697, P06A3 is not set.
 - If any of the DTCs are set

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

- Go to next step: If none of the DTCs are set
3. Determine the current vehicle testing altitude.
 4. Verify the scan tool parameter: MAP Sensor = The value should be within the range listed in the table:
Altitude Versus Barometric Pressure

- **If not in the specified range**

Refer to **DTC P0106, P0107, or P0108**

- **Go to next step: If in the specified range**

5. Verify the scan tool parameter: BARO = The value should be within the range listed in the table:

Altitude Versus Barometric Pressure

- **If not in the specified range**

Refer to: Circuit/System Testing

- **Go to next step: If in the specified range**

6. Verify the scan tool parameter: BARO = The value should not spike or drop out.

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: B75C Multifunction Intake Air Sensor
- Wiggle the harness and connector: K20 Engine Control Module
- If the value spikes or drops out

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If the value does not spike or drop out**

7. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

8. Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

9. 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: B75C Multifunction Intake Air Sensor

3. Test for less than 5 ohms between the test points: Low Reference circuit terminal 3 & Ground

- **If 5 ohms or greater**

1. Disconnect the electrical connector: K20 Engine Control Module

2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 3 @ Component harness & Terminal 63 X2 @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K20 Engine Control Module

- **Go to next step: If less than 5 ohms**

4. Ignition - On / Vehicle - In Service Mode

5. Test for 4.8 to 5.2 V between the test points: 5 V Reference circuit terminal 2 & Low Reference circuit terminal 3

- **If less than 4.8 V**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: K20 Engine Control Module

3. Test for infinite resistance between the test points: 5 V Reference circuit terminal 2 @ Component harness & Ground

- If less than infinite resistance - Repair the short to ground on the circuit.

- Go to next step: If infinite resistance
- 4. Test for less than 2 ohms between the test points: 5 V Reference circuit terminal 2 @ Component harness & Terminal 43 X2 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
- **If greater than 5.2 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: 5 V Reference circuit terminal 2 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module
- **Go to next step: If between 4.8 and 5.2 V**
- 6. Verify the scan tool parameter: BARO = Greater than 4.7 V
 - **If 4.7 V or less**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K20 Engine Control Module
 3. Test for infinite resistance between the test points: Signal circuit terminal 4 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module
 - **Go to next step: If greater than 4.7 V**
- 7. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 4 & Low Reference circuit terminal 3
- 8. Verify the scan tool parameter: BARO = Less than 0.2 V
 - **If 0.2 V or greater**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the electrical connector: K20 Engine Control Module
 3. Ignition - On / Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 4 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - Go to next step: If less than 1 V
 - 5. Ignition/Vehicle - Off
 - 6. Test for less than 2 ohms between the test points: Signal circuit terminal 4 @ Component harness & Terminal 42 X2 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
- **Go to next step: If less than 0.2 V**
- 9. Test or replace the component: B75C Multifunction Intake Air Sensor

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Mass Airflow Sensor with Intake Air Temperature Sensor Replacement](#) - B75C Multifunction Intake Air Sensor

- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P25CA-P25CF

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 P25CA

Intake Camshaft Position Actuator Park Lock Solenoid Valve Control Circuit Bank 1

DTC P25CB

Intake Camshaft Position Actuator Park Lock Solenoid Valve Control Circuit Low Voltage Bank 1

DTC P25CC

Intake Camshaft Position Actuator Park Lock Solenoid Valve Control Circuit High Voltage Bank 1

DTC P25CD

Intake Camshaft Position Actuator Park Lock Solenoid Valve Control Circuit Bank 2

DTC P25CE

Intake Camshaft Position Actuator Park Lock Solenoid Valve Control Circuit High Voltage Bank 2

DTC P25CF

Intake Camshaft Position Actuator Park Lock Solenoid Valve Control Circuit Low Voltage Bank 2

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition - Terminal 1 @ Q84A Camshaft Position Actuator Park Lock Solenoid Valve - Bank 1 Intake	P0458, P25CB, P25CE, P3411, P3435	P0458, P25CB, P25CE, P3411, P3435	P0690	-
Control - Terminal 2 @ Q84A Camshaft Position Actuator Park Lock Solenoid Valve - Bank 1 Intake	P0016, P25CB	P25CA	P25CC	-
Ignition - Terminal 1 @ Q84B Camshaft Position Actuator Park Lock Solenoid Valve - Bank 2 Intake	P0458, P25CB, P25CE, P3411, P3435	P0458, P25CB, P25CE, P3411, P3435	P0690	-
Control - Terminal 2 @ Q84B Camshaft Position Actuator Park Lock Solenoid Valve - Bank 2 Intake	P0018, P25CE	P25CD	P25CF	-

Circuit/System Description

For an overview of the component/system, refer to [Camshaft Actuator System Description](#)

Circuit	Description
Ignition	Supplied from a fuse.
Control	The output circuit is switched to ground to activate the component.

Component	Description
Q84 Camshaft Position Actuator Park Lock Solenoid Valve	A solenoid valve is an electro-mechanically operated valve. The valve is controlled by an electric current through the solenoid.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Conditions for Running the DTC

- Ignition Voltage = Greater than 11 V
- Ignition Switch = Crank/Run/Engine running.
- Q84 Camshaft Position Actuator Park Lock Solenoid Valve = On

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

Control circuit = Commanded state does not match the actual state - For greater than 5 s

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

Engine Controls Wiring Schematics

Connector End View Reference

[Master Electrical Component List](#) , or [Inline Harness Connector End Views - Index](#) or [Component Connector End Views - Index](#)

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

Control Module References

Circuit/System Verification

NOTE: **Verify the engine has the correct oil level and the correct oil pressure before continuing with this diagnostic.**

1. Engine Running
2. Perform the appropriate scan tool control function: Intake Camshaft Position Actuator Park Lock Test - On/Off

Verify the scan tool parameter:

- Intake Camshaft Position Actuator Park Lock Solenoid Valve Control Circuit High Voltage Test Status Bank 1, 2 = OK or Not Run
- Intake Camshaft Position Actuator Park Lock Solenoid Valve Control Circuit Low Voltage Test Status Bank 1, 2 = OK or Not Run
- Intake Camshaft Position Actuator Park Lock Solenoid Valve Control Circuit Open Test Status Bank 1, 2 = OK or Not Run
- **If not the specified state**

Refer to: Circuit/System Testing

- **Go to next step: If the specified state**

3. Perform the appropriate scan tool control function: Intake Camshaft Position Actuator Park Lock Test - Enable/OK

Verify the scan tool parameter:

- Intake Camshaft Position Actuator Park Lock Solenoid Valve Control Circuit High Voltage Test Status Bank 1, 2 = OK or Not Run
- Intake Camshaft Position Actuator Park Lock Solenoid Valve Control Circuit Low Voltage Test Status Bank 1, 2 = OK or Not Run
- Intake Camshaft Position Actuator Park Lock Solenoid Valve Control Circuit Open Test Status Bank 1, 2 = OK or Not Run

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: Q84 Camshaft Position Actuator Park Lock Solenoid Valve
- Wiggle the harness and connector: K20 Engine Control Module
- **If not the specified state**

Repair as necessary - Wiring / Terminal(s) / Electrical Connector(s)

- **Go to next step: If the specified state**

4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

5. All OK.

Circuit/System Testing

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the appropriate electrical connector: Q84 Camshaft Position Actuator Park Lock Solenoid Valve
3. Ignition - On / Vehicle - In Service Mode
4. Verify a test lamp turns On between the test points: Ignition circuit terminal 1/A & Ground
 - **If the test lamp does not turn On and the circuit fuse is OK**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Test for less than 2 ohms between the test points: Ignition circuit terminal 1/A & Output terminal @ Fuse
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not turn On and the circuit fuse is open**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Connect the electrical connector: Q84 Camshaft Position Actuator Park Lock Solenoid Valve
 3. Ignition - On / Vehicle - In Service Mode
 4. Replace the component: Fuse
 5. Verify the fuse does not open.
 - If the fuse opens and there are components connected to the circuit - Disconnect a component and repeat procedure starting at step 4.4
 - If the fuse opens with all components disconnected from the circuit - Repair the short to ground on the circuit.
 - If the fuse does not open after disconnecting a component from the circuit - Replace the component disconnected last.
 - Go to next step: If the fuse does not open with all components connected.
 - 6. Operate each component on the circuit, one at a time. It might be necessary to use scan tool control functions to operate the components.

Verify the fuse does not open when any of the components are activated.

 - If the fuse opens - Replace the component that caused the fuse to open when activated.
 - Go to next step: If the fuse does not open.
7. All OK.
 - **Go to next step: If the test lamp turns On**
5. Verify a test lamp does not turn On between the test points: Control circuit terminal 2/B & B+
 - **If the test lamp turns On**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Disconnect the electrical connector: X3 @ K20 Engine Control Module
 3. Test for infinite resistance between the test points: Control circuit terminal 2/B @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module
 - **Go to next step: If the test lamp does not turn On**
6. Remove - Test Lamp
7. Perform the scan tool control function: Intake Camshaft Position Actuator Park Lock Solenoid Valve Bank 1, 2 - On

Verify the scan tool parameter: Intake Camshaft Position Actuator Park Lock Solenoid Valve Control Circuit High Voltage Test Status Bank 1, 2 = OK

- **If not the specified state**

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: X3 @ K20 Engine Control Module
3. Test for less than 1 V between the test points: Control circuit terminal 2/B @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module

- **Go to next step: If the specified state**

8. Connect a 3 A fused jumper wire between the test points: Control circuit terminal 2/B & Ignition circuit terminal 1/A
9. Perform the scan tool control function: Intake Camshaft Position Actuator Park Lock Solenoid Valve Bank 1, 2 - On

Verify the scan tool parameter: Intake Camshaft Position Actuator Park Lock Solenoid Valve Control Circuit High Voltage Test Status Bank 1, 2 = Malfunction

- **If not the specified state**

1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
2. Disconnect the electrical connector: X3 @ K20 Engine Control Module
3. Test for less than 2 ohms between the test points: Control circuit terminal 2/B @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module

- **Go to next step: If the specified state**

10. Test or replace the component: Q84 Camshaft Position Actuator Park Lock Solenoid Valve

Component Testing

Static Test

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: Q84 Camshaft Position Actuator Park Lock Solenoid Valve
3. Test for 11 to 30 ohms between the test points: Control terminal 2/B & Ignition terminal 1/A
 - **If not between 11 and 30 ohms**

Replace the component: Q84 Camshaft Position Actuator Park Lock Solenoid Valve
 - **Go to next step: If between 11 and 30 ohms**
4. Test for infinite resistance between the test points: Each terminal of the component & The component's housing
 - **If less than infinite resistance**

Replace the component: Q84 Camshaft Position Actuator Park Lock Solenoid Valve
 - **Go to next step: If infinite resistance**
5. All OK.

Dynamic Test

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: Q84 Camshaft Position Actuator Park Lock Solenoid Valve
3. Connect a 3 A fused jumper wire between the test points: Ignition terminal 1/A & 12 V

CAUTION: Complete the testing as quickly as possible in order to prevent overheating and damaging the component.

4. Momentarily connect a jumper wire between the test points: Control terminal 2/B & Ground

Verify the component turns On and Off when connecting and disconnecting the jumper wire: Q84 Camshaft Position Actuator Park Lock Solenoid Valve

- **If the component does not turn On and Off**

Replace the component: Q84 Camshaft Position Actuator Park Lock Solenoid Valve

- **Go to next step: If the component turns On and Off**

5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Camshaft Position Actuator Locating Pin Control Valve Replacement - Bank 1](#)
- [Camshaft Position Actuator Locating Pin Control Valve Replacement - Bank 2](#)
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P2635

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

NOTE: This procedure may also diagnose malfunctions that are not detected by a DTC.

DTC P2635

Fuel Pump Flow Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	P0231	P023F	P0232	P023F, P2635
Low Reference	-	P023F	-	P023F, P2635

Circuit/System Description

For an overview of the component/system, refer to [Fuel System Description](#)

Circuit	Description
Control	The output circuit is switched to 12 V to activate the component.
Low Reference	Grounded through the control module.

Component	Description
A7 Fuel Pump and Level Sensor Assembly	The fuel pump has a DC motor that is controlled by a PWM signal to achieve the desired fuel pressure.
K111 Fuel Pump Driver Control Module	The control module K111 supplies the fuel pump with a PWM signal in order to achieve the desired fuel line pressure.

When the ignition is turned On, the ECM sends a 12 V signal to the control module K111 to enable the fuel pump. If the engine is not started, the control module K111 turns the fuel pump Off after 6 s.

Conditions for Running the DTC

- DTC P018B, P018C, P018D, P0231, P0232, P023F, P0641, P064A, P1255 = Not set
- Fuel Pump Command = On
- Ignition Voltage - 11 to 32 V
- Engine Run Time - Greater than 30 s
- Fuel Level Sensor - Greater than 10%

Conditions for Setting the DTC

The difference between the following parameters is greater than a predefined value:

- Desired Fuel Pressure
- Fuel Pressure

Actions Taken When the DTC Sets

DTC P2635 is a Type B DTC.

Conditions for Clearing the DTC

DTC P2635 is a Type B DTC.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

[Master Electrical Component List](#) , or [Inline Harness Connector End Views - Index](#) or [Component Connector End Views - Index](#)

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 U0074, U18A2 is not set as a history DTC.

- **If DTC U0074, U18A2 is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **Go to next step: If DTC U0074, U18A2 is not set**

3. Verify DTC P018B, P018C, P018D, P0231, P0232, P023F is not set.

- **If DTC P018B, P018C, P018D, P0231, P0232, P023F is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **Go to next step: If DTC P018B, P018C, P018D, P0231, P0232, P023F is not set**

4. Perform the scan tool control function: Fuel Pressure - Increase - 300 kPa (43.5 PSI)

5. Verify the following parameters are within 45 kPa (6.5 PSI) of each other:

- Desired Fuel Pressure
- Fuel Pressure Sensor
- **If not within 45 kPa (6.5 PSI) of each other**

Refer to: Circuit/System Testing

- **Go to next step: If within 45 kPa (6.5 PSI) of each other**

6. Perform the scan tool control function: Fuel Pressure - Increase - 400 kPa (58 PSI)

7. Verify the following parameters are within 60 kPa (8.7 PSI) of each other:

- Desired Fuel Pressure
- Fuel Pressure Sensor
- **If not within 60 kPa (8.7 PSI) of each other**

Refer to: Circuit/System Testing

- **Go to next step: If within 60 kPa (8.7 PSI) of each other**

8. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

9. Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC does not set**

10. All OK.

Circuit/System Testing

NOTE: Do NOT replace the control module if DTC P2635 is set. - K111 Fuel Pump Driver Control Module

1. Verify the correct pressure: [Fuel System Diagnosis](#)

- **If a condition exists**

Replace the appropriate component:

- **Go to next step: If no condition exists**

2. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Fuel Tank Fuel Pump Module Replacement](#) - A7 Fuel Pump and Level Sensor Assembly
- For control module replacement, programming, and setup refer to [Control Module References](#)

DTC P3400, P3409, P3411, P3412, P3433, P3435, OR P3436

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 P3400

Cylinder Deactivation System

DTC P3409

Cylinder 2 Deactivation Solenoid Valve Control Circuit

DTC P3411

Cylinder 2 Deactivation Solenoid Valve Control Circuit Low Voltage

DTC P3412

Cylinder 2 Deactivation Solenoid Valve Control Circuit High Voltage

DTC P3433

Cylinder 5 Deactivation Solenoid Valve Control Circuit

DTC P3435

Cylinder 5 Deactivation Solenoid Valve Control Circuit Low Voltage

DTC P3436

Cylinder 5 Deactivation Solenoid Valve Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition - Terminal 1 @ Q83A Valve Lifter Oil Solenoid Valve - Bank 1	P3435*	P3435*	-	P3400
Control - Terminal 2 @ Q83A Valve Lifter Oil Solenoid Valve - Bank 1	P3435	P3433	P3436	P3400
Ignition - Terminal 1 @ Q83B Valve Lifter Oil Solenoid Valve - Bank 2	P3411*	P3411*	P0690	P3400
Control - Terminal 2 @ Q83B Valve Lifter Oil Solenoid Valve - Bank 2	P3411	P3409	P3412	P3400
*Additional DTCs may set.				

Circuit/System Description

For an overview of the component/system, refer to [Cylinder Deactivation \(Active Fuel Management\) System Description](#)

Circuit	Description
Ignition	Supplied from a fuse.
Control	The output circuit is switched to ground to activate the component.

Component	Description
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.
Q83 Valve Lifter Oil Solenoid Valve	A solenoid valve is an electro-mechanically operated valve. The valve is controlled by an electric current through the solenoid. The solenoid valve controls the oil flow to the appropriate component: Valve Lifter

Conditions for Running the DTC

P3400

- DTCs related to the following system/component = Not Set
 - B26 Crankshaft Position Sensor
 - B34 Engine Coolant Temperature Sensor
 - B74 Manifold Absolute Pressure Sensor
 - B75C Multifunction Intake Air Sensor
 - Q14 Exhaust Gas Recirculation Valve
- Cylinder Deactivation System = Active - For greater than 2 s
- Engine Coolant Temperature = -7 to 129B°C (19 to 264B°F)
- Engine Speed = 400 to 6, 200 RPM
- Intake Air Temperature = -20 to 129B°C (-4 to 264B°F)

Frequency the DTC runs = Continuously - After the running conditions are met

P3409, P3411, P3412, P3433, P3435, P3436

- Engine Speed = Greater than 400 RPM
- Ignition Voltage = Greater than 11 V

Frequency the DTC runs = Continuously - After the running conditions are met

Conditions for Setting the DTC

P3400

MAF Sensor/MAP Sensor = Not within a calibrated range

P3409, P3411, P3412, P3433, P3435, P3436

Commanded state does not match the actual state - For greater than 5 s

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC

Cylinder Deactivation System = Disabled

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

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. Engine - Idling
2. Verify DTC P3400, P3409-P3412, P3433-P3436 is not set.
 - **If any of the DTCs are set**

Refer to: Circuit/System Testing

- **Go to next step: If none of the DTCs are set**

3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC is not set**

4. All OK.

Circuit/System Testing

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the appropriate electrical connector: Q83 Valve Lifter Oil Solenoid Valve
3. Ignition - On / Vehicle - In Service Mode
4. Verify a test lamp turns On between the test points: Ignition circuit terminal 1 & Ground

- **If the test lamp does not turn On and the circuit fuse is OK**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Test for less than 2 ohms between the test points: Ignition circuit terminal 1 & Output terminal @ F47UA Fuse
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not turn On and the circuit fuse is open**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Connect the electrical connector: Q83 Valve Lifter Oil Solenoid Valve
3. Ignition - On / Vehicle - In Service Mode
4. Replace the component: F63UA Fuse
5. Verify the fuse does not open.
 - If the fuse opens and there are components connected to the circuit - Disconnect a component and repeat procedure starting at step 4.4
 - If the fuse opens with all components disconnected from the circuit - Repair the short to ground on the circuit.
 - If the fuse does not open after disconnecting a component from the circuit - Replace the component disconnected last.
 - Go to next step: If the fuse does not open with all components connected.

NOTE: It may be necessary to use a scan tool control function to operate a component.

6. Operate the component: Each component on the circuit - One at a time - Except the following component: Q83 Valve Lifter Oil Solenoid Valve

Verify the fuse does not open when any of the components are activated.

- If the fuse opens - Replace the component that caused the fuse to open when activated.
- Go to next step: If the fuse does not open.

7. Refer to: Component Testing - Dynamic Test

- **Go to next step: If the test lamp turns On**

5. Verify a test lamp does not turn On between the test points: Control circuit terminal 2 & B+

- **If the test lamp turns On**

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Disconnect the appropriate electrical connector: K20 Engine Control Module
3. Test for infinite resistance between the test points: Control circuit terminal 2 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module

- **Go to next step: If the test lamp does not turn On**

6. Remove - Test Lamp

7. Test for 5.6 to 6.2 V between the test points: Control circuit terminal 2 & Ground

- **If 5.6 V or less**

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: K20 Engine Control Module
3. Test for less than 2 ohms between the test points: Control circuit terminal 2 @ Component harness & The other end of the circuit
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module

- **If greater than 6.2 V**

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: K20 Engine Control Module
3. Ignition - On / Vehicle - In Service Mode
4. Test for less than 1 V between the test points: Control circuit terminal 2 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module

- **Go to next step: If between 5.6 and 6.2 V**

8. Perform the following procedure/test: Component Testing - Static Test & Dynamic Test

Verify the procedure/test passes.

- **If the procedure/test does not pass**

Replace the component: Q83 Valve Lifter Oil Solenoid Valve

- **Go to next step: If the procedure/test passes**

9. Replace the component: K20 Engine Control Module

Component Testing

Static Test

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: Q83 Valve Lifter Oil Solenoid Valve
3. Test for 11 to 30 ohms between the test points: Control terminal 2 & Ignition terminal 1
 - **If not between 11 and 30 ohms**

Replace the component: Q83 Valve Lifter Oil Solenoid Valve

- **Go to next step: If between 11 and 30 ohms**

4. Test for infinite resistance between the test points: Each terminal of the component & The component's housing

- **If less than infinite resistance**

Replace the component: Q83 Valve Lifter Oil Solenoid Valve

- **Go to next step: If infinite resistance**

5. All OK.

Dynamic Test

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: Q83 Valve Lifter Oil Solenoid Valve
3. Connect a 3 A fused jumper wire between the test points: Ignition terminal 1 & 12 V

CAUTION: Complete the testing as quickly as possible in order to prevent overheating and damaging the component.

4. Momentarily connect a jumper wire between the test points: Control terminal 2 & Ground

Verify the component turns On and Off when connecting and disconnecting the jumper wire: Q83 Valve Lifter Oil Solenoid Valve

- **If the component does not turn On and Off**

Replace the component: Q83 Valve Lifter Oil Solenoid Valve

- **Go to next step: If the component turns On and Off**

5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Valve Rocker Arm Oil Control Valve Replacement - Bank 1](#) - Q83A Valve Lifter Oil Solenoid Valve - Bank 1
- [Valve Rocker Arm Oil Control Valve Replacement - Bank 2](#) - Q83B Valve Lifter Oil Solenoid Valve - Bank 2
- For control module replacement, programming, and setup refer to [Control Module References](#)

SYMPTOMS - ENGINE CONTROLS

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](#) provide an overview of each diagnostic category.

Symptoms Description

Symptoms covers conditions that are not covered by DTCs. Certain conditions can cause multiple symptoms. These conditions are listed together under Symptoms Testing. Conditions that may only cause specific symptoms are listed separately under Additional Symptoms Testing. Perform the [Symptoms Testing](#) before using the Additional Symptoms Testing.

Symptoms Definition

Backfire

The Fuel ignites in the intake manifold or in the exhaust system, making a loud popping noise.

Cuts Out, Misses

A steady pulsation or jerking that follows engine speed, which is usually more pronounced as the engine load increases. This condition is not normally felt above 1,500 RPM or 48 km/h (30 mph). The exhaust has a steady spitting sound at idle or at low speed.

Detonation/Spark Knock

A mild to severe ping which usually occurs worse while under acceleration. The engine makes sharp metallic knocks that change with throttle opening.

Dieseling, Run-On

The engine continues to run after the key is turned OFF, but runs very rough.

Engine Control Module (ECM) Commanded Reduced Engine Power

The ECM illuminates the Reduced Engine Power lamp and will limit engine power under potential engine/vehicle damaging or emissions related conditions. A DTC may not be set.

Fuel Odor

A noticeable smell of unburned fuel.

Hard Start

The engine cranks OK, but does not start for a long time. The vehicle does eventually run, or may start but immediately stall.

Hesitation, Sag, Stumble

A momentary lack of response as the accelerator is pushed down. This condition can occur at any vehicle speed. This condition is usually more pronounced when first trying to make the vehicle move, as from a stop. This condition may cause the engine to stall in severe conditions.

Lack of Power, Sluggishness, or Sponginess

The engine delivers less than expected power. Little or no increase in vehicle speed when the accelerator pedal is pushed down part way.

Poor Fuel Economy

Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, the fuel economy is noticeably lower than it was on this vehicle at one time, as previously shown by an actual road test.

Rough, Unstable, or Incorrect Idle and Stalling

The engine runs unevenly at idle. If severe, the engine or the vehicle may shake. Engine idle speed may vary. Either condition may be severe enough to stall the engine.

Surges/Chuggles

An engine power variation under steady throttle or cruise. Feels like the vehicle speeds up and slows down with no change in the accelerator pedal position.

Symptoms Verification

Before using the Symptom tables, perform the following inspections:

- Verify the malfunction indicator lamp (MIL) is operating correctly. Use the scan tool to command the lamp ON and OFF.
- Verify there are no DTCs that are stored.
- Verify the scan tool data is within a normal operating range. Refer to [Control Module References](#) for scan tool information.
- Verify the customer concern.
- Perform the Visual/Physical Inspection in this section. The visual/physical inspection is extremely important, and can lead to correcting a condition without additional testing. It may also help reveal the cause of an intermittent condition.

Identifying Intermittent Conditions

Many intermittent conditions occur with harness or connector movement due to engine torque, rough pavement, vibration or physical movements of a component. Refer to the following for a list of issues that may cause an intermittent condition:

- Moisture and water intrusion in connectors, terminals, and components
- Incomplete connector mating
- Poor terminal contact
- High circuit or component resistance - High resistance can include any resistance, regardless of the amount, which can interrupt the operation of the component.
- Harness that is too short or tight
- Wire insulation that is chaffed or cut
- High or low ambient temperature
- High or low engine coolant temperatures
- High underhood temperatures
- Heat build up in component or circuit due to circuit resistance, poor terminal contact, or high electrical load
- High or low system voltage
- High vehicle load conditions
- Rough road surfaces
- Electro-magnetic interference (EMI)/circuit interference from relays, solenoids or other electrical surge
- Incorrect installation of aftermarket, add on accessories

Visual/Physical Check

- Verify the control module grounds are clean, tight, and correctly located.
- Verify the vacuum hoses are not split or kinked, and are properly connected.
- Verify the air filter is clean and free from restrictions.
- Verify there is no water intrusion in connectors terminals and components.
- Inspect the air intake ducts for the conditions listed below:
 - Collapsed
 - Damaged areas
 - Looseness
 - Incorrect installation
 - Leaking

If any condition listed above has allowed non-metered air to enter the air induction system, the [Throttle Body Idle Air Flow Compensation Reset](#) procedure must be performed after the repair is complete.

- Inspect for air leaks at the throttle body mounting area, the mass air flow (MAF) sensor and intake manifold sealing surfaces.
- Inspect the wiring harness for the following conditions:
 - Poor connections
 - Pinches
 - Cuts
- Inspect for loose, damaged, unseated, or missing sensors/components.
- Inspect the terminals for corrosion and correct contact.

Symptoms Testing

Backfire, Cuts Out/Misses, Detonation/Spark Knock, Dieseling/Run-On, Engine Control Module (ECM) Commanded Reduced Engine Power, Hard Start, Hesitation/Sag/Stumble, Lack of Power/Sluggishness/Sponginess, Poor Fuel Economy, Rough, Unstable, or Incorrect Idle and Stalling, or Surges/Chuggles

- Test the fuel system for the following:
 - Incorrect system operation or fuel pressure - Refer to [Fuel System Diagnosis](#) .
 - Leaking or incorrectly operating fuel injectors - Refer to [Fuel Injector Diagnosis](#) .
 - Contaminated or poor quality fuel - Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#) .
- Test the ignition system for the following:
 - Spark plugs with incorrect heat range or an abnormal condition - Refer to [Ignition System Specifications](#) .
 - Coolant or oil fouled spark plugs - For diagnosis, refer to [Coolant in Combustion Chamber](#) , or [Oil Consumption Diagnosis](#) .
 - Secondary ignition system susceptible to moisture. Engine running, wet down the secondary ignition system with water from a spray bottle to help locate damaged or deteriorated components. Look/listen for arcing or misfiring as the water is applied.
 - Weak spark using the J-26792 Spark Tester - Refer to [Electronic Ignition System Diagnosis](#) .
- Inspect for the following conditions:
 - Non-metered air flow into the air induction system. If a leak is found, repair as necessary. The [Throttle Body Idle Air Flow Compensation Reset](#) procedure must be performed when the repair is complete.
 - Incorrectly operating transmission torque converter clutch (TCC) - The scan tool should indicate an engine speed drop when the TCC is commanded ON. Refer to [Torque Converter Diagnosis](#) .
 - Incorrectly operating A/C compressor.
 - An engine that runs lean or rich. Observe the Fuel Trim parameters with a scan tool - Refer to [DTC P0171 or P0172](#) for more information.
 - Slow responding heated oxygen sensors (HO2S) - The HO2S should respond quickly to different throttle positions - Refer to [DTC P013A-P013F, P014A, P014B, P015A-P015D, or P2270-P2273](#) for more information.

CAUTION: Refer to [Heated Oxygen and Oxygen Sensor Caution](#) .

- Water intrusion in the HO2S connector

NOTE: The embossed arrows on the mass air flow (MAF) sensor indicate the direction of the intake air flow. The arrows must point toward the engine.

- Incorrect mass air flow sensor installation. A mass air flow sensor that is incorrectly installed may cause a hard start. Install the mass air flow in the proper direction. Refer to [Mass Airflow Sensor](#)

with Intake Air Temperature Sensor Replacement .

- Incorrect mass air flow sensor connections.
- Engine oil contaminated by fuel
- Split or kinked vacuum hoses - Verify that the routing and connections are correct.
- Excessive knock sensor system spark retard activity - Observe the Knock Retard parameter on the scan tool for activity more than 0B°.
- Electromagnetic interference (EMI) on the reference circuit, which can cause a misfire condition. You can usually detect electromagnetic interference with a scan tool by monitoring the engine speed parameter. A sudden increase in the engine speed parameter with little change in actual engine speed indicates that electromagnetic interference is present. Inspect the high voltage components near the ignition control circuit if a condition exists.
- A crankshaft position sensor with an intermittent condition - Observe the scan tool Crankshaft Position Resync Counter parameter. The Resync Counter parameter should not increment during all operating conditions, and when moving the related harnesses and connectors between the crankshaft position sensor and the ECM.
- A stuck open evaporative emission (EVAP) canister purge solenoid.
- Incorrectly operating crankcase ventilation valve - Refer to [Crankcase Ventilation System Inspection/Diagnosis](#) .
- Inspect the engine cooling system for the following conditions:
 - A thermostat with incorrect heat range. Refer to [Thermostat Diagnosis](#) .
 - Incorrect engine coolant level - If the level is low, refer to [Loss of Coolant](#) .

For more information, refer to [Symptoms - Engine Cooling](#) .

- Inspect the exhaust system components for the following conditions:
 - Physical damage or possible internal failure
 - Restricted three-way catalytic converters

For more information, refer to [Symptoms - Engine Exhaust](#) .

- Inspect the engine for the following mechanical conditions:

Refer to [Symptoms - Engine Mechanical](#) .

- Excessive oil in the combustion chamber or leaking valve seals
- Oil consumption
- Incorrect cylinder compression
- Sticking or leaking valves
- Worn camshaft lobes
- Incorrect valve timing
- Worn rocker arms
- Broken valve springs
- Excessive carbon buildup in the combustion chambers - Clean the chambers with Top Engine Cleaner, if necessary. Follow the instructions on the can.
- Incorrect engine parts
- If the above conditions do not address the symptom, refer to the [Additional Symptoms Tests](#).

[Additional Symptoms Tests](#)

Detonation/Spark Knock

- Verify that the engine coolant temperature (ECT) has not shifted in value. Allow the engine to run and reach operating temperature. Observe the ECT Sensor parameter with a scan tool and compare the reading to that parameter listed on the [K20 Engine Control Module: Scan Tool Information \(LCV and LGZ\)](#) , or [K20 Engine Control Module: Scan Tool Information \(LWN\)](#) , list. If the reading is not in the range specified in the list, test the resistance of the ECT sensor. Refer to [Temperature Versus Resistance - Engine Coolant Temperature Sensor](#) , for resistance specifications. Replace the ECT sensor if the resistance is not within specification. Refer to [Engine Coolant Temperature Sensor Replacement](#) . If the sensor is within the specification, test the ECT sensor circuits for high resistance.
- Test for an engine overheating condition. Refer to [Engine Overheating](#) .
- Inspect for excessive carbon buildup in the combustion chambers. Clean the chambers with Top Engine Cleaner, if necessary. Follow the instructions on the can.
- If there are no engine mechanical faults, fill the fuel tank with a known high quality fuel that meets the vehicle minimum octane requirements.

ECM Commanded Reduced Engine Power

Under certain conditions the engine control module may limit engine power by reducing engine torque and, for some vehicles, fuel pressure as well. For most, but not all of the conditions, the engine control module will illuminate the reduced engine power lamp on the instrument panel cluster, however a DTC may not be set.

A repair may not be necessary. Observe the scan tool Reduced Engine Power History parameter, if applicable, or refer to [K20 Engine Control Module: Scan Tool Information \(LCV and LGZ\)](#) , or [K20 Engine Control Module: Scan Tool Information \(LWN\)](#) to determine the reason for the reduced engine power event.

Verify or inspect for the following:

- Vehicle being operated at sustained high engine speeds, or, towing heavy loads up an incline for an extended period of time, which may cause the engine oil or coolant to overheat. Inspect the airflow passageways in front of the engine for obstructions and clear away any debris or foreign material that is found. If no obstructions are found, review approved driving habits with the customer. The customer may need to operate the vehicle at a higher engine speed to improve cooling system performance, or, at a slower engine speed to reduce engine load.
- A cooling fan condition which may cause the engine control module to reduce engine power. Refer to [Cooling Fan Description and Operation \(with LWN\)](#) , or [Cooling Fan Description and Operation \(with LCV, LGZ\)](#) , or [Cooling System Description and Operation \(LGZ, LWN\)](#) , or [Cooling System Description and Operation \(LCV\)](#) to verify correct operation of the cooling fan.
- Temporarily reduced engine power. Under extremely cold ambient temperatures some SIDI equipped vehicles may experience ECM commanded reduced engine power for a few minutes during engine warm-up. This would be a normal condition, noticeable only at wide open throttle, and the reduced engine power lamp would not be illuminated.
- Reduced engine power due to OnStarB® remote command. Verify the vehicle is not in the OnStarB® initiated Stolen Vehicle Slowdown mode.
- High pressure fuel system condition. Refer to [Fuel System Diagnosis](#) , or [Fuel System Description](#) to verify high pressure fuel system operation.
- Intake air temperature out of range too high. Observe the scan tool IAT Sensor 1 and IAT Sensor 2 parameters. The readings should be within 9B°C (16B°F) of a each other.
- Fuel temperature out of range too high. Observe the scan tool Fuel Temperature Sensor parameter.
- If equipped with automatic transmission, an incorrect learned brake pedal position (BPP) sensor. Verify the following actions have not occurred:
 - An engine control module has been replaced
 - A BPP sensor has been replaced
 - A BPP sensor is misaligned or incorrectly installed

If any of the above actions have occurred, the [Brake Pedal Position Sensor Calibration](#) procedure must be performed.

Fuel Odor

- Inspect for leaking, damaged, or deteriorated fuel lines.
- Inspect for a saturated EVAP canister - Refer to [Evaporative Emission Control System Description](#) .
- Inspect for a condition with the internal components of the fuel tank assembly - Refer to [Fuel System Description](#) .

Hard Start

- Observe the Throttle Body Idle Airflow Compensation parameter with a scan tool. A value greater than 90 % may indicate an excessive accumulation of deposits in the throttle bore. Inspect the throttle body and clean, if necessary.
- Test the engine coolant temperature (ECT) sensor. Compare the ECT sensor value to the intake air temperature (IAT) sensor value on a cold engine. The ECT and IAT sensor values should be within $B \pm 3B^{\circ}C$ ($5B^{\circ}F$). If the engine coolant temperature sensor is out of range with the intake air temperature sensor, test the resistance of the engine coolant temperature sensor. Refer to [Temperature Versus Resistance - Engine Coolant Temperature Sensor](#) , for resistance specifications. Replace the engine coolant temperature sensor if the resistance is not within specification. Refer to [Engine Coolant Temperature Sensor Replacement](#) . If the sensor is within the specification, test the engine coolant temperature sensor circuits for high resistance.
- Verify that the fuel system has adequate pressure for engine start-up. The fuel pump control module should command the fuel pump ON for 2 s when the ignition is turned ON. Refer to [Fuel System Description](#) , or [Fuel System Diagnosis](#) .
- Inspect for excessive crankshaft endplay that will cause the crankshaft position sensor reluctor wheel to move out of alignment with the crankshaft position sensor. Refer to [Crankshaft and Bearing Cleaning and Inspection](#) , or [Engine Mechanical Specifications](#) .

Hesitation, Sag, Stumble

- Test the fuel pressure. Refer to [Fuel System Diagnosis](#) .
- Inspect the mass air flow (MAF) sensor for obstruction, contamination, and damage. Refer to [Mass Airflow Sensor with Intake Air Temperature Sensor Replacement](#) .
- Test the generator. Refer to [Symptoms - Engine Electrical](#) . Repair the charging system if the generator output voltage is less than 9 V or more than 16 V.
- Test the manifold absolute pressure (MAP) sensor. Refer to [DTC P0106, P0107, or P0108](#) .
- Inspect for excessive crankshaft endplay that will cause the crankshaft position sensor reluctor wheel to move out of alignment with the crankshaft position sensor. Refer to [Crankshaft and Bearing Cleaning and Inspection](#) , or [Engine Mechanical Specifications](#) .

NOTE: The following actions may need to be repeated in order to verify an intermittent intake or exhaust camshaft actuator condition.

- Engine warm and idling, verify the correct operation of the camshaft actuator system. Command the intake and exhaust camshaft actuators from 0 degrees to 20 degrees and back to zero while observing the scan tool Intake Camshaft Position Variance and Exhaust Camshaft Position Variance parameters. Each parameter should be less than 2 degrees in each of the commanded states.
 - If any of the parameters is greater than 2 degrees, inspect the suspect camshaft actuator and camshaft actuator solenoid valve and valve bore for contamination, obstruction, and damage. Refer to [Camshaft Position Actuator Exhaust Solenoid Valve Replacement](#) , or [Camshaft Position Actuator Intake Solenoid Valve Replacement](#) , or [Camshaft Actuator System Description](#) .

Poor Fuel Economy

- Observe the Throttle Body Idle Airflow Compensation parameter with a scan tool. A value greater than 90 % may indicate an excessive accumulation of deposits in the throttle bore. Inspect the throttle body and clean, if necessary.
- Inspect for heavy loads being carried or towed
- Inspect for acceleration rate too much or too often
- Inspect for incorrect operation of the speedometer.
- Verify that the engine coolant temperature (ECT) has not shifted in value. Allow the engine to run and reach operating temperature. Observe the ECT Sensor parameter with a scan tool and compare the reading to that parameter listed on the [K20 Engine Control Module: Scan Tool Information \(LCV and LGZ\)](#) , or [K20 Engine Control Module: Scan Tool Information \(LWN\)](#) , list. If the reading is not in the range specified in the list, test the resistance of the engine coolant temperature sensor. Refer to [Temperature Versus Resistance - Engine Coolant Temperature Sensor](#) , for resistance specifications. Replace the engine coolant temperature sensor if the resistance is not within specification. Refer to [Engine Coolant Temperature Sensor Replacement](#) . If the sensor is within the specification, test the engine coolant temperature sensor circuits for high resistance.
- Inspect the mass air flow (MAF) sensor for obstruction, contamination, and damage. Refer to [Mass Airflow Sensor with Intake Air Temperature Sensor Replacement](#) .
- Inspect the brake system for brake drag.

Rough, Unstable, or Incorrect Idle and Stalling

- An excessively high idle may be due to the floor mat interfering with the accelerator pedal. With this condition present, it may not be possible to shift the transmission into gear. Inspect the accelerator pedal for binding and verify that the floor mat is not interfering with the accelerator pedal movement.
- Engine idle speed be unstable or the engine may stall if the ECM has learned an incorrect idle/airflow compensation value. A DTC may also set. Observe the scan tool Throttle Body Idle Airflow Compensation parameter. A value greater than 90 % may indicate an excessive accumulation of deposits in the throttle bore. If the throttle body needs cleaning, refer to [Throttle Body Inspection and Cleaning](#) .

The actions listed below may also cause the ECM to learn an incorrect idle value:

- The engine control module (ECM) has been replaced
- The throttle body has been replaced
- The throttle body has been cleaned but the idle learn procedure was not performed after completing the cleaning
- The air induction system was leaking, allowing non-metered air to enter the combustion chamber. The leak was repaired, but the idle learn procedure was not performed after repairing the leak.

If any of the actions listed above have occurred, the [Throttle Body Idle Air Flow Compensation Reset](#) procedure must be performed.

- Inspect the mass air flow (MAF) sensor for obstruction, contamination, and damage. Refer to [Mass Airflow Sensor with Intake Air Temperature Sensor Replacement](#) .
- Inspect the engine mounts. Refer to [Engine Mount Inspection](#) .
- Inspect the intake and exhaust manifolds for casting flash.

Surges/Chuggles

- Verify that each injector harness is connected to the correct injector.
- Inspect the mass air flow (MAF) sensor for obstruction, contamination, and damage. Refer to [Mass Airflow Sensor with Intake Air Temperature Sensor Replacement](#) .
- Inspect for slow responding heated oxygen sensors (HO2S). The HO2S should respond quickly to a change in throttle position. If the HO2S do not respond to different throttle positions, inspect for

contamination from fuel, silicon, or the incorrect use of RTV sealant. The sensors may have a white powdery coating and result in a high, but false, signal voltage, which gives a rich exhaust indication. The PCM reduces the amount of fuel delivered to the engine, causing a driveability condition. Refer to [DTC P013A-P013E, P014A, P014B, P015A-P015D, or P2270-P2273](#) for more information.

POOR FUEL FILL QUALITY

Problem	Causes
DEFINITION: During the fueling process a continual, occasional, or no-fuel nozzle shut-off condition has occurred.	
Difficult to fill	• Fill limit vent valve (FLVV) stuck closed - Located in and serviced by the fuel tank or fuel pump module. • Evaporative emission (EVAP) canister restricted • EVAP vent valve stuck closed • Hose between canister and canister vent solenoid twisted or kinked if applicable • High fuel temperature • Fuel filler hose is kinked • Faulty dispensing nozzle • Ignition switch ON, vent valve closed
Over fill	• Fill limit vent valve (FLVV) stuck open or leaking - Located in and serviced by the fuel tank or fuel pump module. • Fuel inlet check valve stuck open
Pre-mature shut-off of the fuel dispensing nozzle occurs immediately after engaging dispensing nozzle, tank empty	• Restricted vapor lines or fuel fill pipe • High fuel temperature • Inlet check valve at tank stuck closed, fill pipe full of fuel • Fuel tank full, gauge not accurate
Pre-mature shut-off of the fuel dispensing nozzle, more than 1/8 of tank capacity dispensed	• Kinked, pinched or plugged lines in fuel tank vent system • EVAP vent valve stuck closed or restricted • EVAP canister restricted • Fill limit vent valve (FLVV) stuck closed or obstruction at top of fuel tank - Located in and serviced by the fuel tank or fuel pump module.
Fuel Spitback	• Restricted EVAP canister • High fuel temperature • Ignition switch ON, EVAP vent valve closed

ENGINE CRANKS BUT DOES NOT RUN

Diagnostic Instructions

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

Circuit/System Description

The engine cranks but does not run is an organized approach to identify a condition which causes the engine to crank but not start. This diagnostic directs the technician to the appropriate system diagnosis.

Diagnostic Aids

Inspect for any of the conditions listed below:

- If equipped with a key type ignition system, a partially retracted or folded over ignition key. When attempting to start the engine, the mechanical portion of the vehicle key must be locked in the fully extended position with the fob parallel to the key. Leaving the key partially retracted or folded over when starting may interrupt transponder authentication and result in an intermittent no-start condition. In such instances, DTC B3055 may also be set. If an intermittent no-start complaint is received, it may be necessary to discuss with the customer their starting habits and verify they are locking the key in the fully extended position, fob parallel to the key, before starting.
- A crankshaft position sensor condition. Check the crankshaft position sensor engine reference signal with a scan tool. Observe the Engine Speed parameter while cranking the engine. The scan tool should indicate a steady 200 - 300 RPM while cranking. If erratic values, such as sudden spikes in the engine speed, are displayed, the engine reference signal is not stable enough for the engine to start and run properly.
- Insufficient fuel. Thoroughly inspect the fuel delivery system for sufficient fuel volume to the fuel injectors. Inspect the fuel supply components for partial blockage or restrictions.
- Fuel injectors with partially blocked and restricted nozzles, or a malfunctioning solenoid. Refer to [Fuel Injector Diagnosis](#) for diagnosis.
- Fuel injector ON time inadequate. When this condition is present, there may be fuel spray at the fuel injectors and the indicated fuel pressure may be correct, yet there may not be enough fuel to start the engine. If the engine control module (ECM) receives incorrect inputs from the various information sensors, the fuel delivered by the fuel injectors may be inadequate to start the engine. Check all the engine data parameters with a scan tool and compare the values indicated with the expected values or the values from a known good vehicle.
- Loose unsecured engine electrical grounds. Inspect the engine for good secure electrical grounds.
- Water or foreign material in the fuel, which can cause either a no start or a engine will not stay running condition. During freezing weather water can freeze inside the fuel system. The engine may start after 30 min in a heated repair shop. The malfunction may not recur until parked overnight in freezing temperatures. Extreme weather conditions can cause contaminated fuel to prevent the vehicle from starting.
- An ignition system that is susceptible to moisture. If the engine starts and runs after being brought into a warm, dry repair shop, the ignition system may be susceptible to moisture. Spray water on the ignition system components and wiring while cranking the engine in order to check for an engine starting or will not stay running concern.
- If the engine almost starts and then stalls, check for an open in the ground circuits of the crankshaft position sensor and the camshaft position sensor - Intake or camshaft position sensor - Exhaust.

Reference Information

Schematic Reference

[Engine Controls Wiring Schematics](#)

Connector End View Reference

[Master Electrical Component List](#) , or [Inline Harness Connector End Views - Index](#) or [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](#) for scan tool information

Special Tools

- **EL 26792** HEI Spark Tester

For equivalent regional tools, refer to [Special Tools \(Mechanical Tools\)](#).

Circuit/System Verification

NOTE: This diagnostic assumes the following:

- The battery is completely charged.
- The engine cranking speed is acceptable.
- There is adequate fuel in the fuel tank.

Circuit/System Testing

1. Crank the engine for up to 15 s.
2. Verify that DTC P0117, P0118, P0122, P0123, P0222, P0223, P0335, P0336, P0513, P0562, P0563, P0601, P0602, P0603, P0604, P0606, P062F, P0633, P0641, P0651, P0685, P0689, P0690, P0697, P06A3, P06D2, P1516, P1631, P1682, P16F3, P2101, P2119, or P2610 is not set.

- **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

- **Go to next step: If none of the DTCs are set**

3. Ignition ON.
4. Verify the security indicator on the instrument cluster illuminates momentarily.
 - **If the indicator stays ON or is flashing**

Review the [Diagnostic Trouble Code \(DTC\) List - Vehicle](#), for Immobilizer system DTCs. For additional information, refer to [Immobilizer Description and Operation](#).

- **Go to next step: If the indicator does not stay ON and is not flashing**

5. Verify the scan tool Engine Speed parameter displays greater than 0 RPM while cranking the engine.
 - **If 0 RPM**

Refer to [DTC P0335 or P0336](#).

- **Go to next step: If greater than 0 RPM**

6. Connect the **EL 26792** HEI Spark Tester between the boot of a spark plug wire and ground.

NOTE: An erratic or weak spark is considered a no spark condition.

7. Verify the spark tester sparks while cranking the engine.
 - **If the spark tester does not spark**

Refer to [Electronic Ignition System Diagnosis](#).

- **Go to next step: If the spark tester sparks**

8. Ignition ON.

NOTE:

- If the engine is too hot, high fuel pressure readings may result due to hot soak fuel boiling. Allow the engine coolant temperature to cool to less than 60B° C (150B° F) before attempting to verify fuel pressure.
- The Fuel Pump Enable may need to be commanded On a few times in order to obtain the highest possible fuel pressure.
- Additional DTCs may set when using the fuel pump output control.

9. Command the Fuel Pump Enable On several times with a scan tool.

10. Verify the scan tool Fuel Pressure Sensor parameter is between 345 - 650 kPa (50 - 94 PSI) with the fuel pump running.

- **If not within the specified range**

Refer to [Fuel System Diagnosis](#).

- **Go to next step: If within the specified range**

11. Verify the scan tool Fuel Pressure Sensor parameter, after the fuel pump has turned OFF, decreases to less than 600 kPa (87 PSI) and does not decrease greater than 34 kPa (5 PSI) in 1 minute.

- **If not within the specified range**

Refer to [Fuel System Diagnosis](#).

- **Go to next step: If within the specified range**

12. Verify the conditions listed below do not exist:

- Collapsed air intake duct to the throttle body
- Air filter and air intake system for restrictions and obstructions
- Spark plugs for being gas or coolant fouled
- A skewed manifold absolute pressure (MAP) sensor
- A skewed engine coolant temperature (ECT) sensor
- Test the exhaust system for restrictions. Refer to [Restricted Exhaust](#) .
- Test the fuel for contamination. Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#).
- Engine mechanical condition, for example, worn timing belt or low compression. Refer to [Symptoms - Engine Mechanical](#) .

- **If a condition exists**

Repair as necessary.

- **Go to next step: If no conditions exist**

13. All OK.

Repair Verification

Perform the [Diagnostic Repair Verification](#) after completing the repair.

FUEL SYSTEM DIAGNOSIS

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

For an overview of the component/system, refer to [Fuel System Description](#)

Component	Description
G12 Fuel Pump	The fuel pump has a DC motor that is controlled by a PWM signal to achieve the desired fuel pressure.
K111 Fuel Pump Driver Control Module	The control module K111 supplies the fuel pump with a PWM signal in order to achieve the desired fuel line pressure.
Q17 Fuel Injector	Fuel injectors are solenoid valves that inject fuel either into the intake system or directly into the cylinder. The amount of fuel injected depends on the length of the electrical pulse that is applied. The fuel injectors of this system have an operating voltage of 12 V.
Q18 Fuel Pressure Regulator	Q18 is part of the component: G18 High Pressure Fuel Pump The fuel pressure regulator is a diaphragm relief valve. The diaphragm has fuel pressure on one side and regulator spring pressure on the other side. The fuel pressure regulator maintains the correct fuel pressure to the fuel injection system. The fuel pressure regulator delivers the needed fuel to the fuel rail. The unused fuel drops back into the reservoir of the fuel tank fuel pump module. The fuel pressure regulator is not vacuum biased. The fuel pressure regulator maintains fuel pressure in the fuel feed pipe and the fuel rail in order to prevent long cranking times.
Fuel Pump Check Valve	The one-way check valve is part of the component: G12 Fuel Pump The check valve maintains pressure in the fuel feed pipe and the fuel rail in order to prevent long cranking times.

Reference Information

Schematic Reference

[Engine Controls Wiring Schematics](#)

Connector End View Reference

[Master Electrical Component List](#) , or [Inline Harness Connector End Views - Index](#) or [Component Connector End Views - Index](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Connector Repairs](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#)

Special Tools

- CH-41769 Fuel Line Quick Disconnect Tool

- EN-37287 Fuel Line Shut-Off Adapter

Equivalent regional tools: Refer to [Special Tools \(Mechanical Tools\)](#)

Circuit/System Verification

NOTE:

- **Repair all fuel system related DTCs, except P2635, before performing this diagnostic.**
- **Inspect the fuel system for damage or external leaks before proceeding.**
- **Verify the fuel tank is not empty before proceeding.**
- **The fuel pump may need to be commanded On a few times in order to obtain the highest possible fuel pressure.**
- **Do NOT perform the [Fuel System Diagnosis](#) if the engine coolant temperature is above 60B°C (150B°F). High fuel pressure readings may result due to hot soak fuel boiling. With the engine Off, the fuel pressure may increase beyond the pressure relief regulator valve's setting point of 690 kPa (100 PSI) B± 5%.**

1. Ignition - On / Vehicle - In Service Mode & Engine - Off

2. Perform the scan tool control function: Fuel Pump Enable - On - Command the function On several times.

Verify the scan tool parameter: Fuel Pressure Sensor = 345 to 650 kPa (50 to 94 PSI) - While the fuel pump is running.

- **If less than 345 kPa (50 PSI)**

Refer to: Circuit/System Testing - Fuel Pressure Low

- **If greater than 650 kPa (94 PSI)**

Test or replace the component: G12 Fuel Pump

- **Go to next step: If between 345 and 650 kPa (50 and 94 PSI)**

3. Verify the scan tool parameter: Fuel Pressure Sensor = Pressure should decrease to less than 600 kPa (87 PSI) after the fuel pump is turned Off.

- **If greater than 600 kPa (87 PSI)**

Test or replace the component: G12 Fuel Pump

- **Go to next step: If less than 600 kPa (87 PSI)**

4. Verify the scan tool parameter: Fuel Pressure Sensor = Pressure drops less than 34 kPa (5 PSI) within 1 min.

- **If the pressure drops 34 kPa (5 PSI) or greater**

Refer to: Circuit/System Testing - Fuel Pressure Leaks Down

- **Go to next step: If the pressure drops less than 34 kPa (5 PSI)**

5. Ignition On - Engine Running

6. Verify the scan tool parameter: Fuel Pressure Sensor = 300 to 400 kPa (43 to 58 PSI)

- **If less than 300 kPa (43 PSI)**

Refer to: Circuit/System Testing - Fuel Pressure Low

- **If greater than 400 kPa (58 PSI)**

Test or replace the component: G12 Fuel Pump

- **Go to next step: If between 300 and 400 kPa (43 and 58 PSI)**

7. Verify the scan tool parameter: Short Term Fuel Pump Trim & Long Term Fuel Pump Trim = The product should be less than 1.5 when both parameters are multiplied together.

- **If 1.5 or greater**

Refer to: Circuit/System Testing - Fuel Pressure Low

- **Go to next step: If less than 1.5**

8. Perform the scan tool control function: Fuel Pressure - Increase - 300 kPa (43.5 PSI)

The pressure should not drop off during acceleration, cruise or hard cornering.

9. Verify the following parameters are within 45 kPa (6.5 PSI) of each other:

- Desired Fuel Pressure
- Fuel Pressure Sensor
- **If greater than 45 kPa (6.5 PSI)**

Refer to: Circuit/System Testing - Fuel Pressure Drops Off

- **Go to next step: If less than 45 kPa (6.5 PSI)**

10. Perform the scan tool control function: Fuel Pressure - Increase - 400 kPa (58 PSI)

The pressure should not drop off during acceleration, cruise or hard cornering.

11. Verify the following parameters are within 60 kPa (8.7 PSI) of each other:

- Desired Fuel Pressure
- Fuel Pressure Sensor
- **If greater than 60 kPa (8.7 PSI)**

Refer to: Circuit/System Testing - Fuel Pressure Drops Off

- **Go to next step: If less than 60 kPa (8.7 PSI)**

12. Perform the following procedure/test: **Fuel Injector Diagnosis**

Verify the procedure/test passes.

- **If the procedure/test does not pass**

Replace the component that failed the test: Q17 Fuel Injector

- **Go to next step: If the procedure/test passes**

13. Refer to **Symptoms - Engine Controls**

Circuit/System Testing

Fuel Pressure Low

1. Verify the following conditions do not exist:

- Poor component electrical connections: Fuel Pump - Chassis Ground
- Poor component electrical connections: Fuel Pump - Electrical Connector
- Fuel Feed Pipe - Leaking / Restricted / Visible Damage
- **If a condition exists**

Repair as necessary

- **Go to next step: If no conditions exist**

2. Test or replace the component: G12 Fuel Pump

Fuel Pressure Leaks Down

1. Ignition/Vehicle - Off
2. Relieve the fuel system pressure. - Refer to [Fuel Pressure Relief](#)
3. Install the special tool: EN-37287 Fuel Line Shut-Off Adapter @ Fuel Feed Pipe
4. Open the valve on the tool: EN-37287 Fuel Line Shut-Off Adapter
5. Ignition - On / Vehicle - In Service Mode & Engine - Off
6. Perform the scan tool control function: Fuel Pump Enable - On and Off
7. Close the valve on the tool: EN-37287 Fuel Line Shut-Off Adapter
8. Verify the scan tool parameter: Fuel Pressure Sensor = Pressure drops less than 34 kPa (5 PSI) within 1 min.

- **If the pressure drops 34 kPa (5 PSI) or greater**

Locate and replace the leaking component: Q17 Fuel Injector

- **Go to next step: If the pressure drops less than 34 kPa (5 PSI)**

9. Test or replace the component: G12 Fuel Pump

Fuel Pressure Drops Off

1. Verify the condition does not exist:
 - Poor component electrical connections: Fuel Pump - Chassis Ground
 - Poor component electrical connections: Fuel Pump - Electrical Connector
 - Fuel Feed Pipe - Leaking/Restricted/Visible Damage
 - **If a condition exists**

Repair as necessary

- **Go to next step: If no conditions exist**

2. Test or replace the component: G12 Fuel Pump

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [Fuel Injector Replacement](#)
- [Fuel Tank Fuel Pump Module Replacement](#)

FUEL LEAK DIAGNOSIS

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 Aids

Fluorescent dye assists in locating leaks in the system. A high-intensity black light will make the dye glow: - Green or Yellow

Illuminate the area(s) of concern For example:

- G18 High Pressure Fuel Pump
- Q17 Fuel Injector
- Fuel Line
- Fuel Rail

Reference Information

Special Tools

- GE-28428-E High-Intensity Black Light Kit
- GE-42220 Universal 12 V Leak Detection Lamp

Circuit/System Verification

1. Perform the following action: Clean all of the components in the suspected area using a cleaning solution and allow the components to dry: Fuel System

CAUTION: When performing a Fuel Leak Diagnosis, it is VERY IMPORTANT to use only GM approved Oil Dye, Part Number 88861206. If any other oil dye is used, it will cause damage to the fuel injection system components, as well as the emission control components. This will result in necessary replacement of the damaged components.

2. Perform the following action: Add 237 mL (8 US fl oz) of GM Approved Oil Dye to the component: Fuel Tank - Primary
3. Engine - Idling - For 3 to 5 min
4. Use the special tool: GE-28428-E High-Intensity Black Light Kit or GE-42220 Universal 12 V Leak Detection Lamp - Illuminate the area(s) of concern

Verify there are no leaks in the component/system: High Pressure Side of the Fuel System or Low Pressure Side of the Fuel System

- **If a leak is present**

Repair or replace as necessary

- **Go to next step: If no leak is present**

5. All OK.

FUEL INJECTOR DIAGNOSIS

Diagnostic Instructions

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

Circuit/System Description

Two methods of testing fuel injector balance are available, the Active Fuel Injector Tester or a scan tool. The Active Fuel Injector Tester and SIDI adaptor connects to the engine control module harness connectors to test the high pressure fuel pump performance, fuel injector wiring, and fuel injector operation. The Active Fuel Injector Tester displays step by step instructions to precisely determine pressure drop of each fuel injector. The scan tool fuel injector balance test is performed while the engine is running at idle. The scan tool pressurizes the fuel rail to a predetermined pressure before each fuel injector is pulsed for a precise amount of time

allowing a measured amount of the fuel to be injected. This causes a drop in the system fuel pressure that is recorded and used to compare each fuel injector.

Diagnostic Aids

- Monitoring the scan tool Cylinder 1-6 Current Misfire Counters may help to isolate the fuel injector that is causing the condition.
- Operating the vehicle over a wide temperature range may help isolate the fuel injector that is causing the condition.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Electrical Information Reference

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

Special Tools

- CH-47976 Active Fuel Injector Tester
- CH-47976-500 Active Fuel Injection Tester SIDI Adapter Kit
- CH-47976 - 503 Active Fuel Injection Tester cable G3
- CH-47976 - 512 Active Fuel Injection Tester cable G3b Adapter

For equivalent regional tools, refer to Special Tools (Mechanical Tools).

Fuel Injector Coil Test

NOTE:

- The resistance test must be performed at the fuel injector or misdiagnosis will occur.
- The DMM and test leads must be calibrated to 0 Ω in order to prevent misdiagnosis.

1. Disconnect the appropriate Q17 Fuel Injector.
2. Test for 1.3 - 1.44 Ω at 20B°C (68B°F) between the control + circuit terminal 2 and the control - circuit terminal 1 at the Q17 Fuel Injector.

- **If not between 1.3 - 1.44 Ω**

Replace the Q17 Fuel Injector.

- **Go to next step: If between 1.3 - 1.44 Ω**

3. Test for infinite resistance between each terminal at the Q17 Fuel Injector and the Q17 Fuel Injector housing/case.

- **If less than infinite resistance**

Replace the Q17 Fuel Injector.

- **Go to next step: If infinite resistance**

4. All OK. Perform the Fuel Injector Balance Test.

Fuel Injector Balance Test

NOTE:

- **DO NOT perform this test if the engine coolant temperature (ECT) is above 60B°C (140B°F). Irregular fuel pressure readings may result due to hot soak fuel boiling.**
- **Verify that adequate fuel is in the fuel tank before proceeding with this diagnostic.**

Fuel Injector Balance Test with Active Fuel Injector Tester - Preferred Method

1. Verify the battery is fully charged and all accessories are OFF.
2. Ignition OFF, all vehicle systems OFF. It may take up to 2 min for all vehicle systems to power down. Install **CH-47976** and **CH-47976-500** . Connect **CH-47976 - 503** and **CH-47976 - 512** to **CH-47976-500** .

NOTE:

- **Important that voltage is jumped to the correct fuse terminal.**
 - **Not all (KL9) vehicle are affected. Only vehicles listed below require this jumper step.**
3. For applications with Start/Stop (KL9), battery voltage must be jumped to the low/negative side of the fuse for the KR27 Starter Relay using a 3 amp fused jumper wire. Reference below to determine the appropriate fuse to remove for your application.
 - Cruze (LE2) - Fuse F16UA, Fuse 16, "Fuel Injection"
 - Envision (LCV / LTG) - Fuse F3UA, Fuse F03, "NON/WALK"
 - Equinox/Terrain (LYX / LTG) - Fuse F3UA, Fuse 3, "Lambda 1"
 - Malibu (LFV / LKN / LTG) - Fuse F76UA, Fuse 76, "PWR/TRN OFF Engine"
 - Regal (LGX / LTG) - Fuse F46UA, Fuse 46, "ECM IGN"
 4. Turn ON the Active Fuel Injector Tester and select the vehicle.
 5. Ignition ON, perform the Injector Test with the Active Fuel Injector Tester.
 - **If the Active Fuel Injector Tester aborts testing due to incorrect fuel pressure or fuel leak down**

Refer to [Fuel System Diagnosis](#).
 - **Go to next step: If the Active Fuel Injector Tester does not abort testing**
 6. Compare the test results with the appropriate recommended tolerance.
 - **If any fuel injector exceeds the recommended tolerance**

Replace the appropriate Q17 Fuel Injector(s).
 - **Go to next step: If all fuel injectors are within the recommended tolerance**
 7. All OK.

Fuel Injector Balance Test with Scan Tool

1. Verify the correct low side fuel pressure. Refer to [Fuel System Diagnosis](#).
2. Engine idling, verify the scan tool Fuel Rail Pressure Sensor parameter is approximately 3 MPa (435 PSI).

NOTE:

The engine speed must be between 600 - 1000 RPM to perform this test.

3. Select the Fuel Injector Balance function within the Control Functions menu of a scan tool.

4. Select and test an injector. Repeat for each injector.
5. Obtain and record a pressure drop value for each injector.
6. Add all of the individual pressure drop values except for the injector suspected of being faulty. This is the total pressure drop.

NOTE: For engines with 2 banks of cylinders, only measure average pressure drop on cylinders that are on the same bank.

7. Divide the total pressure drop by the number of fuel injectors that were added together. This is the average pressure drop.
8. Multiply the average pressure drop by 0.20. This is the acceptable variance from the average pressure drop, 20 percent.
9. Verify the difference between any individual pressure drop and the average pressure drop is not greater than the acceptable variance.
 - **If greater than the acceptable variance**
Replace the Q17 Fuel Injector.
 - **Go to next step: If within the acceptable variance**
10. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Fuel Injector Replacement

ALCOHOL/CONTAMINANTS-IN-FUEL DIAGNOSIS

Diagnostic Instructions

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

Circuit/System Description

Water contamination in the fuel system may cause driveability conditions such as hesitation, stalling, no start, or misfires in one or more cylinders. Water may collect near a single fuel injector at the lowest point in the fuel injection system and cause a misfire in that cylinder. If the fuel system is contaminated with water, inspect the fuel system components for rust or deterioration.

Ethanol concentrations of greater than 10% in non-blended gasoline or greater than 85% with E85 blended gasoline for flexible fuel applications can cause driveability conditions such as hesitation, lack of power, stalling, or no start. Excessive concentrations of ethanol used in vehicles not designed for it may cause fuel system corrosion, deterioration of rubber components, and fuel filter restriction.

Reference Information

Special Tools

CH 44175-A Alcohol Tester Kit, if available

For equivalent regional tools, refer to [Special Tools \(Mechanical Tools\)](#).

Circuit/System Verification

1. Remove a sample of fuel from the bottom of the fuel tank and place in a clean, clear container.

2. Place the sample on a level surface for 2 minutes.
3. Verify the sample is clear and bright in color.
 - **If the sample appears cloudy, or contaminated with water, as indicated by a water layer at the bottom of the sample**

Refer to Circuit/System Testing - Particulate Contaminants in Fuel.
 - **If alcohol contamination is suspected**

Refer to Circuit/System Testing - Alcohol in Fuel Testing.
 - **Go to next step: If the sample remains clear and bright**
4. All OK.

Circuit/System Testing

Alcohol in Fuel Testing with Special Tool, If Available

1. Test the fuel composition using **CH 44175-A** and Instruction Manual.
2. Verify no water appears in the fuel sample.
 - **If water appears in the fuel sample**

Clean the fuel system.
 - **Go to next step: If no water appears in the fuel sample**
3. Subtract 50 from the reading on the DMM in order to obtain the percentage of alcohol in the fuel sample.
4. Verify the non-blended gasoline fuel sample does not measure greater than 15% or an E85 blended gasoline fuel sample does not measure greater than 91% ethanol.
 - **If greater than the specified value**
 1. Add fresh regular gasoline to the vehicle's fuel tank.
 2. Remove a new sample of fuel from the tank.
 3. Test the fuel composition using **CH 44175-A** and Instruction Manual.
 4. Subtract 50 from the reading on the DMM in order to obtain the percentage of alcohol in the fuel sample.
 5. Verify the non-blended gasoline fuel sample does not measure greater than 15% or an E85 blended gasoline fuel sample does not measure greater than 91% ethanol.
 - If additional testing indicates that the ethanol percentage is still above 15% for a non-blended gasoline sample, drain and replace the vehicle's fuel. Refer to **Fuel Tank Draining**.
 - If additional testing indicates that the E85 blended gasoline sample still measures above 91%, continue adding fresh, regular gasoline until the ethanol content is 85% or less.
 - **Go to next step: If the specified value or less**
5. All OK.

Alcohol in Fuel Testing without Special Tool

NOTE: This procedure is for non-blended gasoline only. If excessive alcohol content is suspected with E85 fuel add 15% tank volume of fresh, regular gasoline to the fuel tank.

1. Using a 100 ml (3.38 oz) specified cylinder with 1 ml (0.034 oz) graduation marks, fill the cylinder with fuel to the 90 ml (3.04 oz) mark.
2. Add 10 ml (0.34 oz) of water in order to bring the total fluid volume to 100 ml (3.38 oz) and install a stopper.

3. Shake the cylinder vigorously for 10 - 15 seconds.
4. Carefully loosen the stopper in order to release the pressure.
5. Re-install the stopper and shake the cylinder vigorously again for 10 - 15 seconds.
6. Put the cylinder on a level surface for approximately 5 minutes to allow adequate liquid separation. If alcohol is present in the fuel, the volume of the lower layer, which would now contain both alcohol and water, will be more than 10 ml (0.34 oz). For example, if the volume of the lower layer is increased to 15 ml (0.51 oz), this indicates at least 5% alcohol in the fuel. The actual amount of alcohol may be somewhat more because this procedure does not extract all of the alcohol from the fuel.
7. Verify the non-blended gasoline fuel sample does not measure greater than 15%.
 - **If greater than the specified value**
 1. Add fresh regular gasoline to the vehicle's fuel tank.
 2. Remove a new sample of fuel from the tank.
 3. Test the fuel composition of the new sample.
 4. Verify the non-blended gasoline fuel sample does not measure greater than 15%.
 - If greater than the specified value, drain and replace the vehicle's fuel. Refer to [Fuel Tank Draining](#).
 - If the specified value or less, all OK.
 - **Go to next step: If the specified value or less**
8. All OK.

Particulate Contaminants in Fuel

1. Using an approved fuel container, draw approximately 0.5 liter (0.53 qt) of fuel from the bottom of the fuel tank.
2. Place the container on a level surface for approximately 5 minutes in order to allow settling of the particulate contamination. Particulate contamination will show up in various shapes and colors. Sand will typically be identified by a white or light brown crystals. Rubber will appear as black and irregular particles.
3. Verify there are no physical contaminants or water present in the fuel sample.
 - **If any physical contaminants or water are present**

Clean the fuel system.
 - **Go to next step: If no physical contaminants or water are present**
4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Fuel System Cleaning](#)
- [Fuel Tank Draining](#)

CYLINDER DEACTIVATION (ACTIVE FUEL MANAGEMENT) SYSTEM DIAGNOSIS

Diagnostic Instructions

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

Circuit/System Description

[Cylinder Deactivation \(Active Fuel Management\) System Description](#)

Diagnostic Aids

- Review scan tool Cylinder Deactivation Disable History to determine reason for disabling cylinder deactivation.
- DTC P3400 may set if the PCV hose is disconnected from the inlet duct.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics

Connector End View Reference

Master Electrical Component List , or Inline Harness Connector End Views - Index or Component Connector End Views - Index

Description and Operation

Cylinder Deactivation (Active Fuel Management) System Description

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

NOTE: The engine oil level and the oil pressure are critical to the correct operation of the system.

1. Verify no other DTCs are set.

- **If other DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle

- **Go to next step: If no other DTCs are set**

2. Verify the condition does not exist: Engine Oil - Fill Level = Low

- **If a condition exists**

Repair or replace as necessary

- **Go to next step: If no condition exists**

3. Verify the engine oil pressure: Refer to Oil Pressure Diagnosis and Testing

- **If not in the specified range**

Repair or replace as necessary

- **Go to next step: If in the specified range**

4. Engine - Idling - At normal operating temperature - Verify there is no abnormal noise from the component:

- **If an abnormal noise is present**

Refer to [Symptoms - Engine Mechanical](#)

- **Go to next step: If no abnormal noise is present**

5. Refer to: Circuit/System Testing

Circuit/System Testing

WARNING: Road test a vehicle under safe conditions and while obeying all traffic laws. Do not attempt any maneuvers that could jeopardize vehicle control. Failure to adhere to these precautions could lead to serious personal injury and vehicle damage.

1. Operate the vehicle within the conditions of the customer's concern while monitoring the scan tool parameter or tool: Scan Tool
2. Verify the scan tool parameter: Cylinder Deactivation Inhibit = No
 - **If not the specified state**

Refer to the appropriate diagnostic procedure listed below:

- [Symptoms - Engine Controls](#)
- [Symptoms - Engine Cooling](#)
- [Symptoms - Wiring Systems](#)
- [Symptoms - Engine Mechanical](#)
- **Go to next step: If the specified state**

3. Test or replace the component: Q83 Valve Lifter Oil Solenoid Valve

Component Testing

Static Test

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: Q83 Valve Lifter Oil Solenoid Valve
3. Test for 11 to 30 ohms between the test points: Control terminal 2/B & Ignition terminal 1/A
 - **If not between 11 and 30 ohms**

Replace the component: Q83 Valve Lifter Oil Solenoid Valve

- **Go to next step: If between 11 and 30 ohms**

4. Test for infinite resistance between the test points: Each terminal of the component & The component's housing

- **If less than infinite resistance**

Replace the component: Q83 Valve Lifter Oil Solenoid Valve

- **Go to next step: If infinite resistance**

5. All OK.

Dynamic Test

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: Q83 Valve Lifter Oil Solenoid Valve
3. Connect a 3 A fused jumper wire between the test points: Ignition terminal 1/A & 12 V

CAUTION:

Complete the testing as quickly as possible in order to prevent overheating and damaging the component.

4. Momentarily connect a jumper wire between the test points: Control terminal 2/B & Ground

Verify the component turns On and Off when connecting and disconnecting the jumper wire: Q83 Valve Lifter Oil Solenoid Valve

- **If the component does not turn On and Off**

Replace the component: Q83 Valve Lifter Oil Solenoid Valve

- **Go to next step: If the component turns On and Off**

5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: [Diagnostic Repair Verification](#)

- [VALVE ROCKER ARM OIL CONTROL VALVE REPLACEMENT - BANK 1](#) and/or [VALVE ROCKER ARM OIL CONTROL VALVE REPLACEMENT - BANK 2](#) - Q83 Valve Lifter Oil Solenoid Valve
- For control module replacement, programming, and setup refer to [Control Module References](#)

ELECTRONIC IGNITION SYSTEM DIAGNOSIS

Diagnostic Instructions

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

Circuit/System Description

This ignition system uses an individual ignition coil for each cylinder. The Engine Control Module (ECM) controls the spark events by transmitting the timing pulses on the ignition control circuits to the individual ignition coil in firing order sequence.

Diagnostic Aids

- This engine application may use 2 fuses, one for each bank, to supply ignition voltage to the ignition module/coil assemblies. A good indication that a fuse is open is that all misfire counters are incrementing on one side of the engine.
- An open/high resistance on the low reference circuit to the ignition coil may cause a misfire.
- An erratic or weak spark is considered a no spark condition.

Reference Information

Schematic Reference

[Engine Controls Wiring Schematics](#)

Connector End View Reference

[Master Electrical Component List](#) , or [Inline Harness Connector End Views - Index](#) or [Component Connector End Views - Index](#)

Description and Operation

Electronic Ignition System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

Control Module References

Special Tools

EL 26792 HEI Spark Tester

For equivalent regional tools, refer to [Special Tools \(Mechanical Tools\)](#).

Circuit/System Testing

NOTE: Do not perform this diagnostic procedure unless you were sent here from a misfire DTC or the Engine Cranks But Does Not Run diagnostic.

1. Ignition OFF and all vehicle systems OFF. Disconnect the harness connector at the appropriate T8 Ignition Coil. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 1/A and ground.
 - **If 5 Ω or greater**
 1. Ignition OFF.
 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.
 - **Go to next step: If less than 5 Ω**
3. Test for less than 5 Ω between the low reference circuit terminal 2/B and ground.
 - **If 5 Ω or greater**
 1. Ignition OFF, disconnect the X3 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.
 - **Go to next step: If less than 5 Ω**
4. Ignition ON.
5. Verify a test lamp illuminates between the ignition circuit terminal 4/D and ground.
 - **If the test lamp does not illuminate**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **Go to next step: If the test lamp illuminates**
6. Ignition OFF, exchange the suspect T8 Ignition Coil with the T8 Ignition Coil of a known functioning cylinder.
7. Engine Running.

8. Verify the scan tool Cylinder 1 - 6 Current Misfire Counter does not increment for the same cylinder that the suspect T8 Ignition Coil was removed from.

- **If increments**

Replace the K20 Engine Control Module.

- **Go to next step: If does not increment**

9. Test or replace the T8 Ignition Coil.

Component Testing

NOTE: You must perform the Circuit/System Testing before proceeding with Component Testing.

1. Ignition OFF, connect the **EL 26792** to the appropriate T8 Ignition Coil.

2. Engine Running.

3. Verify the spark output of the T8 Ignition Coil.

- **If no output or the output is weak**

Replace the T8 Ignition Coil

- **Go to next step: If the output is good**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Ignition Coil Replacement - Bank 1](#)
- [Ignition Coil Replacement - Bank 2](#)
- [Control Module References](#) for engine control module replacement, programming, and setup.

INSPECTION/MAINTENANCE SYSTEM CHECK

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.

Description

Several states require that a vehicle pass on-board diagnostic (OBD) system tests and inspection/maintenance (I/M) emission inspections in order to renew license plates. This is accomplished by viewing the Inspection/Maintenance System Status or Data display on a scan tool. Using a scan tool, the technician can observe the I/M status in order to verify that the vehicle meets the criteria that complies with the local area requirements.

While testing in the I/M System Status mode, some DTCs may occur that are called I/M Test DTCs. An I/M Test DTC is defined as a fault code that is currently commanding the malfunction indicator lamp (MIL) ON, and is stored in non-volatile memory. The intended use of this data is to prevent vehicles from passing I/M inspection without proper repair to the vehicle. These fault codes are not erasable from any scan tool command or by disconnecting power to the controller. I/M Test DTCs are supported by all emissions related electronic control units, such as engine control modules (ECMs), transmission control modules (TCMs), fuel pump control modules, etc. An I/M Test DTC will not be stored or erased from the electronic control unit except at the end of trip processing which occurs 5 s after ignition OFF.

Conditions for Updating the I/M System Status

NOTE: New vehicles may not report an Inspection/Maintenance System Check pass or fail status for certain post catalyst oxygen sensor or heated oxygen sensor 2 diagnostics prior to 700 miles. After replacing a catalytic converter on a vehicle with greater than 700 miles, it may require up to an additional 700 miles to prevent a false failure status.

Each system requires at least one, and sometimes several, diagnostic tests. The results of these tests are reported by a DTC. A system monitor is complete when either all of the DTCs comprising the monitor have Run and Passed, or any one of the DTCs comprising the monitor have illuminated the MIL. Once all of the tests are completed, the Inspection/Maintenance System Status or Data will indicate YES in the Completed or Value column.

For example, when the HO2S Heater Status indicates YES, either all of the oxygen sensor heater tests have passed or one of the tests has illuminated the MIL. If the vehicle has four heated oxygen sensors, either all four heater circuit tests have passed or one of the heater circuit tests has illuminated the MIL. The Inspection/Maintenance System Status or Data will indicate NO under the Completed or Value column when any of the required tests for that system have not run. The following is a list of conditions that would set the Inspection/Maintenance System or Data indicator to NO:

- The vehicle is new from the factory and has not yet been driven through the necessary drive conditions to complete the tests.
- The battery has been disconnected or discharged below operating voltage.
- The control module power or ground has been interrupted.
- The control module has been reprogrammed.
- The control module DTCs have been cleared as part of a service procedure.

Conditions for Clearing I/M Test DTCs

1. Only the OBD II System can erase I/M Test DTCs. The OBD II system must determine that the malfunction that caused the I/M Test DTC to be stored is no longer present and is not commanding the MIL. Each of the following represents ways to clear an I/M Test DTC:
 - If the MIL goes off due to 3 passing drive cycles, and the scan tool code clear is not used, the I/M Test DTC is erased at power down of the last drive cycle.
 - If a scan tool code clear is used to turn OFF the MIL, the I/M Test DTC is not erased, therefore the DTC must PASS and not FAIL during the drive cycle. The I/M Test DTC is erased at power down of the drive cycle.
 - If the controller is reflashed/reprogrammed, all I/M Test DTCs are erased.
2. For the OBD II System to run a single drive cycle for clearing an I/M Test DTC, all of the following conditions must occur:
 - Cumulative time of engine run time greater than 600 s.
 - Cumulative vehicle operation above 41 km/h (25 mph) over 300 s.
 - Continuous vehicle idle greater than 30 s.
 - Ignition OFF for 5 s to allow the code to clear.

Monitored Emission Control Systems

The OBD II system monitors all emission control systems that are on-board, but not all vehicles need every possible emission control system. For example, a vehicle may not be equipped with secondary air injection or exhaust gas recirculation (EGR). The OBD II regulations require monitoring of the following; if equipped:

- The air conditioning system
- The catalytic converter efficiency
- Comprehensive component monitoring - Emission related inputs and outputs

- The evaporative emission (EVAP) system
- The fuel delivery system
- Heated catalyst monitoring
- Misfire monitoring
- The oxygen sensor system (O2S or HO2S)
- The oxygen sensor heater system (HO2S heater)

For the specific DTCs required for each system, refer to [Inspection/Maintenance \(I/M\) System DTC Table](#). Systems such as misfire and comprehensive components may not be listed in a system status list. These tests run continuously and do not require an I/M System Status indicator.

Diagnostic Aids

The Inspection/Maintenance System Status or Data display provides an indication of when the control module has completed the required tests. This does not necessarily mean that the test has passed, only that a decision was made. If the diagnostic fails, a DTC will indicate the failure. If a failure indication is present for a DTC associated with one of the I/M regulated systems, it may prevent other required tests from running. For example, a DTC for the control circuit of the EVAP purge solenoid may not be listed in the Inspection/Maintenance System DTC Table because it is a continuous test. If this DTC is set, the Active Tests for the EVAP system may not run.

The Inspection/Maintenance System Status or Data information may be useful for a technician to determine if diagnostics have run when verifying repairs.

Circuit/System Verification

1. Verify that all Inspection/Maintenance System Status or Data indicators report YES, and that no I/M Test DTCs are present.
 - **If any I/M Test DTCs are set**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).
 - **Go to next step: If no I/M Test DTCs are set**
2. All OK.

Circuit/System Testing

NOTE: Many DTC related repairs will instruct the technician to clear the DTC information. Clearing the DTC will reset the Inspection/Maintenance System Status or Data indicators to NO. Performing the I/M Complete System Set Procedure will set each of the I/M System Status indicators to YES.

1. Verify no I/M DTCs are present.
 - **If an I/M DTC is set that would prevent the I/M System Status tests from completing, diagnose that DTC before continuing.**
Refer to [Inspection/Maintenance \(I/M\) System DTC Table](#).
 - **Go to next step: If no I/M DTCs are set**
2. Review applicable service bulletins for software updates that would prevent the I/M System Status tests from completing.
 - **If a control module re-program or other repair is required,**
Perform the [Inspection/Maintenance Complete System Set Procedure](#) after repair.
 - **Go to next step: If no repair is required**

3. Observe the Inspection/Maintenance System Status or Data indicators.

- **If any Inspection/Maintenance System Status or Data indicators report NO**

Perform the [Inspection/Maintenance Complete System Set Procedure](#).

- **Go to next step: If no Inspection/Maintenance System Status or Data indicators report NO**

4. All OK.

INSPECTION/MAINTENANCE COMPLETE SYSTEM SET PROCEDURE

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.

Description

The purpose of the Inspection/Maintenance (I/M) complete system set procedure is to satisfy the enable criteria necessary to execute all of the I/M readiness diagnostics and complete the trips for those particular diagnostics. When all I/M monitored diagnostic tests are completed, the I/M System Status indicators are set to YES. Perform the Inspection/Maintenance (I/M) Complete System Set Procedure if any I/M System Status indicators are set to NO.

Conditions for Meeting a Cold Start

- The ignition voltage between 10 and 15 V.
- The barometric pressure (BARO) is more than 75 kPa (10.9 PSI).
- The engine coolant temperature (ECT) at start-up is less than 42B°C (108B°F).
- The intake air temperature (IAT) is between 2 - 32B°C (36-90B°F).
- The engine is OFF for greater than 6 hours or the following conditions must be met:
 - The start-up IAT minus start-up ECT are within 12B°C (22B°F).
 - The start-up ECT minus start-up IAT are within 50B°C (90B°F).
- Fuel level is between 25 and 75%.

Circuit/System Verification

1. Verify that all I/M System Status indicators report YES, and that no I/M Test DTCs are present.

- **If any I/M Test DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **Go to next step: If no I/M Test DTCs are set**

2. All OK.

Inspection/Maintenance (I/M) System Set Procedure

1. Ensure that the vehicle meets the conditions for a cold start listed above.

- If the EVAP I/M System Status indicator displays NO, perform the [EVAP Service Bay Test](#) if applicable.

2. Turn OFF all accessories; HVAC system, other electrical loads, including aftermarket/add-on equipment, etc., and open the hood.

3. Set the vehicle parking brake and ensure the vehicle is in park for automatic transmission or neutral for manual transmission.

4. Start and idle the engine for 2 min.

WARNING: Refer to [Road Test Warning](#) .

5. Close the hood, release the parking brake and Accelerate at part throttle to 72 - 80 km/h (45 - 50 MPH) with this speed maintained until the engine reaches operating temperature, 8 - 10 min.
6. Continue operation under these conditions for an additional 6 min.
7. Accelerate at part throttle to 90 km/h (55 MPH) with this speed maintained for 2 min.
8. Release the accelerator pedal for at least 10 s. This will allow the vehicle to enter the decel fuel cut off.

NOTE: Do NOT touch the accelerator pedal until told to do so. A change in throttle position or an increase in engine speed may invalidate this portion of the test.

9. Safely stop the vehicle, with the engine in drive for automatic or neutral with the clutch pedal depressed and parking brake applied for manual. Allow the vehicle to idle for 2 min.
10. Shift the vehicle to park for automatic and neutral for manual. Turn OFF the ignition and exit the vehicle. Do NOT disturb the vehicle for 45 min.
11. Observe the Inspection/Maintenance (I/M) System Status with a scan tool. All of the I/M System Status indicators should display YES.
 - If the EVAP I/M System Status indicator displays NO, turn OFF the ignition, ensure that the vehicle meets the conditions for a cold start, and repeat steps 6 - 11 three more times, or until the EVAP I/M System Status indicator transitions to YES. If the indicator continues to display NO, refer to the [Inspection/Maintenance \(I/M\) System DTC Table](#) to identify the DTCs that did not run.
 - If any of the I/M System Status indicators display NO, refer to the [Inspection/Maintenance \(I/M\) System DTC Table](#) for the indicator which did not display YES. The I/M System DTC Table identifies the DTCs associated with each I/M System Status Indicator.

NOTE: An I/M Test DTC will not be stored or erased from the ECU except at the end of trip processing, which occurs 5 s after ignition OFF.

12. Observe the I/M Test DTC information with a scan tool. Verify there are no I/M Test DTCs present.
 - If an I/M Test DTC is set, diagnose the DTC using the [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) , and refer to [Inspection/Maintenance System Check](#).
13. Observe the engine DTC information with a scan tool. Verify no DTCs are present.
 - If a DTC is set, diagnose using the [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) . After repairs, perform the [Inspection/Maintenance Complete System Set Procedure](#) to verify no further DTCs are set.

INSPECTION/MAINTENANCE (I/M) SYSTEM DTC TABLE

Description

Perform the following procedure to determine if the inspection/maintenance (I/M) status monitor parameters displays Complete: [Inspection/Maintenance System Check](#)

If the status monitor parameters did not update to Complete, refer to the applicable DTC listed below. Each DTC has specific conditions that must be met for the diagnostic to run. Included within the conditions are additional DTCs which, if set, may inhibit the DTCs from running. Reviewing and operating the vehicle within the conditions for running each DTC will allow the inspection/maintenance system status parameters to display Complete. Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

Scan Tool Parameter	DTCs Required to Set I/M System Status Monitor to Complete
Boost System Monitor - Since Diagnostic Trouble Codes Cleared	P0234, P026A, P0299, P02CA, P02CB, P168A, P168B

Scan Tool Parameter	DTCs Required to Set I/M System Status Monitor to Complete
Catalytic Converter Monitor - Since Diagnostic Trouble Codes Cleared	P0420, P0421, P0422, P0430, P2000, P20CE, P244C
Evaporative Emission Monitor - Since Diagnostic Trouble Codes Cleared	P0440, P0442, P0446, P0455, P0497, P04AF, P145E, P1463, P2421, P2422
Exhaust Gas Recirculation Valve/Camshaft Position Monitor - Since Diagnostic Trouble Codes Cleared	P0011, P0014, P0021, P0024, P0400, P0401, P0402, P0404, P0405, P0406, P040F, P042E, P049B, P05CC, P05CD, P05CE, P05CF, P110E, P110F, P131F, P140B, P140C, P140F, P1426, P1437, P14A5, P16D0, P16D1, P241F, P2457, P2646, P2647
Fuel System Monitor - Since Diagnostic Trouble Codes Cleared	P01CB, P01CC, P01CD, P01CE, P01CF, P01D0, P01D1, P01D2, P01D2, P01D3, P01D4, P01D5, P01D6, P01D7, P01D8, P01D9, P01DA, P026B, P026C, P026D, P1174, P1175, P1488, P14D9, P219A, P219B, P219C, P219D, P219E, P219F, P21A0, P21A1, P21A2, P21A3, P228C, P228D, P229A, P229B
Oxygen Sensor Heater Monitor - Since Diagnostic Trouble Codes Cleared	P0053, P0054, P0059, P0060, P0141, P0155, P0161
Oxygen Sensor/Heated Oxygen Sensor Monitor - Since Diagnostic Trouble Codes Cleared	P0133, P0135, P0136, P013A, P013B, P013C, P013D, P013E, P013F, P0140, P0142, P014A, P014B, P0153, P0156, P015A, P015B, P015C, P015D, P0160, P1133, P1134, P1153, P1154, P2195, P2196, P2197, P2198, P2270, P2271, P2272, P2273, P2A01, P2A02, P2A04

EVAP SERVICE BAY TEST

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.

Description

The purpose of the evaporative emission (EVAP) Service Bay Test is to aid in resetting the EVAP Inspection/Maintenance (I/M) System Status. For this vehicle, that is equipped with the engine off natural vacuum diagnostic, the Service Bay Test uses the scan tool to initiate the engine control module (ECM) regular sequence of EVAP system DTC tests, but with different enable criteria. By using the Service Bay Test the I/M indicator can be set without the need for multiple cold soaks.

The scan tool displays for the Service Bay Test are based on the events that occur within the following three categories:

EVAP Service Bay Test Status - Running

The vehicle must remain at rest, in Park, or in Neutral, during this portion of the test. This test inspects for large leaks and vent system restrictions. The purge valve leak diagnostic may run, but is not required. The scan tool will display test progress or the reason for an abort or failure.

EVAP Service Bay Test Status - Vehicle Ready for Drive Cycle

The scan tool will display time and distance needed to warm the fuel. The drive distance remaining rounds down to zero when there is anything less than 1 mile or kilometer remaining. The vehicle must be

driven until the "return to service bay" message is displayed.

EVAP Service Bay Test Status - Engine Off Conditions Met

During this portion of the test, the ECM will remain active for up to 45 min when the ignition is turned OFF to allow control of the EVAP vent solenoid valve and run the engine off natural vacuum test. The ECM inspects for small leaks during this period by monitoring fuel tank pressure or vacuum. If the system is sealed, there will be a pressure or vacuum change. Pressure or vacuum changes that are not within the calibrated values indicate a leak.

NOTE:

- **Do not reorder the scan tool screen display. The EVAP Service Bay Test Status parameter is the main status message to observe. It will indicate when each category is active with the Test Results status parameter right beneath it.**
- **There are many possible screen messages. It is very important that you watch these messages and record any failure or abort message as this will aid the diagnosis.**
- **If any of these issues occur during or after the engine running portion of the test, the vehicle will need to soak for at least 8 h before retrying.**
- **An incorrect "drive distance not met" message is an indication that the service bay test aborted earlier and the vehicle was keyed off followed by retrying without waiting for at least 10 min before retrying.**

When the EVAP diagnostics are initiated by the Service Bay Test, the scan tool will indicate if the enable conditions listed below are not met, or will display a specific reason if the test aborts. When complete, the display will indicate that the tests completed or failed.

If

- The Service Bay Test aborts
- The scan tool resets
- The scan tool locks up
- The scan tool sets an error
- The diagnostic connector becomes disconnected

Before starting the engine, the vehicle should be left keyed off for at least 10 min before retrying.

After the ignition off portion of the test has completed, the Service Bay Test will delay ECM shut down for 10 min to allow for analysis of scan tool data. A complete Test Results status message along with EVAP Monitor Complete value of YES is the goal.

Conditions for Running the Test

The following conditions must be met in order to enable the Service Bay Test:

- The battery voltage is between 11 - 32 V.
- The engine coolant temperature (ECT) is less than 35B°C (95B°F) at start-up.
- The intake air temperature (IAT) is less than 34B°C (93B°F) at start-up.
- The ambient air temperature is between 0 - 40B°C (32 - 104B°F) at start-up.
- The fuel level is within 10 - 90% capacity and cannot be refueled during the tests.
- The vehicle must have sat for 8 h since the last run time.
- The EVAP I/M System Status indicator is set to NO.

NOTE:

The use of the scan tool Clear DTCs function will reset all I/M statuses.

- There are no DTCs displayed.
- The vehicle must be driven for the time and distance specified on the scan tool.
- The ignition must remain OFF during the engine OFF portion of the test, and the vehicle must remain at rest.

Test Procedure

NOTE:

- If the Service Bay Test aborts or fails, a DTC will NOT be set.
- You must not rush the scan tool selections or erroneous results or error messages could occur.

1. Select the Service Bay Test with the scan tool.

WARNING: Refer to [Road Test Warning](#) .

2. Follow the instructions on the scan tool. The EVAP Service Bay Test should complete and should not abort or fail.

- **If the test aborts**

Correct the condition for running the test, then retest.

or

- **If the test fails**

Repair the vehicle for the condition indicated by the failure message, then retest.

- **Go to next step: If the test passes**

NOTE: There are several test parameters displayed and can vary by engine RPO.

3. Verify that the EVAP Monitor Complete parameter, is set to YES.
