

ENGINE PERFORMANCE

Engine Controls and Fuel - 6.2L (LT1) - Diagnostic Information and Procedures - Corvette

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P0340 OR P0341

Diagnostic Instructions

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

DTC Descriptors

DTC P0340

Camshaft Position Sensor Circuit

DTC P0341

Camshaft Position Sensor Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P018C, P0192, P0340, P0452, P0522, P0532, P0641, P127C, P2227, P2228	P0340	P018D, P0193, P0453, P0523, P0533, P0641, P127D, P2227	-
Signal	P0016, P0340	P0340	P0340, P0341	P0341
Low Reference	-	P0340	-	-

Circuit/System Description

The camshaft position sensor has 3 circuits consisting of an engine control module (ECM) supplied 5 V reference circuit, low reference circuit and an output signal circuit. The camshaft position sensor is an internally magnetic biased digital output integrated circuit sensing device. The sensor detects magnetic flux changes of the teeth and slots of a 4-tooth reluctor wheel attached to the camshaft. As

each reluctor wheel tooth rotates past the camshaft position sensor, the resulting change in the magnetic field is used by the sensor electronics to produce a digital output pulse. The sensor returns a digital ON/OFF DC voltage pulse of varying frequency with 4 varying width output pulses per camshaft revolution that represent an image of the camshaft reluctor wheel. The frequency of the camshaft position sensor output depends on the velocity of the camshaft. The ECM decodes the narrow and wide tooth pattern to identify camshaft position. This information is then used to determine the optimum ignition and injection points of the engine. The ECM uses the camshaft position sensor to determine injector and ignition system synchronization. The ECM uses camshaft position sensor output information to determine the camshaft relative position to the crankshaft to control camshaft phasing and limp-home operation.

Conditions for Running the DTC

P0340 Condition 1

- The starter is engaged and the engine control module detects camshaft position sensor pulses.
- OR
- DTCs P0101, P0102 and P0103 are not set.
 - The airflow into the engine is greater than 3 g/s.

Condition 2

- The engine is running.
- The starter is not engaged.

Condition 3

- The crankshaft is synchronized.
- The starter is engaged.
- DTC P0335 or P0336 are not set.

Condition 4

- The crankshaft is synchronized.
- DTC P0335 or P0336 are not set.

P0341 Condition 1

- The crankshaft is synchronized.
- The starter is engaged.
- DTC P0335 or P0336 are not set.

Condition 2

-
- The crankshaft is synchronized.
 - DTC P0335 or P0336 are not set.

The DTCs run continuously once the above conditions are met.

Conditions for Setting the DTC

P0340 Condition 1

- The ECM does not detect a camshaft position sensor pulse for greater than 5.5 s.
- OR
- The ECM does not detect a camshaft position sensor pulse for greater than 4.0 s since the time the starter has been engaged.

Condition 2

The ECM detects less than 4 camshaft position sensor pulse for greater than 3.0 s.

Condition 3

The ECM does not detect a camshaft position sensor pulse during the first 2 engine revolutions.

Condition 4

The ECM does not detect a camshaft position sensor pulse during 200 engine revolutions.

P0341 Condition 1

- The ECM detects less than 4 camshaft position sensor pulses during 2 engine revolutions.
- OR
- The ECM detects greater than 8 camshaft position sensor pulses during 2 engine revolutions.

Contion 2

The ECM detects less than 398 or greater than 402 camshaft position sensor pulses during 200 engine revolutions.

Action Taken When the DTC Sets

- DTCs P0340 and P0341 are Type B DTCs.
- The camshaft position actuator is commanded to the Home or Parked position.
- The ignition system defaults to a failed camshaft position sensor limp home mode.

Conditions for Clearing the MIL/DTC

DTCs P0340 and P0341 are Type B DTCs.

Diagnostic Aids

- With a DTC set, the engine may crank for an extended period of time at start-up.
- The camshaft position sensor is used for injector and ignition system synchronization. A stalling condition will occur if the camshaft position sensor signal is intermittent and a DTC will not set. Inspect all camshaft position sensor circuits for poor connections.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC P0641 is not set.
 - **If the DTC is set**

Refer to **DTC P0641, P0651, P0697 or P06A3.**

- **If the DTC is not set**

3. Engine Running.
4. Verify the scan tool Camshaft Position Active Counter parameter increments.
 - **If the counter does not increment**

Refer to Circuit/System Testing.

- **If the counter increments**

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.

- **If the DTC does not set**

7. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B23 Camshaft Position Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 ohms between the low reference circuit terminal 2 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If 2 ohms or less, replace the K20 Engine Control Module.
 - **If less than 5 ohms**
3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 1 and ground.
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
 3. Test for less than 2 ohms in the 5 V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms. replace the K20 Engine Control Module.

- **If greater than 5.2 V**
 1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
- **If between 4.8-5.2 V**
- 5. Test for 4.8-5.2 V between the signal circuit terminal 3 and ground.
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
- **If between 4.8-5.2 V**
- 6. Verify DTC P0341 is not set.
 - **If the DTC is set**

Inspect for the conditions listed below:

- Excessive play or looseness of the B23 Camshaft Position Sensor or the reluctor wheel
- Improper installation of the B23 Camshaft Position Sensor
- Foreign material passing between the B23 Camshaft Position Sensor and the reluctor wheel
- Damaged reluctor wheel
- Excessive air gap between the B23 Camshaft Position Sensor and the reluctor wheel
- Engine oil for debris
- Timing chain, tensioner and sprockets for wear or damage
- If any of the conditions above are found, repair as necessary.
- If all components test normal, test or replace the B23 Camshaft Position Sensor.

7. Test or replace the B23 Camshaft Position Sensor.

Repair Instructions

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

- **Camshaft Position Sensor Replacement**
- **Control Module References** for engine control module replacement, programming and setup

DTC P0351-P0358, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, P2316, P2318, P2319, P2321 OR P2322

Diagnostic Instructions

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

DTC Descriptors

DTC 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 P0357

Ignition Coil 7 Control Circuit

DTC P0358

Ignition Coil 8 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

Ignition Coil 6 Control Circuit Low Voltage

DTC P2316

Ignition Coil 6 Control Circuit High Voltage

DTC P2318

Ignition Coil 7 Control Circuit Low Voltage

DTC P2319

Ignition Coil 7 Control Circuit High Voltage

DTC P2321

Ignition Coil 8 Control Circuit Low Voltage

DTC P2322

Ignition Coil 8 Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Coil 1 Control	P0300, P2300	P0300, P0351	P0300, P2301	P0300, P0351
Ignition Coil 2 Control	P0300, P2303	P0300, P0352	P0300, P2304	P0300, P0352
Ignition Coil 3 Control	P0300, P2306	P0300, P0353	P0300, P2307	P0300, P0353
Ignition Coil 4 Control	P0300, P2309	P0300, P0354	P0300, P2310	P0300, P0354
Ignition Coil 5 Control	P0300, P2312	P0300, P0355	P0300, P2313	P0300, P0355
Ignition Coil 6 Control	P0300, P2315	P0300, P0356	P0300, P2316	P0300, P0356
Ignition Coil 7 Control	P0300, P2318	P0300, P0357	P0300, P2319	P0300, P0357
Ignition Coil 8 Control	P0300, P2321	P0300, P0358	P0300, P2322	P0300, P0358
Ignition Coil 1 Ground	-	P0300, P0351	-	P0300, P0351
Ignition Coil 2 Ground	-	P0300, P0352	-	P0300, P0352
Ignition Coil 3 Ground	-	P0300, P0353	-	P0300, P0353
Ignition Coil 4 Ground	-	P0300, P0354	-	P0300, P0354
Ignition Coil 5 Ground	-	P0300, P0355	-	P0300, P0355
Ignition Coil 6 Ground	-	P0300, P0356	-	P0300, P0356
Ignition Coil 7 Ground	-	P0300, P0357	-	P0300, P0357
Ignition Coil 8 Ground	-	P0300, P0358	-	P0300, P0358

Circuit/System Description

The ignition system on this engine uses an individual coil for each cylinder. The engine control module (ECM) controls the spark event for each cylinder through the 8 individual ignition control circuits. When the ECM commands the ignition control circuit ON, electrical current will flow through the primary winding of the ignition coil, creating a magnetic field. When a spark event is requested, the ECM will command the ignition control circuit OFF, interrupting current flow through the primary winding. The magnetic field created by the primary winding will collapse across the secondary coil windings, producing a high voltage across the spark plug electrodes. The ECM uses information from the crankshaft position sensor and the camshaft position sensor for sequencing and timing of the spark events. The ECM monitors each ignition control circuit for improper voltage levels.

Conditions for Running the DTC

- The engine is cranking or running.
- Ignition voltage is greater than 5 V.

The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match.

Action Taken When the DTC Sets

DTCs P0351, P0352, P0353, P0354, P0355, P0356, P0357, P0358, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, P2316, P2318, P2319, P2321 and P2322 are Type B DTCs.

Conditions for Clearing the MIL/DTC

DTCs P0351, P0352, P0353, P0354, P0355, P0356, P0357, P0358, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, P2316, P2318, P2319, P2321 and P2322 are Type B DTCs.

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- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL 26792 HEI Spark Tester

For equivalent regional tools, refer to **Special Tools (Diagnostic Tools)** .

Circuit/System Verification

1. Engine Running.
2. Verify the scan tool parameters listed below do not display Malfunction:
 - Ignition Coil 1-8 Control Circuit High Voltage Test Status
 - Ignition Coil 1-8 Control Circuit Low Voltage Test Status
 - Ignition Coil 1-8 Control Circuit Open Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.
 - **If Malfunction is not displayed**
3. Operate the vehicle within the Conditions for Running the DTCs. 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.
 - **If the DTC does not set**
5. All OK.

Circuit/System Testing

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1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate T8 Ignition Coil. It may take up to 2 minutes for all vehicle systems to power down.
 2. Test for less than 5 ohms between the ground circuit terminal 1 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - 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.
 - **If less than 5 ohms**
 3. Engine Running.
 4. Verify the appropriate scan tool Ignition Coil Control Circuit Low Voltage Test Status does not display Malfunction.
 - **If Malfunction is displayed**
 1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the control circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If Malfunction is not displayed**
 5. Verify the appropriate scan tool Ignition Coil Control Circuit High Voltage Test Status does not display Malfunction.
 - **If Malfunction is displayed**
 1. Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage in the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If Malfunction is not displayed**
 6. Ignition OFF, install a 3 A fused jumper wire between the control circuit terminal 3 and ground, engine Running.
 7. Verify the appropriate scan tool Ignition Coil Control Circuit Low Voltage Test Status displays Malfunction.
 - **If Malfunction is not displayed**
 1. Ignition OFF, remove the fused jumper and disconnect the X3 harness connector at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If Malfunction is displayed**
 8. Test or replace the T8 Ignition Coil.

Component Test

NOTE: You must perform the **Circuit/System Testing** before proceeding with **Component Testing**.

1. Ignition OFF, connect the **EL 26792** HEI spark tester 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.

- **If the output is normal**
4. All OK.

Repair Instructions

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

- **Ignition Coil Replacement**
- **Control Module References** for engine control module replacement, programming and setup

DTC P0420 OR P0430

Diagnostic Instructions

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

DTC Descriptor

DTC P0420

Catalyst System Low Efficiency

DTC P0430

Catalyst System Low Efficiency Bank 2

Circuit/System Description

A 3-way catalyst controls emissions of hydrocarbons, carbon monoxide (CO) and nitrogen oxide (NOx). The catalyst within the converter promotes a chemical reaction, which oxidizes the hydrocarbons and the CO that are present in the exhaust gas. This process converts the

hydrocarbons and the CO into water vapor and carbon dioxide (CO₂) and reduces the NO_x, converting the NO_x into nitrogen. The catalyst also stores oxygen. The engine control module (ECM) monitors this process by using heated oxygen sensors (HO₂S) that are in the exhaust stream before and after the 3- way catalyst. The HO₂S produces an output signal that the ECM uses to calculate the oxygen storage capacity of the catalyst. This indicates the ability of the catalyst to convert the exhaust emissions efficiently. The ECM monitors the efficiency of the catalyst by monitoring the HO₂S during an off-idle, decel fuel cut off (DFCO) event. When the catalyst is functioning properly, the post catalyst HO₂S response to the fuel conditions during the DFCO event is slow compared to the response of the pre catalyst HO₂S. When the post HO₂S response is near that of the pre HO₂S, the oxygen storage capability and efficiency of the catalyst may be degraded below an acceptable threshold.

Conditions for Running the DTC

- DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0053, P0054, P0056, P0057, P0058, P0059, P0060, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0116, P0117, P0118, P0119, P0121, P0122, P0123, P0128, P0131, P0132, P0133, P0135, P0137, P0138, P013A, P013B, P013C, P013D, P013E, P013F, P0141, P014A, P014B, P0151, P0152, P0153, P0155, P0157, P0158, P015A, P015B, P015C, P015D, P0161, P0171, P0172, P0174, P0175, P0201, P0202, P0203, P0204, P0205, P0206, P0207, P0208, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0279, P0280, P0282, P0283, P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307, P0308, P1248, P1249, P124A, P124B, P124C, P124D, P16F3, P2101, P2135, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216C, P216E, P216F, P2270, P2271, P2272 or P2273 is not set.
- Engine speed is between 1, 000-2, 500 RPM to enable the catalyst diagnostic. Once the engine speed is in range, the engine speed must be between 950-2, 550 RPM to keep the test enabled.
- Accelerator pedal position is at most 100 %.
- Ethanol estimation is not active.
- Evaporative emission (EVAP) purge is not active.
- Post HO₂S heaters are ON for greater than 60 s.
- Mass air flow (MAF) is between 4-20 g/s.
- System voltage is between 10-32 V.
- Vehicle speed is between 62-120 km/h (38.5-74.6 MPH) to enable the catalyst diagnostic. To keep the test enabled the vehicle speed is between 58-125 km/h (36-77.7 MPH).
- Catalyst calculated temperature is between 600-900°C (1, 112-1, 652°F).
- Engine is operating in closed loop.
- Engine is operating in decel fuel cut off (DFCO).

This diagnostic attempts one test during each valid OFF-idle period once the above conditions have been met. This diagnostic attempts up to 3 tests during each drive cycle.

Conditions for Setting the DTC

The ECM determines that the efficiency of the catalyst has degraded below a calibrated threshold.

Action Taken When the DTC Sets

DTC P0420 and P0430 are Type A DTCs.

Conditions for Clearing the DTC

DTC P0420 and P0430 are Type A DTCs.

Diagnostic Aids

Inspect for the following conditions, which may cause a catalytic converter to degrade:

- Engine misfire
- High engine oil or high coolant consumption
- Retarded spark timing
- Weak or poor spark
- Lean fuel mixture
- Rich fuel mixture
- Damaged oxygen sensor or wiring harness

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify there are no other DTCs set.
 - **If a DTC is set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
 - **If a DTC is not set**
3. Operate the vehicle within the Conditions for Running the DTC.
4. Verify the scan tool Catalyst Monitor Not At Idle Test Conditions Met parameter changes to Yes.
 - **If Yes is not displayed**

Refer to step 3.

- **If Yes is displayed**

5. Monitor the scan tool Catalyst Monitor Test State parameter. When the parameter indicates Active, the Catalyst Monitor Test is running.

NOTE: When the test has completed, the Catalyst Monitor Test Counter Bank 1 and Bank 2 parameters will increment by one and the Catalyst Monitor Test Result Bank 1 and Bank 2 parameters will indicate Passed, Failed or No Result.

6. Continue to monitor the parameter. When the parameter indicates Inactive, the Catalyst Monitor Test has completed.

- **If the Catalyst Monitor Test Result Bank 1 or Bank 2 parameter indicates No Result**

Repeat steps 3-6 until the Test Result parameters indicate Passed or Failed.

- **If the Catalyst Monitor Test Result Bank 1 or Bank 2 parameter indicates Failed**

Refer to Circuit /System Testing

- **If the Catalyst Monitor Test Result Bank 1 and Bank 2 parameters indicate Pass**

7. All OK.

Circuit/System Testing

1. Verify the conditions listed below do not exist with the appropriate catalytic converter:

- Dents.
- Severe discoloration caused by excessive temperatures.
- Road damage.
- Internal rattles caused by damaged catalyst substrate.
- Restrictions.

- **If a condition is found**

Replace the catalytic converter.

- **If no condition is found**

2. Verify the conditions listed below do not exist with the exhaust system:

- Leaks.
- Restrictions.
- Physical damage.
- Loose or missing hardware.
- **If a condition is found**

Repair or replace the component as necessary.

- **If no condition is found**

3. Verify the conditions listed below do not exist with the appropriate B52B heated oxygen sensor 2:

- Not at the correct torque.
- Damage.

- **If a condition is found**

Replace the B52B heated oxygen sensor 2 or repair the condition as necessary.

- **If no condition is found**

4. Test or replace the catalytic converter.

Repair Instructions

- **Exhaust Leakage**
- **Restricted Exhaust**
- **Catalytic Converter Replacement - Left Side**
- **Catalytic Converter Replacement - Right Side**
- **Heated Oxygen Sensor Replacement - Bank 1 Sensor 2**
- **Heated Oxygen Sensor Replacement - Bank 2 Sensor 2**
- Perform the HO2S Heater Learn procedure with a scan tool after replacing a heated oxygen sensor.

Repair Verification

1. Install any components that have been removed or replaced during diagnosis.
2. Perform any adjustments, programming or setup procedures that are required when a component is removed or replaced.
3. Clear the DTCs with a scan tool.
4. Turn OFF the ignition for 60 s
5. Operate the vehicle within the Conditions for Running the DTC.
6. Verify the scan tool Catalyst Monitor Not At Idle Test Conditions Met parameter changes to Yes.
 - **If Yes is not displayed**

Refer to step 5.

- **If Yes is displayed**

7. Monitor the scan tool Catalyst Monitor Test State parameter. When the parameter indicates Active, the Catalyst Monitor Test is running.

NOTE: When the test has completed, the Catalyst Monitor Test Counter Bank 1 and Bank 2 parameters will increment by one and the Catalyst Monitor Test Result Bank 1 and Bank 2 parameters will indicate Passed, Failed or No Result.

8. Continue to monitor the parameter. When the parameter indicates Inactive, the Catalyst Monitor Test has completed.
 - If the Catalyst Monitor Test Result Bank 1 or Bank 2 parameter indicates No Result
Repeat steps 5-8 until the Test Result parameters indicate Passed or Failed
 - If the Catalyst Monitor Test Result Bank 1 or Bank 2 parameter indicates Failed
Refer to Circuit /System Testing
 - If the Catalyst Monitor Test Result Bank 1 and Bank 2 parameters indicate Pass
9. All OK.

DTC P0442

Diagnostic Instructions

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

DTC Descriptor

DTC P0442

Evaporative Emission (EVAP) System Small Leak Detected

Circuit/System Description

The engine off natural vacuum (EONV) test is the small leak detection diagnostic for the evaporative emission system. This diagnostic tests the evaporative emission (EVAP) system for a small leak when the key is turned OFF and the correct conditions are met. Heat from the exhaust system is transferred into the fuel tank while the vehicle is operating. Prior to running this test fuel volatility is analyzed then factored into this test. When the vehicle 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 engine control module (ECM) using the fuel tank pressure (FTP) sensor input. With a leak in the system, the amount of pressure change will be less than that of a sealed system.

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0125, P0128, P0443, P0446, P0449, P0452, P0453, P0455, P0502, P0503, P0722, P0723, P2610, P2227, P2228, P2229 P2230 are not set.
- The barometric pressure (BARO) is greater than 70 kPa.
- No fuel filling during the EONV test period.
- No key cycle during EONV or test will abort.
- The fuel level is between 10-90 %.
- The cold start-up engine coolant temperature (ECT) and the start-up intake air temperature (IAT) are within 8°C (46°F).
- The engine coolant temperature (ECT) is greater than 63°C (145°F).
- The engine run time before engine shut-off was greater than 10 min.
- The drive distance before engine shut-off was greater than 8 km (5 miles).
- The ambient air temperature at the end of the drive cycle is between 0-34°C (32-93°F).
- DTC P0442 runs once per drive cycle during the hot soak period after the ignition is turned OFF and may require up to 40 min to complete. The controller will not make more than 2 test attempts per day. The time since the last completed EONV test must be at least 17 h if passed or 10 h if failed.

Conditions for Setting the DTC

- The ECM detects a leak in the EVAP system that is greater than a calibrated amount.
- The ECM must complete several EONV tests before the diagnostic can turn the MIL on or off.

Action Taken When the DTC Sets

DTC P0442 is a Type A DTC.

Conditions for Clearing the DTC

DTC P0442 is a Type A DTC.

Diagnostic Aids

- The EVAP system can be filled with smoke more quickly and completely by opening the system opposite the end where the smoke is injected. When injecting smoke at the service port tool remove the fuel fill cap or temporarily leave the vent open, until smoke is observed then close the system and continue testing. If using a fuel cap adapter at the filler neck, use the **EN 41413-VLV** at the service port to allow the system to fill faster.
- To help locate intermittent leaks using the **GE 41413-A** , move all EVAP components while observing smoke with the **GE 41413-SPT** .
- Individual components can be isolated and tested using adapters in the **GE 41413-300** .
- A condition may exist where a leak in the EVAP system only exists under a vacuum condition. This type of leak may be detected by using the scan tool Purge/Seal function to create a

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Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **CH 48096** EVAP Service Access Port Tool
- **GE 41413-SPT** High Intensity White Light
- **GE 41413-A** Evaporative Emissions System Tester (EEST)
- **GE 41413-300** EVAP Cap and Plug Kit
- **EN 41413-VLV** EVAP Service Port Vent Fitting

For equivalent regional tools, refer to Special Tools (Diagnostic Tools)

Circuit/System Testing

NOTE:

- Refer to the **GE 41413-A** operation manual for detailed instructions in Evaporative Emission System Diagnosis .
- Larger volume fuel tanks and/or those with lower fuel levels may require

- **Ensure that the underbody temperature of the vehicle and the tester are similar.**

1. Disconnect the purge tube at the quick connector on the EVAP canister side of the Q12 Evaporative Emission Canister Purge Solenoid Valve and install the **CH 48096** .
2. Connect the **GE 41413-A** to the **CH 48096** .
3. Command the EVAP Purge/Seal function to System Seal with a scan tool to seal the EVAP system.
4. Use the flow meter on the **GE 41413-A** , calibrated to 0.51 mm (0.020 in) to determine if there is a leak.
 - **If a leak is detected**
 1. Use the **GE 41413-A** to apply smoke to the EVAP system at the purge tube until the leak is located using the **GE 41413-SPT** .
 - If leak is detected, repair or replace the affected component as necessary.
 - **If no leak is detected**
5. All OK.

Repair Instructions

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

DTC P0443, P0458 OR P0459

Diagnostic Instructions

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

DTC Descriptors

DTC 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
Ignition	P0030, P0031, P0037, P0050, P0051, P0134 P0135, P0155, P0300, P0443, P0458, P0506, P0597, P0598, P06DA, P0660, P0661, P3401, P3403, P3425, P3427, P3441, P3443	P0031, P0037, P0134 P0135, P0443, P0458, P0597, P0598, P0660, P0661	P0690
Control	P0443, P0458	P0443, P0458	P0459, P0690

Circuit/System Description

The evaporative emission (EVAP) purge solenoid valve is used to purge fuel vapor from the EVAP canister to the intake manifold. The EVAP purge solenoid valve is pulse width modulated (PWM). Ignition voltage is supplied directly to the EVAP purge solenoid valve. The engine control module (ECM) controls the solenoid valve by grounding the control circuit with a solid state device called a driver. The driver is equipped with a feedback circuit that is pulled-up to a voltage. The ECM can determine if the control circuit is open, shorted to ground or shorted to a voltage by monitoring the feedback voltage.

Conditions for Running the DTC

- The ignition voltage is greater than 11 V.
- The DTCs run continuously once the above conditions are met.

Conditions for Setting the DTC

P0443

The ECM detects the EVAP Purge Solenoid Valve control circuit is open within 0.25 s.

P0458

The ECM detects the EVAP Purge Solenoid Valve control circuit is shorted to ground within 0.25 s.

P0459

The ECM detects the EVAP Purge Solenoid Valve control circuit is shorted to voltage within 0.25 s.

Action Taken When the DTC Sets

DTC P0443, P0458 and P0459 are Type B DTCs.

Conditions for Clearing the DTC

DTC P0443, P0458 and P0459 are Type B DTCs.

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: The audible clicking intensity will vary depending on mounting locations and interference with the fuel injectors clicking. You may also feel a change in the frequency of clicking.

1. Ignition ON.
2. Command the EVAP Purge Solenoid Valve from 0 % to 50 % and back to 0 % with a scan tool while observing the following control circuit status parameters:
 - EVAP Purge Solenoid Valve Control Circuit Open Test Status

- EVAP Purge Solenoid Valve Control Circuit Low Voltage Test Status
- EVAP Purge Solenoid Valve Control Circuit High Voltage Test Status
- **If Malfunction is displayed**

Refer to Circuit/System Testing

- **If Malfunction is not displayed**

3. Verify the EVAP Purge Solenoid Valve Control Circuit parameters above do not display Malfunction when moving the related harnesses and connectors of the Q12 Evaporative Emission Purge Solenoid Valve.

- **If Malfunction is displayed**

Refer to Circuit/System Testing

- **If Malfunction is not displayed**

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 the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing

- **If the DTC does not set**

6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the Q12 Evaporative Emission Purge Solenoid Valve. Ignition ON,
2. Verify that a test lamp illuminates between the ignition voltage circuit terminal B or 1 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF, remove the test lamp.
 2. Test for infinite resistance between the ignition circuit and ground
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test all components connected to the ignition voltage circuit for a short and replace as necessary.

-
- **If the test lamp illuminates**
 - 3. Verify that a test lamp does not illuminate between the ignition circuit terminal B or 1 and the control circuit terminal A or 2.
 - **If the test lamp illuminates**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If the test lamp does not illuminate**
 - 4. Remove the test lamp.
 - 5. Verify the EVAP Purge Solenoid Valve Control Circuit High Voltage Test Status parameter is OK when commanding the EVAP Purge Solenoid Valve to 50 % with a scan tool.
 - **If OK is not displayed**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If OK is displayed**
 - 6. Install a 3 A fused jumper wire between the control circuit terminal A or 2 and the ignition circuit terminal B or 1.
 - 7. Verify the EVAP Purge Solenoid Valve Control Circuit High Voltage Test Status parameter is Malfunction when commanding the EVAP Purge Solenoid Valve to 50 % with a scan tool.
 - **If Malfunction is not displayed**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms replace the K20 Engine Control Module.
 - **If Malfunction is displayed**
 - 8. Test or replace the Q12 Evaporative Emission Purge Solenoid Valve.

Component Testing

Static Test

1. Ignition OFF, disconnect the harness connector at the Q12 Evaporative Emission Purge Solenoid Valve.
2. Test for 10-30 ohms between the control terminal A or 2 and the ignition, terminal B or 1.

- **If not between 10-30 ohms**

Replace the Q12 Evaporative Emission Purge Solenoid Valve.

- **If between 10-30 ohms**

3. All OK.

Dynamic Test

1. Ignition OFF, disconnect the harness connector at the Q12 Evaporative Emission Purge Solenoid Valve.
2. Install a 3 A fused jumper wire between the ignition, terminal B or 1 and 12 V. Install a jumper wire between the control terminal A or 2 and ground.
3. Verify the Evaporative Emission Purge Solenoid Valve turns on & off/clicks and flows vacuum.
 - **If it does not turn on & off/click or flow vacuum.**

Replace the Q12 Evaporative Emission Purge Solenoid Valve.

- **If it does turn on & off/clicks and flows vacuum.**

4. All OK

Repair Instructions

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

- **Evaporative Emission Canister Purge Solenoid Valve Replacement**
- **Control Module References** for ECM replacement, programming and setup.

DTC P0446

Diagnostic Instructions

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

DTC Descriptor

DTC P0446

Evaporative Emission (EVAP) Vent System Performance

Typical Scan Tool Data

Fuel Tank Pressure Sensor Signal Voltage	Fuel Tank Pressure
--	--------------------

1.5 V	Atmospheric Pressure / BARO
Less than 1.5 V	Positive Pressure
More than 1.5 V	Negative Pressure / Vacuum

Circuit/System Description

This DTC tests the evaporative emission (EVAP) system for a restricted or blocked EVAP vent path that would cause excess amounts of vacuum to be developed in the EVAP system. The engine control module (ECM) commands the EVAP purge solenoid valve Open and the EVAP vent solenoid valve Closed. This allows vacuum to be applied to the EVAP system. Once a calibrated vacuum level has been reached, the ECM commands the EVAP purge solenoid valve Closed and the EVAP vent solenoid valve Open. The ECM monitors the fuel tank pressure (FTP) sensor for a decrease in vacuum. If the vacuum does not decrease to near 0 in H₂O in a calibrated time, this DTC sets.

The following table illustrates the relationship between the ON and OFF states and the OPEN or CLOSED states of the EVAP purge and vent solenoid valves.

ECM Command	EVAP Purge Solenoid Valve	EVAP Vent Solenoid Valve
ON	Open	Closed
OFF	Closed	Open

Conditions for Running the DTC

- DTC P0068, P00C8, P00C9, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0121, P0122, P0123, P0128, P0191, P0192, P0193, P0222, P0223, P0443, P0601, P0604, P0606, P16A0, P16A1, P16A2, P16F3, P2101, P2135, P2176, is not set.
- The ignition voltage is between 11-32 V.
- The start up IAT is between 4-30°C (39-86°F).
- The start up ECT is less than 35°C (95°F)
- The barometric pressure (BARO) is greater than 70 kPa.
- The fuel level is between 10-90 %.
- This test will start and run once per cold start for no greater than 17 min.

Conditions for Setting the DTC

NOTE: There are two stages to setting this DTC. Stage one, prep test, then stage two test.

- If fuel tank pressure sensor reading is greater than 2.5 in H₂O of pressure or less than -5 in H₂O of vacuum for 60 s.

OR

-
- If fuel tank pressure sensor reading is less than -12 in H₂O of vacuum for 5 s before 10 L (2.6 gal) of purge volume.
 - After setting the DTC for the first time, 2 L (0.5 gal) of fuel must be consumed before setting the DTC for the second time.

Action Taken When the DTC Sets

DTC P0446 is a Type B DTC.

Conditions for Clearing the DTC

DTC P0446 is a Type B DTC.

Diagnostic Aids

An intermittent condition could be caused by a damaged EVAP vent housing, a temporary blockage at the EVAP vent solenoid valve inlet or a pinched vent hose. A blockage in the vent system may also cause a poor fuel fill problem.

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DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- CH 41415-30 Fuel Tank Cap Adapter
- GE 41413-A Evaporative Emissions System Tester (EEST)

For equivalent regional tools, refer to **Special Tools (Diagnostic Tools)** .

Circuit/System Verification

1. Ignition ON.
2. Verify DTC P0443 is not set.
 - **If the DTC is set**

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

- **If the DTC is not set**
3. Ignition OFF, remove the fuel tank filler cap. Ignition ON.
 4. Verify the scan tool Fuel Tank Pressure Sensor voltage parameter is within 1.3-1.7 V.
 - **If not between the 1.3-1.7 V**

Refer to P0452, P0453 within **DTC P0451-P0454**.

- **If between the 1.3-1.7 V**
5. Install the fuel tank filler cap. Engine idling at operating temperature for 5 min,
 6. Verify the scan tool Fuel Tank Pressure Sensor parameter does not increase to greater than 2.5 V when commanding the EVAP Purge Solenoid Valve to 50 %.
 - **If greater than 2.5 V**

Refer to Circuit System Testing.

- **If 2.5 V or less**
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.
 - **If the DTC sets**

Refer to Circuit System Testing.

- **If the DTC does not set**
8. All OK.

Circuit/System Testing

NOTE: **Perform the Circuit/System Verification before proceeding with the Circuit/System Testing.**

1. Test for a blockage or restrictions in the EVAP system components listed below and repair as necessary.
 - Evaporative Emission Vent System Hoses
 - Evaporative Emission Canister
 - Q13 Evaporative Emission Vent Solenoid Valve
 - Evaporative Emission Vent Filter
2. Reconnect all previously disconnected EVAP hardware.

NOTE: **Refer to the GE-41413-A operation manual for detailed instructions in Evaporative Emission System Diagnosis .**

3. Remove the fuel fill cap and connect the CH 41415-30 to the fuel tank filler neck. Connect the GE 41413-A to the CH 41415-30.
4. Command the EVAP Purge/Seal function to System Seal with a scan tool to seal the EVAP system.
5. Turn the nitrogen/smoke valve on the GE 41413-A to nitrogen.

NOTE: **DO NOT exceed the specified value in this step. Exceeding the specified value may produce incorrect test results.**

6. Use the remote switch to activate the GE 41413-A and pressurize the fuel tank to 5.0 in H2O.
7. Verify the scan tool Fuel Tank Pressure Sensor parameter is 0 in H2O when commanding the EVAP Vent Solenoid Valve to OFF.

- **If not 0 in H2O**

Test for a blockage or a restriction in the EVAP vent hose or inlet. If the inlet or hose test normal, replace the Q13 Evaporative Emission Vent Solenoid Valve.

- **If 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.

- **If the DTC sets**

Refer to step 1 above.

- **If the DTC does not set**

9. All OK.

Repair Instructions

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

- **Evaporative Emission Canister Solenoid Replacement** for EVAP Vent Solenoid Valve replacement.
- **Evaporative Emission Canister Replacement**
- **Fuel Tank Pressure Sensor Replacement**

DTC P0449, P0498 OR P0499

Diagnostic Instructions

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

DTC Descriptors

DTC 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
B+	P0449, P0498	P0449	-
Control	P0449, P0498	P0449	P0499

Circuit/System Description

Battery voltage is supplied to the evaporative emission (EVAP) vent solenoid valve through a fuse. The engine control module (ECM) grounds the EVAP vent solenoid valve control circuit through an internal switch called a driver. The ECM monitors the status of the driver. A scan tool will display the commanded state of the EVAP Vent Solenoid Valve as ON (Not Venting) or OFF (Venting).

Conditions for Running the DTC

The DTCs run continuously once the above conditions are met.

Conditions for Setting the DTC

P0449

The ECM detects the EVAP Vent Solenoid Valve control circuit is open within 0.25 s.

P0498

The ECM detects the EVAP Vent Solenoid Valve control circuit is shorted to ground within 0.25 s.

P0499

The ECM detects the EVAP Vent Solenoid Valve control circuit is shorted to voltage within 0.25 s.

Action Taken When the DTC Sets

DTC P0449, P0498 and P0499 are Type B DTCs.

Conditions for Clearing the DTC

DTC P0449, P0498 and P0499 are Type B DTCs.

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **An audible click may be heard when performing step 2 below.**

1. Ignition ON.
2. Command the EVAP Vent Solenoid Valve to ON (Not Venting) and OFF (Venting) with a scan tool while observing the following control circuit status parameters:
 - EVAP Vent Solenoid Valve Control Circuit Open Test Status
 - EVAP Vent Solenoid Valve Control Circuit Low Voltage Test Status
 - EVAP Vent Solenoid Valve Control Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing

- **If Malfunction is not displayed**
3. Verify the EVAP Vent Solenoid Valve Control Circuit parameters above do not display Malfunction when moving the related harnesses and connectors of the Q13 Evaporative Emission Vent Solenoid Valve.
 - **If Malfunction is displayed**

Refer to Circuit/System Testing

- **If Malfunction is not displayed**
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 the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing

- **If the DTC does not set**
6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the Q13 Evaporative Emission Vent Solenoid Valve, Ignition ON,
2. Verify that a test lamp illuminates between the B+ circuit terminal A or 2 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**

-
1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF, remove the test lamp.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test all components connected to the B+ circuit for a short and replace as necessary.
 - **If the test lamp illuminates**
 3. Verify that a test lamp does not illuminate between the B+ circuit terminal A or 2 and the control circuit terminal B or 1.
 - **If the test lamp illuminates**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If the test lamp does not illuminate**
 4. Remove the test lamp.
 5. Verify the scan tool EVAP Vent Solenoid Valve Control Circuit High Voltage Test Status parameter is OK when commanding the EVAP Vent Solenoid Valve to ON (Not Venting) with a scan tool.
 - **If OK is not displayed**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, Ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If OK is displayed**
 6. Install a 3 A fused jumper wire between the control circuit terminal B or 1 and the B+ circuit terminal A or 2.
 7. Verify the scan tool EVAP Vent Solenoid Valve Control Circuit High Voltage Test Status parameter is Malfunction when commanding the EVAP Vent Solenoid Valve to ON (Not Venting) with a scan tool.
 - **If Malfunction is not displayed**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.

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

- **If Malfunction is displayed**

8. Test or replace the Q13 Evaporative Emission Vent Solenoid Valve.

Component Testing

1. Ignition OFF, disconnect the harness connector at the Q13 Evaporative Emission Vent Solenoid Valve.
2. Test for 10-30 ohms between the control terminal B or 1 and the B+ circuit terminal A or 2.
 - **If not between 10-30 ohms**

Replace the Q13 Evaporative Emission Vent Solenoid Valve.

- **If between 10-30 ohms**

3. All OK.

Repair Instructions

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

- **Evaporative Emission Canister Solenoid Replacement** for EVAP Vent Solenoid Valve replacement.
- **Control Module References** for ECM replacement, programming and setup

DTC P0451-P0454

Diagnostic Instructions

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

DTC Descriptors

DTC P0451

Fuel Tank Pressure Sensor Performance

DTC P0452

Fuel Tank Pressure Sensor Circuit Low Voltage

Fuel Tank Pressure Sensor Circuit High Voltage

DTC P0454

Fuel Tank Pressure Sensor Circuit Intermittent

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
5 V Reference	P018C, P0192, P0452, P0522, P0532, P0641, P127C, P2227, P2228	P0451	P0446, P0452	P018D, P0193, P0453, P0523, P0533, P0641, P127D, P2227	-
Signal	P0192, P0452, P0641, P2230	P0451	P0452, P0453	P0453	P0451, P0454
Low Reference	-	P0446, P0451	P0446, P0453, P0463	-	P0451

Typical Scan Tool Data

FTP Sensor Voltage

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON, Engine OFF			
Parameter Normal Range: 1.3-1.7 V			
FTP Sensor 5 V Reference	0 V	0 V	4.2-5 V
FTP Sensor Signal	0 V	0 V	5 V
FTP Sensor Low Reference	-	4.5 V	-

Circuit/System Description

The Fuel Tank Pressure (FTP) sensor measures air pressure or vacuum in the evaporative emission (EVAP) system. The engine control module (ECM) supplies a 5 V reference and a low reference circuit to the FTP sensor. The FTP sensor signal voltage varies depending on EVAP system pressure or vacuum. The controller also uses this FTP signal to determine atmospheric pressure for use in the engine-off small leak test, DTC P0442. Before using this signal as an atmospheric reference it must first be re-zeroed.

Conditions for Running the DTC

P0451

- DTC P0451 runs only when the engine-off natural vacuum small leak test, P0442, executes.
- The number of times this test runs can range from 0-2 per engine-off period. The length of the test can be up to 10 min.

P0452 and P0453

DTC P0452 and P0453 run continuously when the ignition is ON.

P0454

- DTC P0454 runs only when the engine-off natural vacuum small leak test, P0442, executes.
- This test can run once per engine-off period. The length of the test can be up to 10 min.
- A refueling event is not detected. A refueling event is confirmed if the fuel level has a persistent change of 10 % for 30 s during a 10 min refueling rationality test.

Conditions for Setting the DTC

P0451

This DTC will set if the controller is unable to re-zero the FTP Sensor voltage within a calibrated range during the engine-off small leak test, P0442.

P0452

The FTP Sensor voltage is less than 0.15 V for more than 10 s.

P0453

The FTP Sensor voltage is more than 4.9 V for more than 10 s.

P0454

If, during the engine-off natural vacuum small leak test, P0442, the ECM detects an abrupt FTP signal change, other than a refueling event, this DTC will set. An abrupt change is defined as a change of greater than 0.45 in H₂O in the span of 1 s but less than 1 in H₂O in 12.5 ms. This test must fail twice to set this DTC.

Action Taken When the DTC Sets

- DTCs P0451 and P0454 are Type A DTCs.
- DTCs P0452 and P0453 are Type B DTCs.

Conditions for Clearing the MIL/DTC

- DTCs P0451 and P0454 are Type A DTCs.
- DTCs P0452 and P0453 are Type B DTCs.

Diagnostic Aids

P0451 and P0454

- A restriction in the EVAP canister or vent lines could prevent fuel vapor pressure from bleeding off fast enough. If the vent system cannot bleed off pressure fast enough, the re-zero procedure may not complete successfully, which could cause this code to set.
- Ensure that the reference port on the FTP Sensor is unobstructed.
- An FTP Sensor that is skewed or does not have a linear transition from low to high may cause this code to set. Scan tool output controls, snapshot and plot functions can help detect erratic sensor response. To test the sensor signal under vacuum conditions, use the Quick Snapshot and the Purge/Seal functions to capture data while commanding purge to 20 %, then plot the data to look for erratic sensor operation. A similar test can be done for the pressure side of the sensor operation by applying pressure with the **GE 41413-A** while taking a snapshot.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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

Control Module References for scan tool information

Special Tools

GE 41413-A Evaporative Emission System Tester (EEST)

For equivalent regional tools, refer to **Special Tools**

Circuit/System Verification

1. Remove the fuel cap.
2. Ignition ON, engine OFF.
3. Verify the scan tool Fuel Tank Pressure Sensor parameter is between 1.3 and 1.7 V.
 - **If not between 1.3-1.7 V**

Refer to Circuit/System Testing

- **If between 1.3-1.7 V**
4. All OK.

Circuit/System Testing

1. Ignition OFF, all vehicle systems OFF, this may take up to 2 min, for all vehicle systems to power down. Disconnect the harness connector at the B150 Fuel Tank Pressure Sensor.
2. Test for less than 5 ohms of resistance between the low reference circuit terminal 2 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If less than 5 ohms**
3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 3 and ground.
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the 5 V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8-5.2 V**
5. 5. Verify the scan tool Fuel Tank Pressure parameter is less than 0.2 V.
 - **If 0.2 V or greater**
1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON
2. Test for less than 1 V between the signal circuit terminal 1 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If less than 0.2 V**
6. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the 5 V reference circuit terminal 3.
7. Verify the scan tool Fuel Tank Pressure Sensor parameter is greater than 4.7 V.
 - **If 4.7 V or less**
1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If greater than 4.7 V**
8. Test or replace the B150 Fuel Tank Pressure Sensor.

Repair Instructions

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

- **Fuel Tank Pressure Sensor Replacement**
- **Control Module References** for ECM replacement, programming and setup

DTC P0455

Diagnostic Instructions

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

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

DTC Descriptor

DTC P0455

Evaporative Emission (EVAP) System Large Leak Detected

Circuit/System Description

The engine control module (ECM) tests the evaporative emission (EVAP) system for a large leak or restrictions to the purge path in the EVAP system. When the enabling criteria has been met, the ECM commands the EVAP vent solenoid valve and purge solenoid valve ON, allowing vacuum into the EVAP system. The ECM monitors the fuel tank pressure (FTP) sensor voltage to verify that the system is able to reach a predetermined level of vacuum within a set amount of time.

Conditions for Running the DTC

- DTCs P0068, P00C8, P00C9, P00CA, P0090, P0091, P0092, P0106, P0107, P0108, P0111, P0112, P0113, P0114 P0116, P0117, P0118, P0122, P0123, P0125, P0128, P0191, P0192, P0193, P0222, P0223, P06A3, P06DB, P06DE, P0A1D, P0443, P0449, P0452, P0453, P0502, P0503, P0601, P0604, P0606, P0697, P160D, P160E P1682, P16A0, P16A1, P16A2, P16F3, P1104, P127A, P127C, P127D, P15F2, P2100, P2101, P2102, P2103, P2122, P2123, P2127, P2128, P2135, P2138, P215B, P2176, P228C, P228D, U0073, U0074, U0293, U1817 are not set.
- The ignition voltage is between 11-32 V.
- The barometric pressure (BARO) is greater than 70 kPa.
- The fuel level is between 10-90 %.
- The EVAP purge flow is greater than 2.50 %
- The cold startup engine coolant temperature (ECT) and the startup intake air temperature (IAT) are within 8°C (46°F).
- The startup engine coolant temperature (ECT) is less than 35°C (95°F).
- The startup intake air temperature (IAT) is between 4-30°C (39-86°F).
- DTC P0455 runs once per cold start, for up to 17 min, when the above conditions are met.

Conditions for Setting the DTC

- The EVAP system is not able to achieve or maintain a calibrated level of vacuum within a set amount of time.
- After setting the DTC for the first time, 2 L (0.5 gal) of fuel must be consumed before setting the DTC for the second time.
- With a DTC P0455 detected a weak vacuum follow-up test (fuel cap replacement test) will run and passes if tank vacuum is greater than 2.74 kPa (11 in H2O). This test will run for a maximum of 22 min. This test runs until it passes.

Action Taken When the DTC Sets

DTC P0455 is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P0455 is a Type B DTC.

Diagnostic Aids

- Inspect for a loose, missing, damaged or incorrect fuel fill cap.
- Inspect for a damaged fuel filler neck seal surface.
- A blockage or restriction in the EVAP purge solenoid valve, purge pipe, EVAP canister or vapor pipe, can cause this DTC to set.
- The EVAP system can be filled with smoke more quickly and completely by opening the system opposite the end where the smoke is injected. For example, when injecting smoke at the service port remove the fuel fill cap or temporarily leave the vent open, until smoke is observed, then close the system and continue testing. If using a fuel cap adapter at the filler neck, use the **J 41413-VLV** at the service port to allow the system to fill faster.
- To help locate intermittent leaks using the **GE 41413-A** , move all EVAP components while observing smoke with the **GE 41413-SPT** .
- Individual components can be isolated and tested using adapters in the **J 41413-300** .
- A condition may exist where a leak in the EVAP system only exists under a vacuum condition. This type of leak may be detected by using the scan tool Purge/Seal function to create a vacuum in the EVAP system and then observe the Fuel Tank Pressure Sensor parameter for vacuum decay.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Evaporative Emission Control System Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs

- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **CH 48096** EVAP Service Access Port Tool
- **GE 41415-30** Fuel Tank Cap Adapter
- **GE 41413-A** Evaporative Emissions System Tester (EEST)
- **J 41413-300** EVAP Cap and Plug Kit
- **GE 41413-SPT** High Intensity White Light
- **J 41413-311** EVAP Plug
- **J 41413-VLV** EVAP Service Port Vent Fitting

For equivalent regional tools, refer to **Special Tools (Diagnostic Tools)**

Circuit/System Testing

IMPORTANT:

- **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.**
- **Refer to the GE 41413-A operation manual for detailed instructions in Evaporative Emission System Diagnosis .**

1. Disconnect the purge tube at the quick connector on the EVAP canister side of the purge solenoid valve and install the **CH 48096** .
2. Connect the **GE 41413-A** to the vehicle EVAP service port adapter.
3. Command the EVAP Purge/Seal function to System Seal with a scan tool to seal the EVAP system.
4. Verify that there is no leak in the EVAP system using the flow meter on the **GE 41413-A** , calibrated to 0.51 mm (0.020 in).
 - **If a leak is detected**
 1. Apply smoke to the EVAP system at the service access port adapter with the **GE 41413-A** .
 2. Locate the leak using the **GE 41413-SPT** .
 - When the leak is located, repair or replace the affected component as necessary.

- If no leak detected

NOTE: The steps below test for a restriction in the purge path.

5. Connect the **GE 41413-A** nitrogen/smoke hose to the **J 41413-311** .
6. Disconnect the hose at the fuel cap end of the **GE 41415-30** and connect to the **J 41413-311** .
7. Install the **GE 41415-30** , filler neck end only, to the vehicle.
8. Engine idling, command the Purge/Seal function to Not Venting with a scan tool to seal the system.
9. Command the EVAP Purge Solenoid Valve to 30 % with a scan tool.
10. Verify the vacuum/pressure gauge on the **GE 41413-A** and the scan tool Fuel Tank Pressure Sensor parameter both show vacuum.
 - **If the vacuum/pressure gauge shows vacuum and the Fuel Tank Pressure Sensor parameter does not show vacuum**

Replace the B150 Fuel Tank Pressure Sensor.
 - **If both the Fuel Tank Pressure Sensor parameter and the vacuum/pressure gauge do not show vacuum**

Repair the restriction in the purge path.
11. Verify that the Fuel Tank Pressure Sensor parameter increases to greater than 3.2 V and the pressure values are similar between the scan tool Fuel Tank Pressure Sensor and the vacuum/pressure gauge on the **GE 41413-A** .
 - **If not within the specified range**

Replace the B150 Fuel Tank Pressure Sensor.
 - **If within the specified range**
12. All OK

Repair Instructions

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

- **Fuel Tank Pressure Sensor Replacement**
- **Control Module References** for ECM replacement, programming and setup.

DTC P0496

Diagnostic Instructions

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

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

DTC Descriptor

DTC P0496

Evaporative Emission (EVAP) System Flow During Non-Purge

Circuit/System Description

This DTC tests for undesired intake manifold vacuum flow to the evaporative emission (EVAP) system. The engine control module (ECM) seals the EVAP system by commanding the EVAP purge solenoid valve OFF and the vent solenoid valve ON. The ECM 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.

The following table illustrates the relationship between the ON and OFF states and the Open or Closed states of the EVAP purge and vent solenoid valves.

ECM Command	EVAP Purge Solenoid Valve	EVAP Vent Solenoid Valve
ON	Open	Closed
OFF	Closed	Open

Conditions for Running the DTC

- DTCs P0068, P00C8, P00C9, P00CA, P0090, P0091, P0092, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0122, P0123, P0125, P0128, P0191, P0192, P0193, P0222, P0223, P06A3, P06DB, P06DE, P0A1D, P160D, P160E, P1682, P16A0, P16A1, P16A2, P16F3, P1104, P127A, P127C, P127D, P15F2, P0443, P0449, P0452, P0453, P0454, P0502, P0503, P0601, P0604, P0606, P0697, P2100, P2101, P2102, P2103, P2122, P2123, P2127, P2128, P2135, P2138, P215B, P2176, P228C, P228D, U0073, U0074, U0293, U1817 are not set.
- The ignition voltage is between 11-32 V.
- The engine OFF time is greater than 48 min,
- The barometric pressure (BARO) is greater than 70 kPa.
- The fuel level is between 10-90 %.
- The startup engine coolant temperature (ECT) is less than 35°C (95°F).
- The startup intake air temperature (IAT) is between 4-30°C (39-86°F).
- DTC P0496 runs once per cold start, for up to 17 min, when the above conditions are met. This test will run with the purge valve and the vent valve closed.

Conditions for Setting the DTC

Action Taken When the DTC Sets

DTC P0496 is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P0496 is a Type B DTC.

Diagnostic Aids

An intermittent condition could be caused by an improperly installed or damaged EVAP Purge Solenoid Valve or by a temporary blockage or restriction in the EVAP Purge Solenoid Valve.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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 for scan tool information

Circuit/System Verification

1. 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.

- **If the DTC sets**

Refer to Circuit/System Testing

- **If the DTC does not set**

3. All OK

Circuit/System Testing

1. Ignition ON, engine OFF.
2. Command the EVAP Purge/Seal function to System Seal with a scan tool to seal the EVAP system.
3. Start the engine.
4. Observe the Fuel Tank Pressure Sensor with a scan tool. The Fuel Tank Pressure Sensor parameter should be less than 1.7 V after 90 s.

- **If not within specifications**

Replace the Q12 Evaporative Emission Purge Solenoid Valve

- **Within Specifications**

5. All OK

Repair Instructions

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

Evaporative Emission Canister Purge Solenoid Valve Replacement

DTC P0506 OR P0507

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.

DTC Descriptors

DTC P0506

Idle Speed Low

DTC P0507

Idle Speed High

Circuit/System Description

The throttle actuator control (TAC) motor is controlled by the engine control module (ECM). The DC motor located in the throttle body drives the throttle blade. In order to decrease idle speed, along with spark and fuel delivery changes the ECM commands the throttle closed reducing air flow into the engine and the idle speed decreases. In order to increase idle speed, the ECM commands the throttle plate open allowing more air to pass the throttle plate.

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0112, P0113, P0116, P0117, P0118, P0120, P0121, P0122, P0123, P0128, P0171, P0172, P0174, P0175, P0201-P0208, P0220, P0222, P0223, P0300-P0308, P0351-P0358, P0461- P0463, P0496, P0502, P0503, P0606, P0722, P0723, P0806-P0808, P1516, P2066-P2068, P2101, P2135 are not set.
- The engine is operating for at least 60 s.
- The engine is idling for greater than 5 s.
- The barometric pressure (BARO) is greater than 70 kPa (11 psi).
- The engine coolant temperature (ECT) is greater than 60°C (140°F).
- The intake air temperature (IAT) is warmer than -20°C (-4°F).
- The vehicle speed is less than 1.6 km/h (1 mph).
- The commanded engine speed is steady within 25 RPM.
- The transmission is not changing gears.
- The torque converter clutch (TCC) is not changing states.
- The manual transmission clutch pedal position is less than 25 percent or greater than 88 percent - If equipped.
- The manual transmission clutch is not depressed - If equipped.
- The power take-off (PTO) is not active - If equipped.
- The transfer case is not in 4WD Low - If equipped.
- A scan tool output control is not active.
- The system voltage is between 11-32 V.
- DTC P0506 and P0507 run continuously when the above conditions are met for greater than 10 s.

Conditions for Setting the DTC

P0506

The actual idle speed is approximately 94 RPM lower than the desired idle speed.

P0507

The actual idle speed is approximately 188 RPM greater than the desired idle speed.

DTCs P0506 and P0507 are Type B DTCs.

Conditions for Clearing the MIL/DTC

DTCs P0506 and P0507 are Type B DTCs.

Diagnostic Aids

- A stalling condition can cause DTC P0506 to set.
- An intermittent vehicle speed sensor (VSS) signal can cause DTC P0507 to set.
- An intermittent clutch pedal position sensor signal, if equipped, can cause DTC P0506 to set.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

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 for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify there are no other DTCs set.

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for further diagnosis.

- **If no other DTCs are set**

3. Verify the scan tool Throttle Body Idle Airflow Compensation parameter is less than 90 %.

- **90 % or greater**

Refer to **Throttle Body Cleaning** .

- **If less than 90 %**

4. Engine Idling at the normal operating temperature.

NOTE: **The engine must run for greater than 60 s, then idle at a steady state for an additional 10 s before comparing the actual and desired engine speed parameters.**

5. Verify the actual Engine Speed is not 100 RPM less than the Desired Idle Speed.

- **If 100 RPM less than the Desired Idle Speed**

Refer to Circuit/System Testing

- **If 100 RPM greater than the Desired Idle Speed**

6. Verify the actual Engine Speed is not 200 RPM greater than the Desired Idle Speed.

- **If 200 RPM greater than the Desired Idle Speed**

Refer to Circuit/System Testing

- **If 200 RPM less than the Desired Idle Speed**

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 a DTC does not set.

- **If a DTC sets**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for further diagnosis.

- **If no DTC sets**

9. All OK

Circuit/System Testing

P0506

1. Verify the conditions listed below do not exist.

- Restricted exhaust

- Parasitic load on the engine-For example, a transmission condition, a belt driven accessory condition.

- **If a condition is found**

Repair as necessary.

- **If a condition is not found**

2. All OK.

P0507

1. Verify the conditions listed below do not exist.

- Vacuum leaks
- A throttle valve that does not close correctly
- Verify the correct operation of the crankcase ventilation system. Inspect for the conditions listed below:
 - Improper routing of the positive crankcase ventilation (PCV) system
 - Vacuum leaks in the PCV system-Refer to **Crankcase Ventilation System Inspection/Diagnosis** .

- **If a condition is found**

Repair as necessary.

- **If a condition is not found**

2. All OK.

Repair Instructions

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

Throttle Body Assembly Replacement

DTC P050D

Diagnostic Instructions

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

DTC Descriptor

DTC P050D

Cold Start Rough Idle

Circuit/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 sensor 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 code will be set.

Conditions for Running the DTC

- DTCs P0010, P0011, P0016, 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, P0628, P069E, P1248, P1249, P124A, P124B, P124C, P124D, P1258, P135A, P135B, P150C, P163A, P1762, P2122, P2123, P2127, P2128, P2135, P2138, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216B, P216C, P216E, P216F, P228C, P228D, U0109 are not set.
- The catalyst temperature is less than 300°C (572°F).
- The engine coolant temperature is between 17-43°C (62-110°F).
- The barometric pressure is greater than 75 kPa.
- The engine speed is between 550-2000 RPM.
- The engine is running less than 100 seconds.
- Accelerator position is less than 1 %.
- DTC P050D runs once per cold start.

Conditions for Setting the DTC

This DTC will set if the engine control module detects variations in crankshaft rotation speed caused by the lack of adequate fuel delivery during dual-pulse mode.

Action Taken When the DTC Sets

- DTC P050D is a Type B DTC.
- The engine control module disables dual pulse mode and energizes the fuel injector as it would for a warm engine.

Conditions for Clearing the DTC

DTC P050D is a Type B DTC.

Diagnostic Aids

-

and indicates the condition to diagnose is related to fuel and/or injectors, not the ignition/spark system.

- A restricted fuel injector may cause this DTC to set.
- High resistance in the circuits of the fuel injectors could set this DTC without setting an injector DTC. Test the fuel injector circuits of the affected cylinders for a high resistance if you suspect a condition. Refer to **Fuel Injector Diagnosis** .
- A drop in system voltage during cold start may set this DTC.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

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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 for scan tool information

Circuit/System Testing

NOTE: **Circuit/System Testing requires cold start. Do not start vehicle prior to connecting scan tool and preparing to evaluate the condition during engine crank.**

1. Start the engine and observe the Cylinder 1-8 Current Misfire Counters during the first 500 engine cycles. The Cylinder 1-8 Current Misfire Counters should not be incrementing.

- **If the misfire counters are incrementing on one or more cylinders**
 1. Ignition OFF.
 2. Verify that the following conditions do not exist:
 - Fuel pressure that is too low or too high - Refer to **Fuel System Diagnosis** .
 - Contaminated fuel - Refer to **Alcohol/Contaminants-in-Fuel Diagnosis** .
 - If a condition exist, repair as necessary.
 - If none of the conditions exist, replace the Q17 Fuel Injector(s) as indicated by high misfire counts.
 - **If the misfire counters are not incrementing**
- 2. All OK.

Repair Instructions

Fuel Injector Replacement

Repair Verification

NOTE: **Repair Verification requires cold start.**

1. Ignition ON, engine OFF, clear the DTCs with a scan tool.
2. Start the engine.
3. Verify the DTC does not reset.

DTC P057B-P057D

Diagnostic Instructions

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

DTC Descriptors

DTC P057B

Brake Pedal Position Sensor Performance

DTC P057C

Brake Pedal Position Sensor Circuit Low Voltage

DTC P057D

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P057C	P057C	P057D	P057B
5 V Reference	P057C P0651	P057C	P0651	-
Low Reference	-	P057D	P057D	-

Typical Scan Tool Data

Brake Pedal Position Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON. Brake Pedal Position Sensor Parameter Normal Range: 0.25-4.75 V			
5 V Reference	0 V	0 V	-
Signal	0 V	0 V	5 V
Low Reference	-	5 V	-

Circuit/System Description

The brake pedal position (BPP) sensor is part of the engine brake pedal override feature. The engine control module (ECM) continuously monitors the vehicle speed and the position of the brake pedal. These two main inputs, along with other ECM inputs are used to determine if the vehicle is decelerating at the proper speed and rate with the brake pedal applied. When the engine brake pedal override system is active, the ECM reduces engine torque to assist in reducing vehicle speed.

The BPP sensor is a six wire sensor and is part of a dual brake position sensor. One BPP Sensor is used for the stop lamps and the other BPP Sensor is used for the engine brake pedal override feature. The BPP Sensor for engine brake pedal override communicates with the ECM. The ECM supplies a 5 V reference circuit, low reference circuit and signal circuit to the BPP sensor. The BPP sensor sends a voltage signal to the ECM on the signal circuit. The voltage on the signal circuit will vary from a voltage greater than 0.25 V when the brake pedal is released to a voltage less than 4.75 V when the brake pedal is fully applied.

For information on the Stop Lamps side of the BPP Sensor, refer to **Exterior Lighting Systems Description and Operation** .

Conditions for Running the DTC

- Ignition voltage is greater than 10 V.
- DTC runs continuous when above condition is met.

Conditions for Setting the DTC

P057B

ECM detects the BPP sensor signal is stuck in a range.

P057C

ECM detects the BPP sensor voltage is less than 0.25 V for 1 s.

P057D

ECM detects the BPP sensor voltage is greater than 4.75 V for 1 s.

Action Taken When the DTC Sets

- P057B, P057C and P057D are Type A DTCs.
- Engine torque is reduced to 50% of available engine torque during brake torque management.
- Brake torque management is active at 25 kPa (3.7 PSI) of brake apply pressure.

Conditions for Clearing the DTC

P057B, P057C and P057D are Type A DTCs

Reference Information

Schematic Reference

- **Engine Controls Schematics**
- **Exterior Lights Schematics**

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Inline Harness Connector End Views**

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC P0641, P0651, P0697 or P06A3 is not set.

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

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

- **If none of the DTCs are set**

2. Ignition ON, transmission in Park and service brake pedal released.
3. Verify the scan tool Brake Pedal Position Sensor parameter in the ECM displays greater than 0.25 V.

- **If 0.25 V or less**

Refer to Circuit/System Testing.

- **If greater than 0.25 V**

4. Verify the scan tool Brake Pedal Position Sensor parameter voltage changes as the brake pedal is applied and displays less than 4.75 V when the brake pedal is fully applied.

- **If the voltage does not change or is greater than 4.74 V**

Refer to Circuit/System Testing.

- **If the voltage changes and less than 4.75 V**

5. Verify the scan tool Brake Pedal Position Sensor Learned Release Position parameter is within 0.1 V of the Brake Pedal Position Sensor parameter when the brake pedal is fully released.

- **If difference is greater than 0.1 V**

Perform the **Brake Pedal Position Sensor Learn** .

- **If difference is 0.1 V or less**

6. Verify the Brake Pedal Position Sensor parameter transitions smoothly without any spikes or dropouts when slowly applying and releasing the brake pedal.

- **If parameter does not transition smoothly or has spikes or dropouts**

Refer to Circuit/System Testing.

- **If parameter transitions smoothly and there are no spikes or dropouts**

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.

- **If the DTC does not set**

9. All OK.

Circuit/System Testing

NOTE: You must perform the Circuit/System Verification first.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B22 Brake Pedal Position Sensor. It may take up to 2 minutes for all vehicle systems to power down.

NOTE: All terminal references are for the vehicle harness brake pedal position sensor connector.

2. Test for less than 10 ohms between the low reference circuit terminal 6 and ground.

- **If 10 ohms or greater**

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

- **If less than 10 ohms**

3. Ignition ON.

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

- **If less than 4.8 V**

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

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

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

- **If greater than 5.2 V**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.

-
- **If between 4.8-5.2 V**
 - 5. Verify the scan tool Brake Pedal Position Sensor parameter is less than 0.25 V.
 - **If 0.25 V or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 0.25 V between the signal circuit terminal 4 and ground.
 - If 0.25 V or greater, repair the short to voltage on the circuit.
 - If less than 0.25 V, replace the K20 Engine Control Module.
 - **If less than 0.25 V**
 - 6. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the 5 V reference circuit terminal 5.
 - 7. Verify the scan tool Brake Pedal Position Sensor parameter is greater than 4.8 V.
 - **If 4.8 V or less**
 1. Ignition OFF, remove the jumper wire and disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If greater than 4.8 V**
 - 8. Replace the B22 Brake Pedal Position Sensor.

Repair Instructions

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

- **Brake Pedal Position Sensor Replacement**
- Perform the **Brake Pedal Position Sensor Learn** following the replacement of the ECM or BPP sensor or any repair that effects the BPP sensor alignment.
- **Control Module References** for Engine Control Module replacement, programming and setup.

DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3 OR P262B (ECM)

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 of the diagnostic category.

DTC Descriptors

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 P0606

Control Module Processor 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 Control Module (ECM)

DTC P16F3

Control Module Redundant Memory Performance

DTC P262B

Control Module Power Off Timer Performance

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the engine control module (ECM). This diagnostic also addresses if the ECM is not programmed.

Conditions for Running the DTCs

P0601, P0602, P0630

These DTCs run continuously when the ignition is ON.

P0603, P062F

These DTCs run during ECM power up.

P0604

DTC P0604 runs continuously when the ignition is ON for greater than 30 s.

P0606, P062B

- The ignition is ON.
- The system voltage is greater than 11 V.
- These DTCs run continuously when the above conditions are met.

P16F3

- The engine speed is greater than 500 RPM.
- DTCs P0101, P0102, P0103, P0106, P0107, P0108, P2227, P2228, P2229 or P2230 are not set.
- DTC P16F3 runs continuously when the above conditions are met.

P262B

DTC P262B runs during ECM power down.

Conditions for Setting the DTCs

The ECM detects an internal failure or incomplete programming for more than 10 s.

Actions Taken When the DTC Sets

- DTCs P0601, P0602, P0603, P0604, P0606, P062B, P0630 and P16F3 are Type A DTCs.
- DTCs P062F and P262B are Type B DTCs.

Conditions for Clearing the MIL/DTC

- DTCs P0601, P0602, P0603, P0604, P0606, P062B, P0630 and P16F3 are Type A DTCs.
- DTCs P062F and P262B are Type B DTCs.

Diagnostic Aids

Low voltage or a momentary loss of power or ground to the ECM may cause a DTC to set. Verify the following:

- The battery cables are clean and tight and the battery is fully charged. Refer to **Battery Inspection/Test**.
- The ECM ground circuits do not have an open or high resistance.
- The ECM power circuits do not have an open, short to ground or high resistance.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component Views

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON, clear the DTC information with a scan tool. Observe the DTC information with a scan tool.
2. Verify that DTC P0641, P0651, P0697 or P06A3 does not set.
 - **If any of the DTCs are set**

Refer to **DTC P0641, P0651, P0697 or P06A3** for further diagnosis.

-
- **If none of the DTCs are set**
 - 3. Observe the DTC information with a scan tool. Verify DTC P0602 or P0630 is not set.
 - **If any of the DTCs are set**
 1. Program the K20 Engine Control Module. Refer to **Control Module References** .
 2. Verify DTC P0602 or P0630 is not set.
 - If any of the DTCs are set, replace the K20 Engine Control Module.
 - If none of the DTCs are set
 3. All OK.
 - **If none of the DTCs are set**
 - 4. Verify DTC P0601, P0603, P0604, P0606, P062B, P062F, P16F3 or P262B is not set.
 - **If any of the DTCs are set**

Replace the K20 Engine Control Module.
 - **If none of the DTCs are set**
 - 5. All OK.

Repair Instructions

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

Control Module References for Engine Control Module replacement, programming and setup.

DTC P0601-P0606, P060A, P062F OR P262B (CHASSIS CONTROL MODULE)

Diagnostic Instructions

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

DTC Descriptors

DTC P0601

Control Module Read Only Memory Performance

DTC P0602

Control Module Not Programmed

DTC P0603

DTC P0604

Control Module Random Access Memory Performance

DTC P0606

Control Module Processor Performance

DTC P062F

Control Module Long Term Memory Performance

Circuit/System Description

The internal fault detection is handled inside the chassis control module. No external circuits are involved.

Conditions for Running the DTC

The chassis control module runs the program to detect an internal fault when power up is commanded. The only requirements are voltage and ground. This program runs even if the voltage is out of the valid operating range.

Conditions for Setting the DTC

The chassis control module has detected an internal malfunction.

Action Taken When the DTC Sets

DTC P0601, P0602, P0603, P0604, P0606 and P062F are type A DTCs.

Conditions for Clearing the DTC

DTC P0601, P0602, P0603, P0604, P0606 and P062F are type A DTCs.

Reference Information

Schematic Reference

Engine Controls Schematics

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

NOTE: This DTC may be stored as a history DTC without affecting the operation of the module. If stored only as a history DTC and not retrieved as a current DTC, do not replace the module.

1. Ignition ON.
2. Verify DTC P0602 is not set.
 - **If DTC P0602 is set**
 1. Program the K38 Chassis Control Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the K38 Chassis Control Module.
 - If the DTC does not set.
 - 3. All OK.
 - **If DTC P0602 is not set**
3. Verify DTC P0601, P0603, P0604, P0606 or P062F is not set.
 - **If any of the DTCs are set**

Replace the K38 Chassis Control Module.
 - **If none of the DTCs are set**
4. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

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

DTC P0628

Diagnostic Instructions

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

DTC Descriptor

Fuel Pump Enable Circuit Low Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	P0171, P0506, P0628, P12A6	P0171, P0506, P12A6	-	P12A6

Circuit/System Description

The engine control module (ECM) provides ignition voltage to the fuel pump driver control module whenever the engine is cranking or running. The ECM enables the fuel pump driver control module as long as the engine is cranking or running and ignition system reference pulses are received. While this enable voltage is being received, the fuel pump driver control module supplies a varying voltage to the fuel tank fuel pump module in order to maintain the desired fuel line pressure.

Conditions for Running the DTC

- The engine speed is greater than 0 RPM.
- The ignition voltage is greater than 11 V.
- The DTC runs continuously when the conditions above are met.

Conditions for Setting the DTC

The engine control module detects that the commanded state of the driver and the actual state of the control circuit do not match for greater than 2.5 s.

Action Taken When the DTC Sets

DTC P0628 is a Type B DTC.

Conditions for Clearing the DTC

DTC P0628 is a Type B DTC.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

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 for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC P0628 is not set.
 - **If the DTC is set**

Refer to Circuit/System Testing.
 - **If the DTC is not set**
3. Verify the parameters listed below do not display Malfunction when commanding the Fuel Pump Enable On and Off with a scan tool.
 - Fuel Pump Enable Circuit Low Voltage Test Status
 - Fuel Pump Enable Circuit Open Test Status
 - Fuel Pump Enable Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.
 - **If Malfunction is not displayed**
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 the DTC does not set.
 - **If the DTC sets**

- **If the DTC does not set**

6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the K111 Fuel Pump Driver Control Module harness connector.
2. Ignition ON for 10 s.
3. Verify that a test lamp does not illuminate between the control circuit terminal 2 and ground.
 - **If the test lamp illuminates**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector X1 at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If the test lamp does not illuminate**
4. Remove the test lamp.
5. Verify the scan tool Fuel Pump Enable Circuit Low Voltage Test Status parameter is OK when commanding the Fuel Pump Enable On with a scan tool.
 - **If OK is not displayed**
 1. Ignition OFF, disconnect the harness connector X1 at the K20 Engine Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If OK is displayed**
6. Install a 3 A fused jumper wire between the control circuit terminal 2 and ground.
7. Verify the scan tool Fuel Pump Enable Circuit Low Voltage Test Status parameter is Malfunction when commanding the Fuel Pump Enable On with a scan tool.
 - **If Malfunction is not displayed**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector X1 at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If Malfunction is displayed**
8. Replace the K111 Fuel Pump Driver Control Module.

Repair Instructions

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

Control Module References for K20 Engine Control Module or K111 Fuel Pump Driver Control Module replacement, programming and setup.

DTC P0641, P0651, P0697 OR P06A3

Diagnostic Instructions

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

DTC Descriptors

DTC P0641

5V Reference 1 Circuit

DTC P0651

5V Reference 2 Circuit

DTC P0697

5V Reference 3 Circuit

DTC P06A3

5V Reference 4 Circuit

Circuit/System Description

The engine control module (ECM) has 4 internal 5V reference circuits. Each internal reference circuit provides external 5V reference circuits for more than one sensor. A short to ground or short to voltage on one external 5V reference circuit can affect all the components connected to the same internal 5V reference circuit.

Conditions for Running the DTC

These DTCs run continuously when the ignition voltage is greater than 6.4 V.

Conditions for Setting the DTC

The ECM detects a short to voltage or ground on any of the 5V reference circuits for greater than 0.5 s.

Action Taken When the DTC Sets

DTCs P0641, P0651, P0697 and P06A3 are Type A DTCs.

Conditions for Clearing the DTC

DTCs P0641, P0651, P0697 and P06A3 are Type A DTCs.

Diagnostic Aids

The 5V reference 1 circuit provides 5 V to the sensors listed below:

- Air conditioning (A/C) refrigerant pressure sensor
- Camshaft position sensor
- Engine oil pressure sensor
- Fuel pressure sensor
- Fuel rail pressure sensor
- Fuel tank pressure sensor
- Multifunction intake air sensor

The 5V reference 2 circuit provides 5 V to the sensors listed below:

- Brake pedal position sensor (automatic transmission)
- Center console multifunction switch (automatic transmission)
- Clutch pedal position sensor (manual transmission)
- Crankshaft position sensor
- Transmission gear position sensor (manual transmission)

The 5V reference 3 circuit provides 5 V to the sensors listed below:

- Accelerator pedal position sensor 2
- Manifold absolute pressure sensor

The 5V reference 4 circuit provides 5 V to the sensors listed below:

- Accelerator pedal position sensor 1
- Throttle position sensor

Disconnecting one component at a time from the affected 5V reference circuit while observing the scan tool 5V Reference Circuit Status parameter may help locate the fault. The scan tool parameter will change from Malfunction to OK when the source of the fault is disconnected. If all 5V reference components have been disconnected and a fault is still indicated, the fault may exist in the wiring harness.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component Views

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify all scan tool 5V Reference Circuit Status parameters do not display Malfunction.
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.
 - **If Malfunction is not displayed**
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.
 - **If the DTC does not set**

Circuit/System Testing

NOTE: Additional DTCs will set when disconnecting the components.

1. Ignition OFF, disconnect the harness connector at all appropriate sensors for the applicable DTC. Refer to Diagnostic Aids.
2. Ignition ON.
3. Test for 4.8-5.2 V between one of the 5V reference circuits and ground.
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect the harness connectors at the K20 Engine Control Module.
 2. Test for infinite resistance between the 5V reference circuit for each applicable component and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 1. Ignition OFF, disconnect the harness connectors at the K20 Engine Control Module.
 2. Test for less than 1 V between the 5V reference circuit for each applicable component and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8-5.2 V**

NOTE: A short to voltage or ground on the signal circuit of certain components may cause this DTC to set.

4. Verify the appropriate scan tool 5V Reference 1, 2, 3 or 4 Circuit Status parameter displays OK while connecting each component associated with the 5V reference circuit one at a time.
 - **If OK is not displayed when a component is connected**

Replace the component.
 - **If OK is displayed after all components have been connected**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

-
- **Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement**
- **Brake Pedal Position Sensor Replacement**
- **Camshaft Position Sensor Replacement**

- **Clutch Pedal Position Sensor Replacement**
- **Crankshaft Position Sensor Replacement**
-
- **Fuel Pressure Sensor Replacement**
- **Fuel Injection Fuel Rail Fuel Pressure Sensor Replacement**
- **Fuel Tank Pressure Sensor Replacement**
- **Manifold Absolute Pressure Sensor Replacement**
- **Mass Airflow Sensor with Intake Air Temperature Sensor Replacement** for multifunction intake air sensor replacement.
- **Throttle Body Assembly Replacement**
- **Control Module References** for engine control module replacement, programming and setup.

DTC P0650, P263A OR P263B

Diagnostic Instructions

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

DTC Descriptor

DTC 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 Voltage	P0650	P0650	-	-
MIL Control	P0650, P263A*	P0650, P263A	P0650, P263B	-
* The MIL remains ON				

The malfunction indicator lamp (MIL) illuminates to inform the driver that an emission system fault has occurred and the engine control system requires service. Ignition voltage is supplied directly to the MIL. The engine control module (ECM) turns the MIL ON by grounding the MIL control circuit when the emission system fault occurs. Under normal operating conditions, the MIL should be ON only when the ignition is ON and the engine is OFF.

Conditions for Running the DTC

- The ignition voltage is between 11-32 V.
- Remote vehicle start is not active
- The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

DTC P0650

The ECM detects low voltage during the MIL control circuit driver OFF state. This indicates an open MIL control circuit.

DTC P263A

The ECM detects low voltage during the MIL control circuit driver OFF state. This indicates a shorted to ground MIL control circuit.

DTC P263B

The ECM detects high voltage on the MIL control circuit during the driver ON state. This indicates a shorted to voltage MIL control circuit.

Action Taken When the DTC Sets

DTC P0650, P263A and P263B are Type B DTCs.

Conditions for Clearing the DTC

DTC P0650, P263A and P263B are Type B DTCs.

Diagnostic Aids

- If the condition is intermittent, move the related harnesses and connectors while monitoring the scan tool MIL control circuit status parameters. Perform this test with the ignition ON and the engine OFF and with the engine running. The MIL control circuit status parameters change from OK or Not Run to Fault if there is a condition with a circuit or a connection.
- If the ECM detects low voltage on the MIL control circuit during the control circuit driver OFF state, DTCs P0650 and DTC P263A may set simultaneously.

Reference Information

Schematic Reference

- **Engine Controls Schematics**
- **Instrument Cluster Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the parameters listed below do not display Malfunction when commanding the malfunction indicator lamp ON and OFF with a scan tool.
 - The MIL Control Circuit Low Voltage Test Status
 - The MIL Control Circuit Open Test Status
 - The MIL Control Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.
 - **If Malfunction is not displayed**
3. Engine running.
4. Verify the parameters listed below do not display Malfunction when commanding the malfunction indicator lamp ON and OFF with a scan tool.
 - The MIL Control Circuit Low Voltage Test Status
 - The MIL Control Circuit Open Test Status
 - The MIL Control Circuit High Voltage Test Status

- **If Malfunction is displayed**

Refer to Circuit/System Testing.

- **If Malfunction is not displayed**

5. Verify the malfunction indicator lamp turns ON and OFF when commanding the malfunction indicator lamp ON and OFF with a scan tool.

- **If the malfunction indicator lamp does not turn ON and OFF**

Refer to Circuit/System Testing.

- **If the malfunction indicator lamp turns ON and OFF**

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.

- **If any DTC sets**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for further diagnosis.

- **If a DTC does not set**

7. All OK.

Circuit/System Testing

1. Ignition OFF.
2. Disconnect the X1 harness connector at the K20 Engine Control Module.
3. Ignition ON, verify the malfunction indicator lamp does not illuminate.
 - **If the malfunction indicator lamp illuminates**
 1. Test for infinite resistance between the malfunction indicator lamp control circuit terminal X1 46 and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance, replace the P16 instrument cluster.
 - **If the malfunction indicator lamp does not illuminate**
4. Connect a 3 A fused jumper wire between the malfunction indicator lamp control circuit terminal X1 46 and ground.
5. Verify the malfunction indicator lamp illuminates.
 - **If the malfunction indicator lamp illuminates**

Replace the K20 Engine Control Module.
 - **If the malfunction indicator lamp does not illuminate**
 1. Test for less than 1 V between the malfunction indicator lamp control circuit terminal X1 46 and ground.

-
- If less than 1 V
 - 2. Ignition OFF.
 - 3. Test for less than 2 ohms in the malfunction indicator lamp control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms.
 - 6. Ignition OFF, disconnect the harness connector at the instrument cluster.
 - 7. Ignition ON, verify a test lamp illuminates between the ignition voltage circuit terminal 8 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 - 1. Ignition OFF.
 - 2. Test for infinite resistance between the ignition voltage circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 - 1. Ignition OFF.
 - 2. Test for less than 2 ohms in the ignition voltage circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - **If the test lamp illuminates**
 - 8. All OK.

Repair Instructions

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

- **Instrument Cluster Replacement**
- **Control Module References** for engine control module replacement, programming and setup.

DTC P0685-P0687, P0689, P0690 OR P1682

Diagnostic Instructions

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

DTC Descriptors

DTC 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

DTCP0689

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

Diagnostic Fault Information

Ignition Run Relay

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Relay Coil Supply Voltage	P0689, P1682	P0685, P0689, P1682	-
Relay Control Circuit	P0686, P0690	P0685, P0689, P1682	P0685, P0687, P0689, P1682
Relay Feedback Circuit	P0689, P1682	P0689, P1682	P0690

Typical Scan Tool Data

Engine Controls Ignition Relay Control Circuit Low Voltage, Open and High Voltage Test Status-Component Commanded OFF

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Component commanded OFF Parameter Normal Range: The following illustrates the normal parameter state with no circuit conditions: • Component OFF - OK for Open/Low Voltage Test Status and Not Run for High Voltage Test Status • Component ON - Not Run for Open/Low Voltage Test Status and OK for High Voltage Test Status			
B+	Malfunction	Malfunction	-
Control	Malfunction	Malfunction	Not Run

Status-Component Commanded ON

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Component commanded ON Parameter Normal Range: The following illustrates the normal parameter state with no circuit conditions: • Component OFF - OK for Open/Low Voltage Test Status and Not Run for High Voltage Test Status • Component ON - Not Run for Open/Low Voltage Test Status and OK for High Voltage Test Status			
B+	Not Run	Not Run	-
Control	Not Run	Not Run	Malfunction

Circuit/System Description

There are 2 ignition voltage circuits supplied to the engine control module (ECM). One is supplied by the ignition run relay and the other is supplied by the ignition main relay. The ECM monitors and compares the ignition voltage supplied by the 2 relays.

Conditions for Running the DTC

P0685, P0686, P0687

The DTC runs when Ignition 1 signal voltage is greater than 11 V.

P0689

- DTCs P0685, P0686 or P0687 are not set.
- The ignition run relay is commanded ON.
- Ignition 1 signal voltage is greater than 11 V.
- The DTC runs continuously when the above conditions are met.

P0690

- DTCs P0685, P0686 or P0687 are not set.
- The ignition run relay is commanded OFF.
- The DTC runs continuously when the above conditions are met.

P1682

- The ignition run relay is commanded ON.
- Ignition voltage is greater than 5.5 V.
- The DTC runs continuously when the above conditions are met.

P0685

The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match for greater than 2 s.

P0686

The ECM detects a short to ground on the control circuit for greater than 2 s.

P0687

The ECM detects a short to voltage on the control circuit for greater than 2 s.

P0689

The ECM detects the engine controls ignition relay feedback circuit is less than 5 V.

P0690

The ECM detects the engine controls ignition relay feedback circuit is greater than 4 V for greater than 5 s.

P1682

The ECM detects that the voltage level difference is greater than 3 V between the 2 ignition voltage circuits for greater than 1 s.

Action Taken When the DTC Sets

- DTCs P0685, P0686, P0687 and P0690 are Type B DTCs.
- DTC P0689 is a Type C DTC.
- DTC P1682 is a Type A DTC.

Conditions for Clearing the DTC

- DTCs P0685, P0686, P0687 and P0690 are Type B DTCs.
- DTC P0689 is a Type C DTC.
- DTC P1682 is a Type A DTC.

Diagnostic Aids

The ignition run relay may also be labeled the powertrain relay, engine controls ignition relay, the engine control module relay or the main relay. The ignition main relay may also be labeled the run/crank relay, the ignition 1 relay or the ignition relay.

Reference Information

Schematic Reference

- **Engine Controls Schematics**
- **Power Distribution Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Electrical Center Identification Views**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- **A short to voltage on other components may cause DTC P0690 to set. If any other DTC is set, diagnose that DTC first.**
- **If you were sent here from Engine Cranks But Does Not Run, proceed to Circuit/System Testing.**

1. Ignition ON, observe the scan tool DTC information. Verify DTC P0685, P0686, P0687, P0689, P0690 or P1682 is not set.

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

Refer to Circuit/System Testing.

- **If none of the DTCs are set**

2. 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.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

3. All OK.

Circuit/System Testing

NOTE: You must perform the Circuit/System Verification before proceeding with Circuit/System Testing unless sent here from Engine Cranks But Does Not Run.

1. Ignition OFF, disconnect the KR74 Ignition Run Relay.
2. Verify a test lamp illuminates between ground and the B+ terminals listed below:
 - Terminal 85
 - Terminal 30
 - **If the test lamp does not illuminate**

Replace the front compartment fuse block.

- **If the test lamp illuminates**

NOTE:

- High resistance in the circuit/underhood fuse block for either the KR74 Ignition Run Relay or the KR73 Ignition Main Relay can cause DTC P1682 to set.
- A short to voltage on any of the circuits supplied by the engine controls ignition relay can cause DTC P0690 to set.

3. Ignition ON.
4. Verify that a test lamp does not illuminate between the ignition voltage circuit terminal 87 and ground.
 - **If the test lamp illuminates**
 1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
 2. Ignition ON.
 3. Test for less than 1 V between ground and connector terminal 73.
 - If 1 V or greater, repair the short to voltage in the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If the test lamp does not illuminate**
5. Ignition OFF, connect a 20 A fused jumper wire between the B+ circuit terminal 30 and the ignition voltage circuit terminal 87.

-
7. Verify the scan tool Engine Controls Ignition Relay Feedback Signal parameter displays B+.
 - **If B+ is not displayed**
 1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module
 2. Test for less than 2 ohms in the relay switch ignition voltage circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms
 3. Test for infinite resistance between the relay switch ignition voltage circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If B+ is displayed**
 8. Ignition OFF, connect a DMM, set to the diode setting, between control circuit terminal 86 and ground.
 9. Verify the DMM displays OL.
 - **If OL is not displayed**
 1. Disconnect the X1 harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between ground and the relay control circuit.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If OL is displayed**
 10. Ignition ON.
 11. Verify the DMM displays less than 1 V.
 - **If 1 V or greater**
 1. Ignition OFF, disconnect the X1 connector at the K20 Engine Control Module.
 2. Ignition ON.
 3. Test for less than 1 V on the relay control circuit.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 4. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - if less than 2 ohms, replace the K20 Engine Control Module.
 - **If less than 1 V**
 12. Test or replace the KR74 Ignition Run Relay.

Component Testing

Relay Test

1. Ignition OFF, disconnect the KR74 Ignition Run Relay.
2. Test for 70-110 ohms between terminals 85 and 86.

- **If less than 70 ohms or greater than 110 ohms**

Replace the relay.

- **If between 70-110 ohms**

3. Test for infinite resistance between the terminals listed below:

- 30 and 86
- 30 and 87
- 30 and 85
- 85 and 87

- **If less than infinite resistance**

Replace the relay.

- **If infinite resistance**

4. Install a 20 A fused jumper wire between relay terminal 85 and 12 V. Install a jumper wire between relay terminal 86 and ground.

5. Test for less than 2 ohms between terminals 30 and 87.

- **If 2 ohms or greater**

Replace the relay.

- **If less than 2 ohms**

6. All OK.

Repair Instructions

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

- **Underhood Electrical Center or Junction Block Replacement** .
- **Relay Replacement (Within an Electrical Center)** , **Relay Replacement (Attached to Wire Harness)**
- **Control Module References** for Engine Control Module replacement, programming and setup.

DTC P0700

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 of the diagnostic category.

DTC Descriptor

DTC P0700

Transmission Control Module Requested MIL Illumination

Circuit/System Description

The transmission control module (TCM) constantly monitors the transmission system for any condition which may adversely affect vehicle emissions. If a condition is detected, the TCM sets a DTC and sends a serial data message to the engine control module (ECM). The ECM sets DTC P0700 to inform the technician that the TCM has set the emission related DTC. The serial data message sent by the TCM also contains a request for the ECM to illuminate the malfunction indicator lamp (MIL).

The technician can observe the DTC that was set by the TCM by reviewing the ECM Freeze Frame records on the scan tool. The ECM Freeze Frame records also contain the engine operating conditions present when the transmission DTC set.

Conditions for Running the DTC

- The ignition is ON or the engine is operating.
- DTC P0700 runs continuously.

Conditions for Setting the DTC

The ECM receives a serial data message from the TCM indicating that an emission related DTC has set in the TCM.

Action Taken When the DTC Sets

DTC P0700 is a Type A DTC.

Conditions for Clearing the MIL/DTC

DTC P0700 is a Type A DTC.

Diagnostic Aids

Communication codes, U-codes, as well as powertrain codes, P-codes, set in the TCM can cause the TCM to request DTC P0700 to be set in the ECM.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- Do not replace the engine control module for this DTC. DTC P0700 is an informational DTC.
- Correct any engine controls and communication DTCs before diagnosing transmission control module DTCs.

1. Verify there are no engine control or communication DTCs set.

- If a DTC is set

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

- If a DTC is not set

2. Verify there are no transmission control module DTCs set.

- If a DTC is set

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

- If a 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.

4. Verify the DTC does not set.

- If the DTC sets

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

- If the DTC does not set

5. All OK.

Repair Instructions

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

DTC P1248-P124F

Diagnostic Instructions

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

DTC Descriptors

DTC 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

DTC P124E

Cylinder 7 Injector High Control Circuit Shorted to Control Circuit

DTC P124F

Cylinder 8 Injector High Control Circuit Shorted to Control Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Short from Supply Circuit to Control Circuit
Direct Fuel Injector High Voltage Control Cylinder 1	P0261	P0201	P0262	P1248
Direct Fuel Injector High Voltage Supply Cylinder 1	P2147	P0201	P2148	P1248
Direct Fuel Injector High Voltage Control Cylinder 2	P0264	P0202	P0265	P1249
	P2150	P0202	P2151	P1249

Voltage Supply Cylinder 2				
Direct Fuel Injector High Voltage Control Cylinder 3	P0267	P0203	P0268	P124A
Direct Fuel Injector High Voltage Supply Cylinder 3	P2153	P0203	P2154	P124A
Direct Fuel Injector High Voltage Control Cylinder 4	P0270	P0204	P0271	P124B
Direct Fuel Injector High Voltage Supply Cylinder 4	P2156	P0204	P2157	P124B
Direct Fuel Injector High Voltage Control Cylinder 5	P0273	P0205	P0274	P124C
Direct Fuel Injector High Voltage Supply Cylinder 5	P216B	P0205	P216C	P124C
Direct Fuel Injector High Voltage Control Cylinder 6	P0276	P0206	P0277	P124D
Direct Fuel Injector High Voltage Supply Cylinder 6	P216E	P0206	P216F	P124D
Direct Fuel Injector High Voltage Control Cylinder 7	P0279	P0207	P0280	P124E
Direct Fuel Injector High Voltage Supply Cylinder 7	P217B	P0207	P217C	P124E
Direct Fuel Injector High Voltage Control Cylinder 8	P0282	P0208	P0283	P124F
Direct Fuel Injector High Voltage Supply Cylinder 8	P217E	P0208	P217F	P124F
DTC P0300 may also be present for all fault conditions				

Circuit/System Description

The engine control module (ECM) supplies voltage to each fuel injector on the injector high voltage supply circuits. The ECM energizes each fuel injector by grounding the high voltage control circuit of the fuel injector. The ECM monitors the status of the fuel injector high voltage supply circuits and the fuel injector high voltage control circuits. When a fuel injector circuit condition is detected by the ECM, the affected fuel injector(s) is disabled.

Conditions for Running the DTC

- Engine is running.
- Ignition voltage is greater than 11 V.
- DTC P062B is not present.
- The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

side driver is shorted to the low side driver.

Action Taken When the DTC Sets

DTCs P1248, P1249, P124A, P124B, P124C, P124D, P124E and P124F are Type A DTCs.

Conditions for Clearing the DTC

DTCs P1248, P1249, P124A, P124B, P124C, P124D, P124E and P124F are Type A DTCs.

Diagnostic Aids

- Performing the fuel injector coil test may help isolate an intermittent condition. Refer to **Fuel Injector Diagnosis** .
- If the condition is intermittent, move the related harnesses and connectors, with the engine operating, while monitoring the scan tool Injector Control Circuit Status parameters. An Injector Control Circuit Status parameter will change from OK or Not Run to Malfunction if there is a condition with the circuit or a connection.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

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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 for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC P062B is not set.
 - **If DTC P062B is set**

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

- **If DTC P062B is not set**

NOTE: **The engine must be running for the injector circuit status parameters to function.**

3. Engine idling.
4. Verify with a scan tool the Cylinder 1-8 Injector Control Circuit Status parameters display OK or Not Run.
 - **If OK or Not Run is not displayed**

Refer to Circuit/System Testing.

- **If OK or Not Run is displayed**

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 P1248, P1249, P124A, P124B, P124C, P124D, P124E or P124F does not set
 - **If DTC P1248, P1249, P124A, P124B, P124C, P124D, P124E or P124F set**

Refer to Circuit/System Testing.

- **If DTC P1248, P1249, P124A, P124B, P124C, P124D, P124E or P124F does not set**

7. All OK.

Circuit/System Testing

1. Ignition OFF, all vehicle systems OFF, disconnect the harness connector X3 at the K20 Engine Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for greater than 3 ohms between the appropriate fuel injector direct fuel injector high voltage supply and direct fuel injector high voltage control circuits at the engine control module connector.
 - **If 3 ohms or less**
 1. Disconnect the appropriate Q17 Fuel Injector.
 2. Test for infinite resistance between the appropriate fuel injector direct fuel injector high voltage supply and direct fuel injector high voltage control circuits

- If less than infinite, repair the short in the circuit.
- If infinite, test or replace the Q17 Fuel Injector.

- **If greater than 3 ohms**

3. Test or Replace the K20 Engine Control Module.

Component Testing

NOTE: The engine coolant temperature (ECT) sensor must be between 10-32°C (50-90°F) for an accurate measurement.

1. Ignition OFF, disconnect the harness connector at the appropriate Q17 Fuel Injector.
2. Test for 1.06 ohms +/- 10% @ 20°C (68°F) between the terminals of the fuel injector.
 - **If not within the specified range**

Replace the Q17 Fuel Injector.

- **If within the specified range**

3. Test for infinite resistance between each terminal and the fuel injector housing/case.
 - **If less than infinite resistance**

Replace the Q17 Fuel Injector.

- **If infinite resistance**

4. All OK.

Repair Instructions

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

- **Fuel Injector Replacement**
- **Control Module References** for K20 Engine Control Module replacement, programming and setup.

DTC P1255

Diagnostic Instructions

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

DTC Descriptors

DTC P1255

Fuel Pump Control Module Driver High Temperature

Circuit/System Description

The engine control module (ECM) supplies voltage to the fuel pump driver control module when the ECM detects that the ignition is on. The voltage from the ECM to the fuel pump driver control module remains active for 2 seconds, unless the engine is in crank or run. While this voltage is being received, the fuel pump driver control module supplies a varying voltage to the fuel tank fuel pump module in order to maintain the desired fuel pressure.

Conditions for Running the DTC

- The ignition voltage is greater than 7 V.
- The engine is cranking or running.
- The fuel pump enable circuit is commanded ON.
- The DTC runs continuously when the conditions above are met.

Conditions for Setting the DTC

The fuel pump driver control module detects a driver temperature greater than 150°C (302°F) for less than 0.5 s.

Action Taken When the DTC Sets

DTC P1255 is a Type A DTC.

Conditions for Clearing the DTC

DTC P1255 is a Type A DTC.

Diagnostic Aids

Using the Failure Records data may help locate an intermittent condition. If you cannot duplicate the DTC, the information in the Failure Records can help determine how many miles since the DTC set. The Fail Counter and Pass Counter can help determine how many ignition cycles that the diagnostic test reported a pass and/or a fail.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC P0231, P0232 or P023F is not set.
 - **If any of the DTCs are set**

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

- **If none of the DTCs are set**
3. Verify that the area where the K111 Fuel Pump Driver Control Module is located is free of debris, clutter or any insulating material that would cause the fuel pump driver control module to overheat.
 - **If any debris, clutter or other material is found**
 1. Clear the area where the K111 Fuel Pump Driver Control Module is located.
 2. Clear the DTC and test drive the vehicle.
 3. Verify DTC P1255 is not set.
 - If DTC P1255 is set, replace the K111 Fuel Pump Driver Control Module.
 - If DTC P1255 is not set
 4. All OK.
 - **If no debris, clutter or other material is found**
 - 4. Clear the DTC and test drive the vehicle.
 - 5. Verify DTC P1255 is not set.
 - **If DTC P1255 is set**

Replace the K111 Fuel Pump Driver Control Module.

- **If DTC P1255 is not set**

6. All OK.

Repair Instructions

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

Control Module References for K111 Fuel Pump Driver Control Module replacement, programming and setup.

DTC P127C OR P127D

Diagnostic Instructions

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

DTC Descriptors

DTC P127C

Fuel Rail Pressure Sensor 2 Circuit Low Voltage

DTC P127D

Fuel Rail Pressure Sensor 2 Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference Voltage	P0192, P0193, P0340, P0345, P0365, P0390, P0506, P0641, P2227	P0192	P0193, P0641, P2227, P2229	P0191
Fuel Rail Pressure Sensor Signal 1	P0192	P0192, P0193	P0193	P0191
Fuel Rail Pressure Sensor Signal 2	P127C	P127C, P127D	P127D	P0191

Low Reference	-	P0193	P0193	P0191
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Circuit/System Description

The fuel rail pressure sensor is a dual analog sensor that provides two fuel rail pressure signals to the engine control module (ECM). The ECM provides a 5 V reference voltage on the 5 V reference circuit and ground on the reference circuit. The ECM receives a varying signal voltage on both the fuel rail pressure sensor 1 and fuel rail pressure sensor 2 signal circuits. The ECM monitors the voltage on both of the fuel rail pressure sensor circuits and compares the values to determine if the sensors are accurate. When the fuel pressure is high, the signal voltage is high. When the fuel pressure is low, the signal voltage is low.

Conditions for Running the DTC

- The engine is running.
- Battery voltage is greater than 11 V.
- The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

P127C

The engine control module detects that the fuel rail pressure sensor 2 signal voltage is less than 0.25 V for greater than 2.5 s.

P127D

The engine control module detects that the fuel rail pressure sensor 2 signal voltage is greater than 4.75 V for greater than 2.5 s.

Action Taken When the DTC Sets

- DTCs P127C and P127D are Type A DTCs.
- A message center or an indicator may display Reduced Engine Power.

Conditions for Clearing the DTC

DTCs P127C and P127D are Type A DTCs.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

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- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC P0641 is not set.
 - **If DTC P0641 is set**

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

- **If DTC P0641 is not set**
3. Engine at idle.
4. Verify DTC P127C or P127D is not set.
 - **If DTC P127C or P127D is set**

Refer to Circuit/System Testing.

- **If DTC P127C or P127D 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.
6. Verify DTC P127C or P127D is not set
 - **If DTC P127C or P127D is set**

Refer to Circuit/System Testing.

- **If DTC P127C or P127D is not set**

7. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the B47B Fuel Rail Pressure Sensor connector. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 ohms between the low reference circuit terminal 3 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF, disconnect the harness connector X2 at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If less than 5 ohms**
3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 1 and ground.
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect the harness connector X2 at the K20 Engine Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the 5 V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 1. Ignition OFF, disconnect the harness connector X2 at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8-5.2 V**
5. Verify the scan tool Fuel Rail Pressure Sensor 2 parameter is less than 0.25 V.
 - **If 0.25 V or greater**
 1. Ignition OFF, disconnect the harness connector X1 at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal 2 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If less than 0.25 V**

-
6. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the 5 V reference circuit terminal 1.
 7. Verify the scan tool Fuel Rail Pressure Sensor 2 parameter is greater than 4.75 V.
 - **If 4.75 V or less**
 1. Ignition OFF, disconnect the harness connector X1 at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If greater than 4.75 V**
 8. Test or replace the B47B Fuel Rail Pressure Sensor.

Repair Instructions

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

- **Fuel Injection Fuel Rail Fuel Pressure Sensor Replacement** for B47B Fuel Rail Pressure Sensor replacement.
- **Control Module References** for K20 Engine Control Module replacement, programming and setup.

DTC P129B OR P129C

Diagnostic Instructions

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

DTC Descriptors

DTC P129B

Fuel Pump Driver Control Module System Voltage Low Voltage

DTC P129C

Fuel Pump Driver Control Module System Voltage High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
B+	P018B, P0506, P129B, P2635, U18A2	P018B, P0506, P129B, P2635, U18A2	P129C

Circuit/System Description

The fuel pump driver control module monitors the battery positive voltage circuit to verify the voltage is between the normal operating range. The DTC can set for a circuit or system voltage out of range.

Conditions for Running the DTC

P129B

- The engine is running.
- The ignition voltage is greater than 7 V.
- The fuel pump enable circuit is commanded ON.
- The DTC runs continuously when the conditions above are met.

P129C

- The engine is not running.
- The ignition voltage is greater than 7 V.
- The fuel pump enable circuit is commanded ON.
- The DTC runs continuously when the conditions above are met.

Conditions for Setting the DTC

P129B

The fuel pump driver control module detects the battery positive voltage is less than 7 V for 1 s.

P129C

The fuel pump driver control module detects the battery positive voltage is greater than 18 V for 1 s.

Action Taken When the DTC Sets

DTC P129B and P129C are Type C DTCs.

Conditions for Clearing the DTC

DTC P129B and P129C are Type C DTCs.

Schematic Reference

Engine Controls Schematics

Connector End View Reference

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 for scan tool information

Circuit/System Verification

1. Ignition OFF.
2. Test for 12.4-12.8 V at the battery terminals and record the reading. The battery voltage should stabilize after a few minutes of turning the ignition OFF.

- **If not between 12.4 V-12.8 V**

Refer to **Battery Inspection/Test** .

- **If between 12.4 V-12.8 V**

3. Engine running, accessories OFF.
4. Test for 13.4-15 V at the battery terminals and record the reading.

- **If not between 13.4-15 V**

Refer to **Charging System Test** .

- **If between 13.4-15 V**

of the battery voltage.

- **If not within 1 V of the battery voltage**

Refer to Circuit/System Testing.

- **If within 1 V of the battery voltage**

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.

- **If the DTC does not set**

8. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the K111 Fuel Pump Driver Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 ohms between the ground circuit terminal 9 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - 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.
 - **If less than 5 ohms**
3. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF, remove the test lamp.
 2. Test for infinite resistance between the B+ circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K111 Fuel Pump Driver Control Module.
4. Replace the K111 Fuel Pump Driver Control Module.

Repair Instructions

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

Control Module References for K111 Fuel Pump Driver Control Module replacement, programming and setup.

DTC P129D

Diagnostic Instructions

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

DTC Descriptor

DTC 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	-	-

Circuit/System Description

The fuel pump driver control module monitors the ignition voltage circuit in order to determine if the voltage is within the normal operating range.

Conditions for Running the DTC

The DTC runs continuously when the modules are awake.

Conditions for Setting the DTC

The fuel pump driver control module Power Mode does not agree with the engine control module (ECM) Power Mode for 1 s.

Action Taken When the DTC Sets

DTC P129D is a Type A DTC.

Conditions for Clearing the DTC

DTC P129D is a Type A DTC.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

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 for scan tool information

Circuit/System Verification

1. Verify the engine cranks.
 - **If the engine does not crank**

Refer to **Starter Solenoid Does Not Click** .

- **If the engine cranks**
2. Ignition ON.
3. Verify DTC P0562 is not set.
 - **If the DTC is set**

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

- **If the DTC is not set**
- 4. Verify DTC P129D is not set.
- **If the DTC is set**

Refer to Circuit/System Testing.

- **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.
- **If DTC P129D is set**

Refer to Circuit/System Testing.

- **If DTC P129D is not set**
- 6. All OK.

Circuit/System Testing

NOTE: **Circuit/System Verification must be performed first or misdiagnosis may result.**

1. Ignition OFF, all vehicle systems OFF, disconnect the harness connector at the K111 Fuel Pump Driver Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Ignition ON.
3. Verify a test lamp illuminates between the ignition circuit terminal 6 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF, remove the test lamp.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K111 Fuel Pump Driver Control Module.
 - **If the test lamp illuminates**
4. Replace the K111 Fuel Pump Driver Control Module.

Repair Instructions

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

Control Module References for K111 Fuel Pump Driver Control Module replacement, programming and setup.

DTC P129E

Diagnostic Instructions

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

DTC Descriptors

DTC P129E

Fuel Pump Driver Control Module Signal Message Counter Incorrect

Circuit/System Description

The fuel pump power control module is constantly sending serial data messages to the ECM regarding the operating state of the fuel pump power control system. These messages are sent in a continuously repeating series of rolling counts with associated password protect samples and each count/sample is assigned a value. When the ECM determines that too many of the counts/samples contain an error value, the ECM sets DTC P129E.

Conditions for Running the DTC

- The ignition voltage is greater than 9 V.
- The DTC runs continuously when the above condition is met.

Conditions for Setting the DTC

The ECM detects that 64 of 80 counts/samples contain an error value.

Action Taken When the DTC Sets

DTC P129E is a Type A DTC.

Conditions for Clearing the DTC

DTC P129E is a Type A DTC.

Diagnostic Aids

An intermittent fault in the CAN circuits will cause the ECM to set DTC P129E.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- DTC P129E is an informational DTC.
- Diagnose all other engine control module DTCs prior to DTC P129E.

1. Verify that no other DTCs are set except for DTC P129E.

- If any other DTCs are set

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

- If only DTC P129E is set

2. Replace the K111 Fuel Pump Power Control Module.

3. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

- If DTC sets

Replace the K20 Engine Control Module.

- If DTC does not set

4. All OK.

Repair Instructions

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

- **Fuel Pump Power Control Module Replacement**
- **Control Module References** for Engine Control Module replacement, programming and setup

DTC P12A6

Diagnostic Instructions

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

DTC 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, P0506, P12A6	-	P12A6

Circuit/System Description

The engine control module (ECM) provides ignition voltage to the fuel pump driver control module whenever the engine is cranking or running. The ECM enables the fuel pump driver control module as long as the engine is cranking or running and ignition system reference pulses are received. While this enable voltage is being received, the fuel pump driver control module supplies a varying voltage to the fuel tank fuel pump module in order to maintain the desired fuel line pressure.

Conditions for Running the DTC

- The ignition voltage is greater than 7 V.
- The DTC runs continuously when the above condition is met.

Conditions for Setting the DTC

The engine control module state of the fuel pump enable circuit does not match the state of the fuel pump enable circuit sensed by the fuel pump driver control module for 0.5 s.

Action Taken When the DTC Sets

DTC P12A6 is a Type A DTC.

Conditions for Clearing the DTC

DTC P12A6 is a Type A DTC.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

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 for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC P12A6 is not set.
 - **If the DTC is set**

Refer to Circuit/System Testing.
 - **If the DTC is not set**
3. Verify the parameters listed below do not display Malfunction when commanding the Fuel Pump Enable On and Off with a scan tool.
 - Fuel Pump Enable Circuit Low Voltage Test Status
 - Fuel Pump Enable Circuit Open Test Status
 - Fuel Pump Enable Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.
 - **If Malfunction is not displayed**
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 the DTC does not set.
 - **If the DTC sets**

- **If the DTC does not set**

6. All OK.

Circuit/System Testing

1. Ignition OFF, all vehicle systems OFF, disconnect the harness connector at the K111 Fuel Pump Driver Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Ignition ON for 10 s.
3. Verify that a test lamp does not illuminate between the control circuit terminal 2 and ground.
 - **If the test lamp illuminates**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector X1 at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If the test lamp does not illuminate**
4. Remove the test lamp.
5. Verify the scan tool Fuel Pump Enable Circuit Low Voltage Test Status parameter is OK when commanding the Fuel Pump Enable On with a scan tool.
 - **If OK is not displayed**
 1. Ignition OFF, disconnect the harness connector X1 at the K20 Engine Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If OK is displayed**
6. Install a 3 A fused jumper wire between the control circuit terminal 2 and ground.
7. Verify the scan tool Fuel Pump Enable Circuit Low Voltage Test Status parameter is Malfunction when commanding the Fuel Pump Enable On with a scan tool.
 - **If Malfunction is not displayed**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector X1 at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If Malfunction is displayed**
8. Replace the K111 Fuel Pump Driver Control Module.

Repair Instructions

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

Control Module References for K20 Engine Control Module or K111 Fuel Pump Driver Control Module replacement, programming and setup.

DTC P12A8

Diagnostic Instructions

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

DTC Descriptors

DTC P12A8

Fuel Pump Control Signal Message Counter Incorrect

Circuit/System Description

The fuel pump power control module is constantly sending serial data messages to the ECM regarding the operating state of the fuel pump power control system. These messages are sent in a continuously repeating series of rolling counts with associated password protect samples and each count/sample is assigned a value. When the ECM determines that too many of the counts/samples contain an error value, the ECM sets DTC P12A8.

Conditions for Running the DTC

- The ignition voltage is greater than 9 V.
- The engine run time is greater than 0.5 s.
- No other CAN errors are present.
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM detects that 64 of 80 counts/samples contain an error value.

Action Taken When the DTC Sets

DTC P12A8 is a Type A DTC.

Conditions for Clearing the DTC

DTC P12A8 is a Type A DTC.

Diagnostic Aids

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that no other DTCs are set except for DTC P12A8.
 - **If any other DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
 - **If only DTC P12A8 is set**
2. Replace the K111 Fuel Pump Power Control Module.
3. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.
 - **If DTC sets**

Replace the K20 Engine Control Module.
 - **If DTC does not set**
4. All OK.

Repair Instructions

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

- **Fuel Pump Power Control Module Replacement**
- **Control Module References** for Engine Control Module replacement, programming and setup.

DTC P135A OR P135B

Diagnostic Instructions

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

DTC Descriptor

DTC 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 Voltage	P135A, P135B, 1	P0300, P135A, P135B, 2	P0690	-
1. The engine cranks but does not run and opens the fuse that supplies voltage to the ignition coils. 2. The engine cranks but does not run or will misfire on the affected cylinder.				

Circuit/System Description

The ignition system uses an individual ignition coil for each cylinder. The engine control module (ECM) monitors the ignition voltage from the fuse to the individual coils.

Conditions for Running the DTC

- The engine does not start after 5 engine revolutions.
- Ignition Run/Crank and PT relay voltages are greater than 11 V.

The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM detects less than 2.5 V on the ignition coil supply voltage circuit.

Action Taken When the DTC Sets

DTC P135A and P135B are Type A DTCs.

Conditions for Clearing the DTC

DTC P135A and P135B are Type A DTCs.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

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

Circuit/System Verification

1. Ignition ON.
2. Verify the appropriate scan tool Ignition Coil Supply Voltage parameter displays ON.
 - **If ON is not displayed**

Refer to Circuit/System Testing.
 - **If ON is displayed**
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.
 - **If the DTC does not set**
5. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
2. Connect a 3 A fused jumper wire between the control circuit terminal 72 and ground, ignition ON.
3. Verify a test lamp illuminates between the appropriate ignition circuit terminal listed below and

ground.

- Terminal 62
- Terminal 67

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition OFF, remove the test lamp.
2. Test for less than 2 ohms in the ignition circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
- **If the test lamp does not illuminate and the circuit fuse is open**

NOTE: **The ignition circuit may supply voltage to other components. Make sure to test all circuits and components for a short to ground that share the ignition circuit.**

1. Ignition OFF, remove the test lamp and disconnect all components on the circuit.
2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Replace the fuse, ignition ON.
4. Verify the fuse is good after connecting each of the components one at a time.
 - If the fuse opens, replace the component that opens the fuse when connected.
 - If the fuse is good, all OK.
- **If the test lamp illuminates**
4. Replace the K20 Engine Control Module.

Repair Instructions

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

- **Ignition Coil Replacement**
- **Control Module References** for engine control module replacement, programming and setup

DTC P1380 OR P1381

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.

DTC Descriptors

DTC P1380

Misfire Detected - Rough Road Data Not Available

DTC P1381

Misfire Detected - No Communication with Brake Control Module

System Description

The engine control module (ECM) detects engine misfire by detecting variations in crankshaft deceleration between firing strokes. For accurate detection of engine misfire, the ECM must distinguish between crankshaft deceleration caused by actual misfire and deceleration caused by rough road conditions. The antilock brake system (ABS) can detect if the vehicle is on a rough road based on wheel acceleration/deceleration data supplied by the wheel speed sensors. If the ABS detects rough road above predetermined threshold, this information is sent to the ECM. The ECM uses the rough road information when calculating engine misfire. If the ABS is malfunctioning and cannot detect rough roads, the misfire diagnostic will continue to run; however, if an engine misfire DTC sets, this DTC also sets indicating that rough road data was not available or there was no communication with the brake control module during the misfire calculation due to an ABS malfunction.

Conditions for Running the DTC

- The vehicle speed is greater than 8 km/h (5 mph).
- The engine speed is less than 7,000 RPM.
- The engine load is less than 60 percent.
- Engine misfire is detected and DTC P0300 sets with the MIL illuminated.
- DTCs P1380 and P1381 run continuously when the above conditions are met.

Conditions for Setting the DTC

P1380

- The ABS controller sends a message to the ECM indicating that a failure has occurred in the ABS module.
- Engine misfire is detected and DTC P0300 set.

P1381

- An ABS malfunction exists for more than 10 seconds, preventing the ECM from receiving rough road detection data.
- Engine misfire is detected and DTC P0300 set.

Action Taken When the DTC Sets

DTCs P1380 and P1381 are Type C DTCs.

Conditions for Clearing the DTC

DTCs P1380 and P1381 are Type C DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Monitor the ABS DTCs on the scan tool.

- If any ABS DTCs are set, diagnose those first. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
- If there are no ABS DTCs set, refer to **Symptoms - Antilock Brake System** .

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

DTC P1400

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.

DTC Descriptor

DTC P1400

Cold Start Emission Reduction Control System

Circuit/System Description

The catalyst must be warmed to efficiently reduce the emissions. The cold start strategy is to reduce the amount of time it takes to warm the catalyst. During a cold start, the engine spark timing is altered to allow the catalyst to warm quickly. This diagnostic monitors the following to build an exhaust

energy model:

- Spark advance
- Engine airflow
- Engine coolant temperature
- Engine run time
- Engine idle speed
- Catalyst temperature

The actual model is then compared to the expected exhaust energy model.

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0114, P0116, P0117, P0118, P0121, P0122, P0123, P0125, P0128, P0201-P0208, P0222, P0223, P0261, P0262, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0279, P0280, P0282, P0283, P0300-P0308, P0335, P0336, P0351-P0358, P0502, P0503, P0506, P0507, P0641, P0651, P0697, P06A3, P0722, P0723, P182E, P1915, P2122, P2123, P2127, P2128, P2135, P2138, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2313, P2315, P2316, P2318, P2319, P2321 and P2322 are not set.
- The engine coolant temperature (ECT) is between -17-43°C (63-109°F).
- The calculated 3-way catalyst temperature is colder than 300°C (572°F).
- The barometric (BARO) pressure is greater than 75 kPa.
- The engine control module (ECM) will exit the diagnostic if the calculated 3-way catalyst temperature is greater than 800°C (1472°F) when the engine run time is greater than 1 s.
- Vehicle speed is less than 1.6 km/h (1 mph).
- The accelerator pedal is not depressed.
- The ECM will exit the diagnostic if the engine run time is greater than a calibrated value.
- This DTC runs within the first 10 s of start-up. This diagnostic runs once per trip when a cold start has been determined.

Conditions for Setting the DTC

The actual exhaust energy model does not match the expected exhaust energy model.

Action Taken When the DTC Sets

DTC P1400 is a Type A DTC.

Conditions for Clearing the DTC

DTC P1400 is a Type A DTC.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle OFF, allow the engine to cool to be within the temperatures listed in the Conditions for Running the DTC.
2. Engine running.
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**
5. Verify that none of the conditions listed below exists with the air intake system:
 - Damage, restriction or modification
 - Dirty or deteriorating air filter element
 - Crankcase ventilation system for correct operation
 - Water intrusion
 - Vacuum leak and other unmetered air downstream of the mass air flow (MAF) sensor
 - Intake manifold leak
 - **If any of the conditions exist**

Repair as necessary.

- **If none of the conditions exist**

6. Verify that none of the conditions listed below exists with the exhaust system:

- Exhaust leak
- Damaged, restricted or modified exhaust system - Refer to **Symptoms - Engine Exhaust** .
- **If any of the above conditions exist**

Repair as necessary.

- **If none of the conditions exist**

7. If all of the above conditions test normal, inspect for an engine mechanical condition that could alter the air flow into the combustion chamber. Refer to **Symptoms - Engine Mechanical** .

- **If the DTC does not set**

8. All OK.

Repair Instructions

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

DTC P150C

Diagnostic Instructions

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

DTC Descriptor

DTC P150C

Transmission Control Module Engine Speed Request Signal Message Counter Incorrect

Circuit/System Description

To improve vehicle shift feel, the transmission control module (TCM) is constantly sending the ECM serial data messages with information regarding its request for modifying engine speed or torque. The ECM sets this code when it detects a discrepancy in the structure of this message causing its integrity to be questioned.

An intermittent fault in the controller area network (CAN) circuits will cause DTC P150C to set.

Conditions for Running the DTC

- DTCs P0506, P0507 or U0101 are not set.

-
- The engine is running 0.5 s.
 - The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM detects that the TCM engine speed request does not match the expected engine speed request.

Action Taken When the DTC Sets

DTC P150C is a Type B DTC.

Conditions for Clearing the DTC

DTC P150C is a Type B DTC.

Reference Information

Description and Operation

Data Link Communications Description and Operation

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- DTC P150C is an informational DTC.
- Diagnose all other engine control module DTCs prior to DTC P150C.

1. Verify that no other DTCs are set except for DTC P150C.
 - If any other DTCs are set

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

- If only DTC P150C is set
2. Replace the K17 Electronic Brake Control Module.
 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**

Replace the K20 Engine Control Module.

- **If the DTC does not set**

5. All OK.

Repair Instructions

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

Control Module References for ECM or control solenoid valve assembly replacement, programming and setup.

DTC P1516, P2101, P2119 OR P2176

Diagnostic Instructions

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

DTC Descriptors

DTC P1516

Throttle Actuator Control (TAC) 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 or High Resistance	Short to Voltage	Signal Performance
TAC Motor Control Closed	P2101	P2101	P2101	P1516, P2101, P2176

TAC Motor Control Open	P2119	P2101	P2101	P1516, P2101, P2176
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Circuit/System Description

The throttle body assembly contains a contact-less inductive throttle position sensing element that is managed by a customized integrated circuit. The throttle position (TP) sensor is mounted within the throttle body assembly and is not serviceable. The engine control module (ECM) supplies the throttle body with a 5 V reference circuit, a low reference circuit, an H-bridge motor directional control circuit and an asynchronous signal/serial data circuit. The asynchronous signal means communication is only going from the throttle body to the ECM. The throttle body cannot receive data from the ECM over the signal/serial data circuit. The TP sensor provides a signal voltage that changes relative to throttle blade angle. The customized integrated circuit translates the voltage based position information into serial data using the Society of Automotive Engineers (SAE) J2716 Single Edge Nibble Transmission (SENT) protocol. The TP sensor information is transmitted between the throttle body and the ECM on the signal/serial data circuit. The ECM decodes the serial data signal into separate voltages which are displayed on a scan tool as the voltage inputs from TP sensors 1 and 2.

The ECM controls the throttle valve by applying a varying voltage to the control circuits of the throttle actuator control (TAC) motor. The ECM monitors the duty cycle that is required to actuate the throttle valve. The ECM monitors the TP sensor signal/serial data circuit to determine the actual throttle valve position.

Conditions for Running the DTC

P1516

- DTC P1682 is not set.
- The run/crank or powertrain relay voltage is greater than 6.41 V and reduced power is not active.
- DTC P1516 runs continuously when the above conditions are met.

P2101

- DTC P1682 is not set.
- The run/crank or powertrain relay voltage is greater than 6.41 V and reduced power is not active.
- The engine is running or the following conditions are met:
 - The engine is not running.
 - The ignition voltage is greater than 11 V.
 - The TAC system is not in the Battery Saver mode.
 - The ECM is commanding the throttle.
 - The ECM has learned the minimum throttle position.
- DTC P2101 runs continuously when the above conditions are met.

P2119

- DTCs P0122, P0123, P0222, P0223 or P06A3 is not set.
- The run/crank or powertrain relay voltage is greater than 6.41 V and reduced power is not active.
- The system is not in the Battery Save mode.
- The ECM is not commanding the throttle.
- DTC P2119 runs continuously when the above conditions are met.

P2176

- The run/crank or powertrain relay voltage is greater than 6.41 V and reduced power is not active.
- The throttle minimum learn is active.
- DTC P2176 runs continuously when the above conditions are met.

Conditions for Setting the DTC

P1516

The ECM detects an unstable throttle position for greater than 1 s.

P2101

- The ECM detects the actual throttle position does not match the predicted throttle position for greater than 1 s.

OR

- The ECM detects the throttle control is driving the throttle in the incorrect direction or exceed the reduced power limit.

P2119

The ECM determines that the throttle blade did not return to the rest position within 1 s.

P2176

The ECM detects that both throttle position (TP) sensors were greater than a predetermined voltage during the minimum throttle learn procedure for greater than 2 s.

Action Taken When the DTC Sets

- DTCs P1516, P2101 and P2176 are type A DTCs.
- DTC P2119 is a type C DTC.

-
- The ECM commands the TAC system to operate in the Reduced Engine Power mode.
 - A message center or an indicator displays Reduced Engine Power.
 - Under certain conditions, the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- DTCs P1516, P2101 and P2176 are type A DTCs.
- DTC P2119 is a type C DTC.

Diagnostic Aids

- Depending on the scan tool Start Up ECT parameter, the Desired Throttle Position percentage maybe greater or less than the Throttle Position with the TAC motor at rest. When the ignition is initially turned ON or when the engine is cranking or running the scan tool Desired and Actual Throttle positions should closely match.
- Inspect for a condition in which the throttle valve may have been held open. For example, ice may have formed in the throttle bore causing the throttle valve not to close.
- A high resistance condition on the throttle position and throttle actuator control circuits could cause a DTC to set.
- A low battery condition may cause a DTC to set.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.

NOTE: A low battery voltage or charging system condition may cause a DTC to set.

2. Verify DTC P0121, P0122, P0123, P0222, P0223, P0562, P0621, P0622 or P2135 is not set.
 - o If any of the DTCs are set

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for further diagnosis.

- o If none of the DTCs are set

3. Verify the scan tool Throttle Body Idle Air flow Compensation parameter is less than 90 %.
 - o If 90 % or greater

Refer to **Throttle Body Cleaning** .

- o If less than 90 %

4. Clear the DTCs with a scan tool.
5. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
6. Ignition ON.
7. Verify the scan tool TAC Motor parameter displays Enabled while slowly depressing the accelerator pedal.

- o If Enabled is not displayed

Refer to Circuit/System Testing.

- o If Enabled is displayed

8. Verify DTC P1516, P2101, P2119 or P2176 is not set.
 - o If any of the DTCs are set

Refer to Circuit/System Testing.

- o If none of the DTCs are set

NOTE: If there is a condition with the throttle body, the TAC Motor Command parameter will go to 99 % for a predetermined amount of time and then a DTC sets. Once a DTC is set, the TAC Motor Command parameter will go

to 0 % and the TAC Motor parameter will display Disabled.

9. Verify the scan tool TAC Motor parameter displays Enabled while performing the Throttle Sweep Test with a scan tool.

- **If Enabled is not displayed**

Test or replace the Q38 Throttle Body Assembly.

- **If Enabled is displayed**

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.

11. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

12. All OK.

Circuit/System Testing

1. Ignition OFF.

WARNING: Turn OFF the ignition before inserting fingers into the throttle bore. Unexpected movement of the throttle blade could cause personal injury.

2. Verify the conditions listed below do not exist with the Q38 Throttle Body Assembly:

NOTE:

- The rest position is defined as the actual Throttle Position percentage when the ignition is OFF or with the ignition ON for greater than 30 seconds.
- When the ignition is OFF, spring tension should hold the throttle plate in the rest position. You should be able to open the throttle plate to wide open throttle (WOT) or push the throttle plate to the fully closed position. In each case, the throttle plate should return to the rest position without assistance.

- A throttle blade that is not in the rest position
- A throttle blade that is binding open or closed
- A throttle blade that is free to move open or closed without spring pressure
- **If a condition is found**

Test or replace the Q38 Throttle Body Assembly.

- **If a condition is not found**

3. Ignition OFF.

NOTE:

- **Disconnecting the throttle body harness connector may cause additional DTCs to set.**
- **Before testing each circuit, the ignition must be OFF and the ECM completely powered down.**
- **The Test Lamp must be connected to circuit before turning ignition on or incorrect diagnosis may occur.**

4. Disconnect the harness connector at the Q38 Throttle Body Assembly.

5. Ignition ON.

6. Verify that a test lamp does not illuminate continuously between each motor control circuit listed below and ground.

- TAC Motor Control Open circuit terminal 1
- TAC Motor Control Closed circuit terminal 2

- **If the test lamp illuminates continuously**

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

2. Ignition ON.

3. Test for less than 1 V between the control circuit and ground.

- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the K20 Engine Control Module.

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

7. Verify that a test lamp does not illuminate between each motor control circuit listed below and B+.

- TAC Motor Control Open circuit terminal 1
- TAC Motor Control Closed circuit terminal 2

- **If the test lamp illuminates**

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

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

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K20 Engine Control Module.

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

8. Ignition OFF, set the DMM to the 40 V scale or higher, select the Min/Max Recording Mode and set the Peak Min/Max response time to 1 ms or faster.

NOTE:

- **The DMM Min/Max Recording Mode and the response time of 1 ms or**

be recorded.

- **The ignition must be OFF and the ECM completely powered down before testing each circuit or a lower voltage will be recorded.**

9. Verify the Max voltage is within 3 V of B+ while using DMM Min/Max Recording Mode function on each control circuit listed below and ground as the ignition is turned ON.
 - TAC Motor Control Open circuit terminal 1
 - TAC Motor Control Closed circuit terminal 2
 - **If not within 3 V of B+**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If within 3 V of B+**
10. Test or replace the Q38 Throttle Body Assembly.

Repair Instructions

- **Throttle Body Assembly Replacement**
- **Control Module References** for ECM replacement, programming and setup

Repair Verification

1. Install any components that have been removed or replaced during diagnosis.
2. Perform any adjustments, programming or setup procedures that are required when a component is removed or replaced.
3. Clear the DTCs with a scan tool.
4. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
5. Ignition ON.
6. Verify the scan tool TAC Motor parameter displays Enabled while performing the Throttle Sweep Test with a scan tool.
 - **If Enabled is not displayed**

Test or replace the Q38 throttle body assembly.
 - **If Enabled is displayed**
7. If the repair was related to a DTC, duplicate the Conditions for Running the DTC and use the Freeze Frame/Failure Records, if applicable, in order to verify the DTC does not set.
 - **If DTC sets**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for further diagnosis.

- If DTC does not set

8. All OK.

DTC P159F OR P15A0

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.

DTC Descriptors

DTC P159F

Fuel Economy Mode Switch Circuit Low Voltage

DTC P15A0

Fuel Economy Mode Switch Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Fuel Economy Mode Switch 5 V Reference	P159F	P159F, P15A1	P159F	P15A0	P15A1
Fuel Economy Mode Switch Signal	P159F	P159F	P159F	P15A0	P15A1
Fuel Economy Mode Switch Ground	-	P15A0, P15A1	P15A0	-	P15A1

Circuit/System Description

The multifunction switch-center console allows the vehicle operator to modify the traction, ride and fuel economy characteristics of the vehicle. To activate the system, the outer control ring of the momentary-type switch is rotated in either a clockwise or counter-clockwise direction to scroll through and select the desired mode. Each time the control ring is rotated, the next mode in the display order appears on the instrument cluster. Tour mode is the default mode. This means that each time the ignition is cycled OFF/ON, the system defaults to the Tour mode. The control ring can then be rotated to select one of the available modes. The available modes are:

- Weather mode: Indicated on the instrument cluster by the letter W.
- Economy mode: Indicated on the instrument cluster by the letter E.
- Tour mode: Indicated on the instrument cluster by the letter T.

-
- Sport mode: Indicated on the instrument cluster by the letter S.
 - Track mode: Indicated on the instrument cluster by the letters Tr.

The Engine Control Module (ECM) supplies 5V reference voltage to the multifunction switch-center console. The 5V reference voltage induces current to flow through a series of four resistors in the switch to the switch ground circuit. The ECM monitors the reference voltage through a discrete signal circuit. Rotating the switch in one direction allows the 5V reference voltage to by-pass one of the resistors. Rotating the switch in the other direction allows the 5V reference voltage to by-pass two of the resistors. The ECM determines which mode is being selected based on the mode that is displayed on the instrument cluster when the switch control ring is released.

Conditions for Running the DTC

- Ignition key must be turned to ON.
- DTCs P159F and P15A0 run continuously when the above condition is met.

Conditions for Setting the DTC

The ECM detects that the voltage on the multifunction switch-center console signal wire is either too low or too high out of range.

Action Taken When the DTC Sets

DTCs P159F and P15A0 are Type B DTCs.

Conditions for Clearing the MIL/DTC

DTCs P159F and P15A0 are Type B DTCs.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Rotate the S48E Multifunction Switch-Center Console through the following modes.
 - Weather mode
 - Eco mode
 - Tour mode
 - Sport mode
 - Track mode
3. Verify that the modes displayed on the instrument cluster change each time the switch is rotated.
 - **If the modes do not change**

Refer to Circuit/System Testing.
 - **If the modes change**
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 the DTC does not set.
 - **If the DTC sets**

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

Circuit/System Testing

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

1. Ignition OFF and all vehicle systems OFF, It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the X1 harness connector at the S48E Multifunction Switch-Center Console.
3. Test for 266-294 ohms between terminal 1 of the switch and terminal 3 of the switch.

- **If not within the specified range,**

Replace the S48E Multifunction Switch-Center Console.

- **If within the specified range**

4. Test for 2, 640-2, 920 ohms between terminal 1 of the switch and terminal 5 of the switch.

- **If not within the specified range**

Replace the S48E Multifunction Switch-Center Console.

- **If within the specified range**

5. With the switch control ring rotated to the clockwise position, test for 447-495 ohms between terminal 1 of the switch and terminal 5 of the switch.

- **If not within the specified range**

Replace the S48E Multifunction Switch-Center Console.

- **If within the specified range**

6. With the switch control ring rotated to the counter-clockwise position, test for 1045-1145 ohms between terminal 1 of the switch and terminal 5 of the switch.

- **If not within the specified range**

Replace the S48E Multifunction Switch-Center Console.

- **If within the specified range**

7. Test for less than 5 ohms between the ground circuit terminal 5 of the harness connector and ground.

- **If 5 ohms or greater**

Repair the open/high resistance in the circuit.

- **If less than 5 ohms**

8. Ignition ON.

9. Test for 4.8-5.2 V between the 5 V reference circuit terminal 1 of the harness connector and ground.

- **If less than 4.8 V**

1. Ignition OFF, disconnect the X-2 harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 ohms in the 5 V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.

- If less than 2 ohms, replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 1. Ignition OFF, disconnect the X-2 harness connector at the K20 Engine Control Module.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If within 4.8-5.2 V**
 1. Ignition OFF, disconnect the X-2 harness connector at the K20 Engine Control Module.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance
 4. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms
10. Replace the K20 Engine Control Module.

Repair Instructions

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

- **Ride Control Switch Replacement**
- **Control Module References** for ECM replacement, programming and setup

DTC P15A1

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.

DTC Descriptor

DTC P15A1

Fuel Economy Mode Switch Performance

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Fuel Economy Mode Switch 5 V Reference	P159F	P159F, P15A1	P159F	P15A0	P15A1
Fuel Economy Mode Switch Signal	P159F	P159F	P159F	P15A0	P15A1
Fuel Economy Mode Switch Ground	-	P15A0, P15A1	P15A0	-	P15A1

Circuit/System Description

The multifunction switch-center console allows the vehicle operator to modify the traction, ride and fuel economy characteristics of the vehicle. To activate the system, the outer control ring of the momentary-type switch is rotated in either a clockwise or counter-clockwise direction to scroll through and select the desired mode. Each time the control ring is rotated, the next mode in the display order appears on the instrument cluster. Tour mode is the default mode. This means that each time the ignition is cycled OFF/ON, the system defaults to the Tour mode. The control ring can then be rotated to select one of the available modes. The available modes are:

- Weather mode: Indicated on the instrument cluster by the letter W.
- Economy mode: Indicated on the instrument cluster by the letter E.
- Tour mode: Indicated on the instrument cluster by the letter T.
- Sport mode: Indicated on the instrument cluster by the letter S.
- Track mode: Indicated on the instrument cluster by the letters Tr.

The Engine Control Module (ECM) supplies 5V reference voltage to the multifunction switch-center console. The 5V reference voltage induces current to flow through a series of four resistors in the switch to the switch ground circuit. The ECM monitors the reference voltage through a discrete signal circuit. Rotating the switch in one direction allows the 5V reference voltage to by-pass one of the resistors. Rotating the switch in the other direction allows the 5V reference voltage to by-pass two of the resistors. The ECM determines which mode is being selected based on the mode that is displayed on the instrument cluster when the switch control ring is released.

Conditions for Running the DTC

- The ignition key is turned to ON.
- DTC P15A1 runs continuously when the above condition is met.

Conditions for Setting the DTC

The ECM detects that the voltage on the multifunction switch-center console signal wire is in an indeterminate range.

Action Taken When the DTC Sets

Conditions for Clearing the MIL/DTC

DTC P15A1 is a Type B DTC.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON, observe the scan tool DTC information.
2. Verify that DTC P159F or P15A0 is not set.

- **If DTC P159F or P15A0 is set**

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

- **If DTC P159F or P15A0 is not set**

3. Rotate the S48E Multifunction Switch-Center Console through the following modes.
 - Weather mode
 - Eco mode
 - Tour mode
 - Sport mode
 - Track mode

4. Verify that the modes displayed on the instrument cluster change each time the switch is rotated.

- **If the modes do not change**

Refer to Circuit/System Testing.

- **If the modes change**

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.

- **If the DTC does not set**

7. All OK.

Circuit/System Testing

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

1. Ignition OFF and all vehicle systems OFF, It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the X1 harness connector at the S48E Multifunction Switch-Center Console.
3. Test for less than 5 ohms between the ground circuit terminal 5 of the harness connector and ground.

- **If 5 ohms or greater**

Repair the open/high resistance in the circuit.

- **If less than 5 ohms**

4. Test for 266-294 ohms between the 5 V reference voltage circuit terminal 1 of the switch and signal circuit terminal 3 of the switch.

- **If not within the specified range**

Replace the S48E Multifunction Switch-Center Console.

- **If within the specified range**

5. Test for 2, 640-2, 920 ohms between the 5 V reference voltage circuit terminal 1 of the switch and the ground circuit terminal 5 of the switch.

- **If not within the specified range**

Replace the S48E Multifunction Switch-Center Console.

- **If within the specified range**

6. With the switch control ring rotated to the clockwise position, test for 447-495 ohms between the 5 V reference voltage circuit terminal 1 of the switch and the ground circuit terminal 5 of the switch.

- **If not within the specified range**

Replace the S48E Multifunction Switch-Center Console.

- **If within the specified range**

7. With the switch control ring rotated to the counter-clockwise position, test for 1, 045-1, 145 ohms between the 5 V reference voltage circuit terminal 1 of the switch and the ground circuit terminal 5 of the switch.

- **If not within the specified range**

Replace the S48E Multifunction Switch-Center Console.

- **If within the specified range**

8. Disconnect the X2 harness connector at the engine control module (ECM).
9. Test for less than 5 ohms in the 5 V reference voltage circuit end to end.

- **If 5 ohms or greater**

Repair the open/high resistance in the 5 V reference voltage circuit.

- **If less than 5 ohms**

10. Test for less than 5 ohms in the signal circuit end to end.

- **If 5 ohms or greater**

Repair the open/high resistance in the signal circuit.

- **If less than 5 ohms**

11. Replace the K20 ECM.

Repair Instructions

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

- **Ride Control Switch Replacement**
- **Control Module References** for ECM replacement, programming and setup

DTC P163A

Diagnostic Instructions

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

DTC Descriptor

DTC P163A

Control Module Fuel Pressure Regulator 1 Control System Circuitry Performance

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the engine control module (ECM).

Conditions for Running the DTC

- Fuel rail pressure is greater than 0.275 MPa (40 psi).
- Battery voltage is greater than 11 V.
- Fuel temperature is between -10°C (14°F) and 100°C (212°F).
- Intake air temperature is greater than -10°C (14°F).
- The engine has been running for greater than 2 m.
- Barometric pressure is greater than 70 kPa.
- DTCs P0010, P0011, P0016, P0089, P0090, P0091, P0092, P0096, P0097, P0098, P0099, P00C8, P00C9, P00CA, P0117, P0118, P0178, P0179, P018B, P018C, P018D, P0192, P0193, P0231, P0232, P023F, P0335, P0336, P0340, P0341 or P1692 are not present.
- Vehicle is not in a low fuel state.
- DTC P163A runs continuously when the above conditions are met.

Conditions for Setting the DTC

The engine control module detects a condition with the integrated circuits of the high pressure fuel pump actuator driver module or the engine control module detects that the current used to drive the high pressure fuel pump actuator is out of range for greater than 1 s.

Action Taken When the DTC Sets

DTC P163A is a Type B DTC.

Conditions for Clearing the DTC

DTC P163A is a Type B DTC.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

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 for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTCs P0010, P0011, P0016, P0089, P0090, P0091, P0092, P0096, P0097, P0098, P0099, P00C8, P00C9, P00CA, P0117, P0118, P0178, P0179, P018B, P018C, P018D, P0192, P0193, P0231, P0232, P023F, P0335, P0336, P0340, P0341 or P1682 are not present.

- **If any of the listed DTCs are present**

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

- **If none of the DTCs listed are present**

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 P163A does not set.
 - **If DTC P163A sets**

Refer to Circuit/System Testing.

- **If DTC P163A does not set**

5. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the G18 High Pressure Fuel Pump. It may take up to 2 min for all vehicle systems to power down.
2. Ignition ON.
3. Verify that a test lamp does not illuminate between the high control circuit terminal 2 and ground.
 - **If the test lamp illuminates**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector X3 at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the high control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If the test lamp does not illuminate**
4. Verify that a test lamp does not illuminate between the low control circuit terminal 1 and ground.
 - **If the test lamp illuminates**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector X3 at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the low control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If the test lamp does not illuminate**
5. Verify that a test lamp does not illuminate between the high control circuit terminal 2 and B+.
 - **If the test lamp illuminates**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector X3 at the K20 Engine Control Module.
 2. Test for infinite resistance between the high control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If the test lamp does not illuminate**
6. Verify that a test lamp does not illuminate between the low control circuit terminal 1 and B+.
 - **If the test lamp illuminates**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector X3 at the K20 Engine Control Module.
 2. Test for infinite resistance between the low control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

-
- **If the test lamp does not illuminate**
 - 7. Remove the test lamp, connect a 3 A fused jumper wire between the high control circuit terminal 2 and ground.
 - 8. Verify the Fuel Pressure Regulator High Control Circuit Low Voltage Test Status transitions from OK to Malfunction.
 - **If Malfunction is not displayed**
 - 1. Ignition OFF, remove the fused jumper, disconnect the harness connector X3 at the K20 Engine Control Module.
 - 2. Test for less than 2 ohms in the high control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If Malfunction is displayed**
 - 9. Connect a 3 A fused jumper wire between the low control circuit terminal 2 and B+.
 - 10. Verify the Fuel Pressure Regulator Control Circuit High Voltage Test Status transitions from OK to Malfunction.
 - **If Malfunction is not displayed**
 - 1. Ignition OFF, remove the fused jumper, disconnect the harness connector X3 at the K20 Engine Control Module.
 - 2. Test for less than 2 ohms in the low control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If Malfunction is displayed**
 - 11. Test or replace the G18 High Pressure Fuel Pump.

Component Testing

1. Ignition OFF, disconnect the harness connector at the G18 High Pressure Fuel Pump.

NOTE: **The DMM and test leads must be calibrated to 0 ohms in order to prevent misdiagnosis.**

2. Test for 0.34 - 0.44 ohms at 20°C (68°F) between the low control circuit terminal 1 and the high control circuit terminal 2.
 - **If not within the specified range**

Replace the G18 High Pressure Fuel Pump.
 - **If within the specified range**
3. Test for infinite resistance between each terminal and the G18 High Pressure Fuel Pump housing.
 - **If less than infinite resistance**

Replace the G18 High Pressure Fuel Pump.

- **If infinite resistance**

4. All OK.

Repair Instructions

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

- **Fuel Pump Removal** for G18 High Pressure Fuel Pump replacement.
- **Control Module References** for K20 Engine Control Module replacement, programming and setup.

NOTE: Some vehicles do not support the Fuel Rail Pressure Relief Valve Reset procedure. Applications not supporting this procedure will return an error message stating "Parameter ID not supported. Check for proper vehicle selection."

- Perform the Fuel Rail Pressure Relief Valve Reset procedure.

DTC P2096-P2099

Diagnostic Instructions

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

DTC Descriptor

DTC 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 Description

Fuel trim bias is used to keep the post catalyst air/fuel ratio within a predetermined range. This allows optimal catalyst efficiency under various operating conditions. The engine control module (ECM) constantly monitors how lean or rich the fuel trim bias is commanded, to determine if the fuel trim bias is greater than a calibrated amount.

Conditions for Running the DTC

- DTC P0016, P0030, P0036, P0053, P0054, P0056, P0059, P0060, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0128, P0131-P0135, P0137, P0138, P013A, P013B, P013C, P013D, P013E, P013F, P0140, P0141, P0151-P0155, P0157, P0158, P015A, P015B, P015C, P015D, P0160, P0161, P0178, P0179, P0201-P0208, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0279, P0280, P0282, P0283, P0300-P0308, P0340, P0341, P0442, P0443, P0446, P0449, P0452, P0453, P0455, P0458, P0459, P0496, P0498, P0499, P1248, P1249, P124A, P124B, P124C, P124D, P124E, P124F, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216B, P216C, P216E, P216F, P217B, P217C, P217E, P217F, P219A, P219B, P2227, P2228, P2229, P2269, P2270, P2271, P2272 or P2273 is not set.
- The barometric pressure is greater than 70 kPa (10.2 PSI).
- The manifold absolute pressure is between 0-200 kPa (0-29 PSI).
- The intake air temperature is between -20°C and +200°C (-4 and +392°F).
- The start up engine coolant temperature is warmer than -20°C (-4°F).
- The fuel control intrusive diagnostics are not active.
- The engine is operating under light acceleration, heavy acceleration or cruise conditions.
- DTCs P2096, P2097, P2098 and P2099 run continuously when the conditions above have been met.

Conditions for Setting the DTC

The correction limit for a condition causing a rich or lean air/fuel ratio has been exceeded.

Action Taken when the DTC Sets

- DTCs P2096, P2097, P2098 and P2099 are Type B DTCs.
- The ECM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the ECM stores this information in the Failure records. If the diagnostic reports a failure on the second ignition cycle, the ECM records the operating conditions at the time of the failure. The ECM writes the operating conditions to the Freeze Frame and updates the Failure records. The ECM illuminates the malfunction indicator lamp (MIL) when one of the following occurs:
 - The ECM detects the same fuel trim failure during 2 consecutive trips.
 - The ECM detects any fuel trim failure during any subsequent trip if the conditions at the time of failure meet the following criteria:
 - The engine load is within 20 percent of the previous test that failed.

-
- The engine speed is within 375 RPM of the previous test that failed.
 - The engine coolant temperature is in the same range of the previous test that failed.

Conditions for Clearing the MIL/DTC

- DTCs P2096, P2097, P2098 and P2099 are Type B DTCs.
- The ECM turns OFF the malfunction indicator lamp (MIL) at the beginning of the fourth ignition cycle, after 3 ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.

Diagnostic Aids

- The post catalyst fuel trim diagnostic is very sensitive to heated oxygen sensor (HO2S) design. A non-OE sensor or an incorrect part number may cause a DTC to set.
- Certain aftermarket air filters may cause a DTC to set.
- Certain aftermarket air induction systems or modifications to the air induction system may cause a DTC to set.
- Certain aftermarket exhaust system components may cause a DTC to set.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component Views

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 for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify no other HO2S or fuel trim DTC is set.
 - **If any other HO2S or fuel trim DTC is set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for further diagnosis.

- **If no other HO2S or fuel trim DTC is set**
3. Verify DTC P2096, P2097, P2098 or P2099 is not set.
 - **If a DTC is set**

Refer to Circuit/System Testing.

- **If no DTC is set**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed in the Freeze Frame/Failure Records data.
 5. Verify DTC P2096, P2097, P2098 or P2099 is not set.
 - **If a DTC is set**

Refer to Circuit/System Testing.

- **If no DTC is set**
6. All OK.

Circuit/System Testing

Verify none of the conditions listed below exist:

P2096 or P2098

- Air intake duct collapsed or restricted.
- Air filter dirty or restricted.
- Contamination of the mass air flow sensor with oil or other foreign material
- Objects blocking the throttle body.
- Excessive fuel in the crankcase. Change engine oil as necessary.
- Rich fuel injectors. Refer to **Fuel Injector Diagnosis** .
- Excessive fuel system pressure. Refer to **Fuel System Diagnosis** .
- Fuel contamination. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis** .
- Fuel saturation of the evaporative emissions (EVAP) canister.

-
- Restricted exhaust. Refer to **Symptoms - Engine Exhaust** .
 - Improper operation of the crankcase ventilation system.

P2097 or P2099

- Exhaust system leaks. Refer to **Symptoms - Engine Exhaust** .
- Split, kinked or improperly connected vacuum hoses.
- Contamination of the mass air flow sensor with oil or other foreign material
- Insufficient fuel in the tank.
- Leaks in the air induction system and air intake ducts.
- Missing air filter element.
- Cracked evaporative canister.
- Evaporative pipes plugged, obstructed or leaking.
- Crankcase ventilation system leaking.
- Engine vacuum leaks.
- Low fuel system pressure. Refer to **Fuel System Diagnosis** .
- Contaminated fuel. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis** .
- Lean fuel injectors. Refer to **Fuel Injector Diagnosis** .

- **If a condition is found**

Repair as necessary.

Repair Instructions

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

Reset the fuel trim after completing the repair.

DTC P2122, P2123, P2127, P2128 OR P2138

Diagnostic Instructions

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

DTC Descriptors

DTC 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	High Resistance	Open	Short to Voltage	Signal Performance
Accelerator Pedal Position (APP) Sensor 1 5 V Reference Circuit	P06A3	P2138	P2122	P06A3	P2138
Accelerator Pedal Position (APP) Sensor 2 5 V Reference Circuit	P0106, P0108, P0107, P0697	P2138	P2127	P0106, P0108, P0697	P2138
Accelerator Pedal Position (APP) Sensor 1 Signal	P2122	P2138	P2122	P2123, P2138	P2138
Accelerator Pedal Position (APP) Sensor 2 Signal	P2127	P2138	P2127	P2128, P2138	P2138
Accelerator Pedal Position (APP) Sensor 1 Low Reference	-	P2138	P2123	-	P2138
Accelerator Pedal Position (APP) Sensor 2 Low Reference	-	P2138	P2128	-	P2138

Typical Scan Tool Data

APP Sensor 1

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: The engine is operating at idle. Parameter Normal Range: APP Sensor 1 0.88-1.08 V			

5 V Reference	0.00 V	0.00 V	2-3 V
Signal	0.00 V	0.00 V	4-5 V
Low Reference	-	4-5 V	-

APP Sensor 2

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: The engine is operating at idle. Parameter Normal Range: APP Sensor 2 0.39-0.59 V			
5 V Reference	0.00 V	0.00 V	1-3 V
Signal	0.00 V	0.00 V	2-5 V
Low Reference	-	4-5 V	-

Circuit/System Description

The accelerator pedal assembly contains 2 accelerator pedal position (APP) sensors. The APP sensors are mounted to the accelerator pedal assembly and are not serviceable. The APP sensors provide a signal voltage that change relative to pedal position. The engine control module (ECM) supplies each APP sensor with a 5 V reference circuit, a low reference circuit and a signal circuit.

Both the APP sensors 1 and 2 signal percentages increase as the pedal is depressed, from approximately 0 percent at rest to above 95 percent when fully depressed.

Conditions for Running the DTC

P2122, P2123, P2127 or P2128

- DTC P06A3 or P0697 are not set.
- The ignition is ON or the engine is operating.
- The ignition voltage is greater than 6.41 V.
- The DTCs run continuously when the above conditions are met.

P2138

- DTCs P06A3, P0697, P2122, P2123, P2127 or P2128 are not set.
- The ignition is ON or the engine is operating.
- The ignition voltage is greater than 6.41 V.
- The ECM is not commanding reduced power.
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

P2122

The ECM detects that the APP sensor 1 voltage is less than 0.46 V for less than 1 s.

P2123

The ECM detects that the APP sensor 1 voltage is greater than 4.75 V for less than 1 s.

P2127

The ECM detects that the APP sensor 2 voltage is less than 0.32 V for less than 1 s.

P2128

The ECM detects that the APP sensor 2 voltage is greater than 2.6 V for less than 1 s.

P2138

The ECM detects that APP sensor 1 and APP sensor 2 disagree greater than 10 percent for less than 1 s.

OR

The ECM detects that both APP sensor 1 and APP sensor 2 are 5 percent greater than the learned minimum position for less than 1 s.

Action Taken When the DTC Sets

- DTCs P2122, P2123, P2127, P2128 and P2138 are type A DTCs.
- The ECM commands the TAC system to operate in a Reduced Engine Power mode.

Conditions for Clearing the DTC

DTCs P2122, P2123, P2127, P2128 and P2138 are type A DTCs.

Diagnostic Aids

- A high resistance condition on the accelerator pedal position circuits could cause a DTC to set.
- Ensure that the in-line harness connector seals are installed correctly. Improper installation could result in water intrusion into the connector and cause a DTC to set.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

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 for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC P0697 or P06A3 is not set.
 - **If any of the DTCs are set**

Refer to **DTC P0641, P0651, P0697 or P06A3** for further diagnosis.

- **If none of the DTCs are set**

3. Verify the APP Sensor 1 Circuit Status and APP Sensor 2 Circuit Status displays OK.
 - **If OK is not displayed**

Refer to Circuit/System Testing.

- **If OK is displayed**

4. Verify the scan tool APP Sensor 1 and 2 Agree/Disagree parameter displays Agree while performing the tests listed below:
 - Rapidly depress the accelerator pedal from the rest position to the wide open throttle position (WOT) and release pedal. Repeat the procedure several times.
 - Slowly depress the accelerator pedal to WOT and then slowly return the pedal to closed throttle. Repeat the procedure several times.
 - **If Agree is not displayed**

Refer to Circuit/System Testing.

- **If Agree is displayed**

5. Verify that DTC P2122, P2123, P2127, P2128 or P2138 is not set.

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

Refer to Circuit/System Testing.

- **If none of the DTCs set**

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

- **If the DTC does not set**

8. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B107 Accelerator Pedal Position Sensor. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 5 ohms between each low reference circuit terminal listed below and ground.

- APP sensor 1 low reference circuit terminal 4
- APP sensor 2 low reference circuit terminal 3

- **If 5 ohms or greater**

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

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

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

- **If less than 5 ohms**

3. Ignition ON.

4. Test for 4.8-5.2 V between each 5 V reference circuit terminal listed below and ground.

- APP sensor 1, 5 V reference circuit terminal 6
- APP sensor 2, 5 V reference circuit terminal 1

- **If less than 4.8 V**

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

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

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

-
3. Test for less than 2 ohms in the 5 V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8-5.2 V**
 5. Verify each APP sensor voltage parameter is less than 0.2 V.
 - **If 0.2 V or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal listed below and ground.
 - APP sensor 1 signal circuit terminal 5
 - APP sensor 2 signal circuit terminal 2
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If less than 0.2 V**
 6. Install a 3 A fused jumper wire between the appropriate signal circuit terminal listed below and a 5 V reference circuit terminal 1 or 6.
 - APP sensor 1 signal circuit terminal 5
 - APP sensor 2 signal circuit terminal 2
 7. Verify the scan tool APP Sensor 1 or 2 voltage parameter is greater than 4.8 V.
 - **If 4.8 V or less**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If greater than 4.8 V**
 8. Test or replace the B107 Accelerator Pedal Position Sensor.

Repair Instructions

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

-
- **Accelerator Pedal Position Sensor Replacement**
 - **Control Module References** for ECM replacement, programming and setup

DTC P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216B, P216C, P216E, P216F, P217B, P217C, P217E OR P217F

Diagnostic Instructions

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

DTC Descriptors

DTC 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

DTC P217B

Cylinder 7 Injector High Control Circuit Low Voltage

DTC P217C

Cylinder 7 Injector High Control Circuit High Voltage

DTC P217E

Cylinder 8 Injector High Control Circuit Low Voltage

DTC P217F

Cylinder 8 Injector High Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Short from Supply Circuit to Control Circuit
Direct Fuel Injector High Voltage Control Cylinder 1	P0261	P0201	P0262	P1248
Direct Fuel Injector High Voltage Supply Cylinder 1	P2147	P0201	P2148	P1248
Direct Fuel Injector High Voltage Control Cylinder 2	P0264	P0202	P0265	P1249
	P2150	P0202	P2151	P1249

Voltage Supply Cylinder 2				
Direct Fuel Injector High Voltage Control Cylinder 3	P0267	P0203	P0268	P124A
Direct Fuel Injector High Voltage Supply Cylinder 3	P2153	P0203	P2154	P124A
Direct Fuel Injector High Voltage Control Cylinder 4	P0270	P0204	P0271	P124B
Direct Fuel Injector High Voltage Supply Cylinder 4	P2156	P0204	P2157	P124B
Direct Fuel Injector High Voltage Control Cylinder 5	P0273	P0205	P0274	P124C
Direct Fuel Injector High Voltage Supply Cylinder 5	P216B	P0205	P216C	P124C
Direct Fuel Injector High Voltage Control Cylinder 6	P0276	P0206	P0277	P124D
Direct Fuel Injector High Voltage Supply Cylinder 6	P216E	P0206	P216F	P124D
Direct Fuel Injector High Voltage Control Cylinder 7	P0279	P0207	P0280	P124E
Direct Fuel Injector High Voltage Supply Cylinder 7	P217B	P0207	P217C	P124E
Direct Fuel Injector High Voltage Control Cylinder 8	P0282	P0208	P0283	P124F
Direct Fuel Injector High Voltage Supply Cylinder 8	P217E	P0208	P217F	P124F
DTC P0300 may also be present for all fault conditions				

Circuit/System Description

The engine control module (ECM) supplies voltage to each fuel injector on the injector high voltage supply circuits. The ECM energizes each fuel injector by grounding the high voltage control circuit of the fuel injector. The ECM monitors the status of the injector high voltage supply circuits and the fuel injector high voltage control circuits. When a fuel injector circuit condition is detected by the ECM, the affected fuel injector(s) is disabled.

Conditions for Running the DTC

- Engine is running.
- Ignition voltage is greater than 11 V.
- DTC P062B is not present.
- The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

The engine control module detects the fuel injector high voltage supply circuit is shorted to ground for greater than 2 s.

P2148, P2151, P2154, P2157, P216C, P216F, P217C or P217F

The engine control module detects the fuel injector high voltage supply circuit is shorted to voltage for greater than 2 s.

Action Taken When the DTC Sets

DTCs P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216B, P216C, P216E, P216F, P217B, P217C, P217E and P217F are Type A DTCs.

Conditions for Clearing the DTC

DTCs P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216B, P216C, P216E, P216F, P217B, P217C, P217E and P217F are Type A DTCs.

Diagnostic Aids

- The MIL indicator flashes when there is an engine misfire.
- High resistance in the circuits of the fuel injectors may set a misfire DTC without setting an injector DTC. Test the fuel injector circuits of the affected cylinder(s) for a high resistance if you suspect a condition.
- Performing the fuel injector coil test may help isolate an intermittent condition. Refer to **Fuel Injector Diagnosis**.
- If the condition is intermittent, move the related harnesses and connectors, with the engine operating, while monitoring the scan tool Injector Control Circuit Status parameters. An Injector Control Circuit Status parameter will change from OK or Not Run to Malfunction if there is a condition with the circuit or a connection.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

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 for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC P062B is not set
 - **If DTC P062B is set**

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

- **If DTC P062B is not set**

NOTE: **The engine must be running for the injector circuit status parameters to function.**

3. Engine idling.
4. Verify with a scan tool the Cylinder 1-6 Injector Control Circuit Status parameters display OK or Not Run.
 - **If OK or Not Run is not displayed**

Refer to Circuit/System Testing.

- **If OK or Not Run is displayed**

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 set**

Refer to Circuit/System Testing.

- **If the DTC does not set**

7. All OK.

Circuit/System Testing

1. Ignition OFF, all vehicle systems OFF, disconnect the harness connector X3 at the K20 Engine Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for infinite resistance between the appropriate Q17 Fuel Injector direct fuel injector high voltage supply circuit and ground.
 - **If less than infinite resistance**
 1. Disconnect the harness connector of the appropriate Q17 Fuel Injector.
 2. Test for infinite resistance between the appropriate Q17 Fuel Injector direct fuel injector high voltage supply circuit and ground.
 - If less than infinite, repair the short to ground in the circuit.
 - If infinite, test or replace the appropriate Q17 Fuel Injector.
 - **If infinite resistance**
3. Ignition ON.
4. Test for less than 1 V between the appropriate Q17 Fuel Injector direct fuel injector high voltage supply circuit and ground.
 - **If 1 V or greater**
 1. Disconnect the harness connector of the appropriate Q17 Fuel Injector, ignition ON.
 2. Test for less than 1 V between the appropriate Q17 Fuel Injector direct fuel injector high voltage supply circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, repair the short to voltage on the direct fuel injector high voltage control circuit.
 - **If less than 1 V**
5. Test or replace the K20 Engine Control Module.

Component Testing

- **Fuel Injector Diagnosis**
- **Fuel Injector Balance Test**

Repair Instructions

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

- **Fuel Injector Replacement**
- **Control Module References** for K20 Engine Control Module replacement, programming and setup.

DTC P2199

Diagnostic Instructions

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

DTC Descriptor

DTC P2199

Intake Air Temperature (IAT) Sensors 1-2 Not Plausible

Diagnostic Fault Information

IAT 1 Sensor

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 ECM or sensor damage may occur if the circuit is shorted to B+.

IAT Sensor 2

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Voltage	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, P2230	-	P0096, P0102

*Internal ECM or sensor damage may occur if the circuit is shorted to B+.

Typical Scan Tool Data

IAT 1 Sensor

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Operating Conditions: Engine Running			
Parameter Normal Range: Varies with ambient temperature; and engine bay conditions			
Signal	150°C (302°F)	-40°C (-40°F)	-40°C (-40°F)*
Low Reference	-	-40°C (-40°F)	-40°C (-40°F)*
*Internal ECM or sensor damage may occur if the circuit is shorted to B+			

IAT Sensor 2

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Operating Conditions: Engine Running			
Parameter Normal Range: Varies with ambient temperature			
Ignition Voltage	-40°C (-40°F) 10 Hz	-40°C (-40°F) 10 Hz	-
Signal	-40°C (-40°F) 10 Hz	-40°C (-40°F) 10 Hz	-40°C (-40°F)* 10 Hz
Ground	-	-40°C (-40°F) 10 Hz	-
*Internal ECM or sensor damage may occur if the circuit is shorted to B+.			

Circuit/System Description

The sensors listed below are integrated within the mass air flow/multifunction intake air sensor:

- IAT sensor 1
- IAT sensor 2
- Humidity sensor
- MAF sensor
- BARO pressure sensor

The intake air temperature (IAT) sensor 1 is a variable resistor that changes the voltage on the engine control module (ECM) supplied 5 V signal circuit. The signal varies with inlet air temperature in the sensor bore and is displayed by the scan tool as °C (°F). The IAT sensor 2 and the humidity sensor share the same circuit. The IAT sensor 2 signal is displayed by the scan tool as Hertz (Hz) and °C (°F).

The sensors listed below share an ECM supplied 5 V reference circuit:

- IAT sensor 2
- Humidity sensor
- Barometric pressure (BARO) sensor

- IAT sensor 1
- IAT sensor 2
- Humidity sensor
- Barometric pressure (BARO) sensor

IAT Sensor 1 - Temperature, Resistance, Voltage Table

IAT Sensor 1	IAT Sensor 1 Resistance	IAT Sensor 1 Signal Voltage
Cold	High	High
Warm	Low	Low

IAT Sensor 2 - Temperature, Frequency Table

IAT Sensor 2	IAT Sensor 2 Frequency	IAT Sensor 2 Temperature
Cold	45 Hz	-40°C (-40°F)
Warm	302 Hz	104°C (219°F)

Conditions for Running the DTC

- DTC P1682 is not set.
- The ignition is ON.
- Ignition voltage is at least 11 V.
- This DTC runs continuously within the enabling conditions.

Conditions for Setting the DTC

The ECM detects that the absolute difference between the IAT sensor 1 and the IAT sensor 2 temperatures is greater than 55°C (99°F) for longer than 5 s.

Action Taken When the DTC Sets

DTC P2199 is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P2199 is a Type B DTC.

Diagnostic Aids

- With the ignition ON, the engine OFF and the engine is cold, a properly functioning IAT sensor 2 will gradually increase the scan tool IAT Sensor 2 parameter. This is due to the heat that is generated by the multifunction intake air sensor heating elements.
- The humidity sensor and the IAT sensor 2 signals are sent to the ECM on the same circuit. If the IAT Sensor 2 parameter displays the values: 10 Hz; -40°C (-40°F) and there are Humidity Sensor DTCs, check for a circuit problem.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

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

Powertrain Component Views

Powertrain Component Views

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38522-A Variable Signal Generator

For equivalent regional tools, refer to **Special Tools (Diagnostic Tools)** .

Circuit/System Verification

NOTE: To minimize the effects of residual engine heat and sensor internal heating elements, perform Steps 1 and 2 of this verification procedure only if the ignition has been OFF for 8 hours or more.

1. Ignition ON.

2. Verify the following scan tool parameters are within 25°C (45°F) of each other.

- Start-Up IAT Sensor 1
- Start-Up IAT Sensor 2
- Start-Up ECT
- **If not within 25°C (45°F)**

Refer to Circuit/System Testing.

- **If within 30°C 25°C (45°F)**

3. Engine idling, verify the following scan tool parameters are between: -38 and +149°C (-36 and +300°F).

- IAT Sensor 1
- IAT Sensor 2
- ECT Sensor
- **If not between: -38 and +149°C (-36 and +300°F)**

Refer to Circuit System Testing.

- **If between: -38 and +149°C (-36 and +300°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.

5. Verify the DTC does not set.

- **If any DTC sets**

Refer to Circuit/System Testing.

- **If no DTC sets**

6. All OK

Circuit/System Testing

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

1. Verify none of the following conditions exist:

- A restricted or collapsed air intake duct
- An intake manifold leak
- A MAP sensor seal that is leaking, missing or damaged
- A restricted or collapsed air intake duct
- A misaligned or damaged air intake duct
- Any water intrusion in the induction system

- An Intake Manifold Resonator with a leaking seal or a cracked or broken housing
- **If a condition exists**

Repair or replace the component as appropriate.

- **If no condition exists**

2. Ignition OFF and all systems OFF, it may take up to for 2 minutes for all vehicle systems to power down. Disconnect the harness connector at the B75C Multifunction Intake Air sensor.
3. Test for less than 2 ohms between the low reference circuit terminal 3 and ground.
 - **If 2 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the low reference circuit end to end.
 - If 2 ohms or greater, repair the open or high resistance in the circuit.
 - If less than 2 ohms replace the K20 Engine Control Module.
 - **If less than 2 ohms**
4. Ignition OFF, all vehicle systems OFF, test for less than 2 ohms between the ground circuit terminal 7 and ground.
 - **If 2 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open or high resistance in the circuit.
 - If less than 2 ohms, repair the open/high resistance in the ground connection.
 - **If less than 2 ohms**
5. Ignition ON, verify that a test lamp illuminates between the ignition circuit terminal 5 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp and remove the fuse for the ignition voltage circuit.
 2. Test for less than 2 ohms in the ignition voltage circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF, remove the test lamp and remove the fuse for the ignition voltage circuit.
 2. Test for infinite resistance between the ignition voltage circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for greater than 2 ohms between the ignition voltage circuit terminal 5 and ground.
 - If less than 2 ohms, repair the short to ground on the circuit.
 - If greater than 2 ohms, test all the components connected to the circuit and repair or replace as necessary.

-
6. Ignition ON, test for 4.8-5.2 V between the intake air temperature signal 1 circuit terminal 1 and ground.

- **If less than 4.8 V**

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

- **If greater than 5.2 V**

NOTE: If the signal circuit is shorted to a voltage the engine control module or the sensor may be damaged.

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

- **If between 4.8-5.2 V**

7. Ignition ON, verify the scan tool IAT Sensor 1 parameter is colder than -39°C (-38°F).

- **If warmer than -39°C (-38°F).**

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

- **If colder than -39°C (-38°F).**

8. Ignition OFF, install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 3.

9. Verify the scan tool IAT Sensor 1 parameter is warmer than 148°C (298°F).

- **If colder than 148°C (298°F).**

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

-
3. Ignition OFF.
 4. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If warmer than 148°C (298°F).**
 10. Ignition ON, test for 4.8-5.2 V between the Intake Air Temperature sensor 2 signal circuit terminal 8 and ground.
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If greater than 5.2 V**

NOTE: If the signal circuit is shorted to a voltage the engine control module or the sensor may be damaged.

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Ignition ON, test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
- **If between 4.8-5.2 V**
11. Determine if **EL-38522-A** Variable Signal Generator or equivalent is available.
 - **EL-38522-A, Variable Signal Generator; or equivalent is not available**
 1. Test or replace the B75C Multifunction Intake Air sensor.
 2. 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.
 3. Verify the DTC does not set.
 - **If the DTC sets**

Replace the K20 Engine Control Module.
 - **If no DTCs set**
 - **EL-38522-A, Variable Signal Generator; or equivalent is available**
12. Ignition OFF, connect the leads of the **EL-38522-A** Variable Signal Generator as follows:

-
- Red lead to the signal circuit terminal 8 at the harness connector
 - Black leads to ground
 - Battery voltage supply lead to B+
13. Set the **EL-38522-A** Variable Signal Generator to the following specifications.
 - Signal switch to 5 V
 - Duty Cycle switch to 50 % (Normal)
 - Frequency switch to 30 Hz
 14. Ignition ON, verify the scan tool IAT Sensor 2 parameter is between 28-32 Hz.
 - **If not between 28-32 Hz**

Replace the K20 Engine Control Module.
 - **If between 28-32 Hz**
 15. Test or replace the B75C Multifunction Intake Air sensor.

Component Testing

Multifunction Intake Air Sensor

1. Ignition OFF, disconnect the harness connector at the B75C Multifunction Intake Air sensor.

NOTE: **A thermometer can be used to test the sensor off the vehicle.**

2. Test the IAT sensor 1 by varying the sensor temperature while monitoring the sensor resistance. Compare the readings with the **Temperature Versus Resistance - Intake Air Temperature Sensor** table for Hitachi Sensors. The resistance values should be in range of the table values.

- **If not within the table values.**

Replace the B75C Multifunction Intake Air sensor.

- **If within the table values.**

3. All OK

Multifunction Intake Air Sensor

1. Test the IAT Sensor 2 by varying the sensor temperature while monitoring the air temperature with a thermometer. Compare the readings with the scan tool IAT Sensor 2 parameter. The values should be within 5%.

- **If not within 5%**

Replace the B75C Multifunction Intake Air sensor.

- If within 5%
2. All OK.

Repair Instructions

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

- **Mass Airflow Sensor with Intake Air Temperature Sensor Replacement** for multifunction intake air sensor replacement.
- **Control Module References** for engine control module replacement, programming and setup

DTC P219A OR P219B

Diagnostic Instructions

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

DTC Descriptor

DTC P219A

Fuel Trim Cylinder Balance Bank 1

DTC P219B

Fuel Trim Cylinder Balance Bank 2

Circuit/System Description

The Fuel Trim Cylinder Balance diagnostic detects a rich or lean cylinder to cylinder air/fuel ratio imbalance. The diagnostic monitors the pre-catalyst heated oxygen sensor (HO2S) signal's frequency and amplitude characteristics by calculating an accumulated voltage over a predetermined sample period. An imbalance is indicated when multiple samples of the accumulated voltage are consistently higher than the desired value.

Conditions for Running the DTC

- DTCs P0016, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0116, P0117, P0118, P0122, P0123, P0128, P0201-P0208, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0279, P0280, P0282, P0283, P0300, P0301-P0308, P0340, P0341, P0442, P0455, P0458, P0496, P1248, P1249, P124A, P124B, P124C, P124D, P124E, P124F, P16F3, P2101, P2135, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216B, P216C, P216E, P216F, P217B, P217C, P217E or P217F are not set.

-
- The evaporative emission system device control and intrusive diagnostics are not active.
 - The engine overspeed protection is not active.
 - The engine is in closed loop status.
 - The system voltage is greater than 10 V.
 - The engine coolant temperature is warmer than -20°C (-4°F).
 - The engine speed is between 800-3, 750 RPM.
 - The mass air flow is between 5-1, 000 g/s.
 - Engine run time is greater than 25 s.
 - Fuel level is greater than 10% and no fuel level sensor fault is present.
 - The DTC runs continuously when the above conditions have been met.

Conditions for Setting the DTC

Multiple samples of the pre-catalyst HO2S accumulated voltage are consistently greater than the desired value.

Action Taken When the DTC Sets

DTCs P219A and P219B are Type A DTCs.

Conditions for Clearing the MIL/DTC

DTCs P219A and P219B are Type A DTCs.

Diagnostic Aids

- The fuel trim cylinder balance diagnostic is very sensitive to heated oxygen sensor (HO2S) design. A non-OE sensor or an incorrect part number may cause a DTC to set.
- Monitoring the misfire current counters or misfire graph, may help to isolate the cylinder that is causing the condition.
- Certain aftermarket air filters may cause a DTC to set.
- Certain aftermarket air induction systems or modifications to the air induction system may cause a DTC to set.
- Certain aftermarket exhaust system components may cause a DTC to set.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component Views

Electrical Information Reference

- **Circuit Testing**
- **Troubleshooting with a Test Lamp**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify no other DTCs are set.
 - **If any other DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for further diagnosis.

- **If no other DTCs are set**
3. Verify DTC P219A or P219B is not set.
 - **If a DTC is set**

Refer to Circuit/System Testing.

- **If no DTC is set**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed in the Freeze Frame/Failure Records data.
 5. Verify DTC P219A or P219B is not set.
 - **If a DTC is set**

Refer to Circuit/System Testing.

- **If no DTC is set**
6. All OK.

Circuit/System Testing

1. Engine idling, transmission in Park or Neutral, verify the manifold absolute pressure (MAP) sensor parameter is between 19-42 kPa (2.7-6 PSI).

- If not within the specified range .

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

- If within the specified range, inspect for the conditions listed below:
 - Air induction system for modified, damaged, leaking or restricted components.
 - Crankcase ventilation system for improper operation. Refer to **Crankcase Ventilation System Inspection/Diagnosis** .
 - Vacuum hoses for splits, kinks and improper connections.
 - Restricted, damaged, leaking or modified exhaust system from the catalytic converter forward. Refer to **Symptoms - Engine Exhaust** .
 - Fuel injectors for improper operation. Refer to **Fuel Injector Diagnosis** .
 - Test for fuel contamination. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis** .
 - Excessive fuel in the crankcase due to leaking injectors. Change engine oil as necessary.
 - Ignition system for improper operation. Refer to **Electronic Ignition System Diagnosis** .
- If a condition is found

Repair as necessary.

- If no condition is found

2. Test the engine for any mechanical conditions such as sticking valves, lifters, etc., which could alter the flow into the combustion chamber. Refer to **Symptoms - Engine Mechanical** .

Repair Instructions

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

Reset the fuel trim after completing the repair.

DTC P2227-P2230

Diagnostic Instructions

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

DTC Descriptors

DTC 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	P0641, P2227, P2228	P2227, P2228	P0193, P0641, P2227, P2229	P2227
Signal	P2227, P2228	P2227, P2228	P2227, P2229	P2227
Low Reference	-	P0113, P2199, P2227, P2228, P2229	-	P2227

Typical Scan Tool Data

BARO

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON, Engine OFF Parameter Normal Range: 56-105 kPa (8.1-15.2 psi), varies with altitude			
5 V Reference	0 kPa (0 psi)	0 kPa (0 psi)	128 kPa (18.6 psi)
Signal	0 kPa (0 psi)	0 kPa (0 psi)	128 kPa (18.6 psi)
Low Reference	-	128 kPa (18.6 psi)	-

Circuit/System Description

The barometric pressure (BARO) sensor is integral to the multifunction intake air sensor and responds to changes in altitude and atmospheric conditions. This gives the ECM an indication of barometric pressure. The ECM uses this information to calculate fuel delivery. The BARO sensor

monitors the BARO sensor signal for a voltage outside of the normal range.

Conditions for Running the DTC

P2227

- DTC P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0117, P0118, P0119, P0121, P0122, P0123, P0222, P0223, P2101, P2135, P2228 or P2229 is not set.
- Engine is running.

OR

- DTC P0106, P0107, P0108, P2228, P2229, P2230 or P2610 is not set and P0107, P0108, P2228 or P2229 is not pending.
- Ignition ON, engine OFF
- Time between the current ignition cycle and the last time the engine was running is greater than 5 s.
- DTC P2227 runs continuously when the above conditions are met.

P2228 or P2229

- Engine is running.
- The DTCs run continuously when the above condition is met.

P2230

- DTC P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0117, P0118, P0119, P0121, P0122, P0123, P0222, P0223, P2101, P2135, P2228 or P2229 is not set.
- Ignition is ON.
- DTC P2230 runs continuously when the above conditions are met.

Conditions for Setting the DTC

P2227

- Engine is running.
- The ECM detects that the difference between the BARO signal and the calculated BARO is greater than 15 kPa (2.2 psi) if the vehicle has traveled at most 1.0 km (0.06 mi) since the last calculated BARO update or the ECM detects that the difference between the BARO signal and the calculated BARO is greater than 20 kPa (2.9 psi) if the vehicle has traveled greater than 1.0 km (0.06 mi) since the last calculated BARO update.

OR

-
- Ignition ON, engine OFF
 - The ECM detects that the BARO pressure is less than 50 kPa (7.3 psi) or greater than 115 kPa (16.7 psi).

P2228

The ECM detects that the BARO sensor voltage is less than 2.0 V for greater than 4 s.

P2229

The ECM detects that the BARO sensor voltage is greater than 4.5 V for greater than 4 s.

P2230

The ECM detects that the cumulative difference between BARO sensor readings, over a specific length of time, is greater than a calibrated threshold.

Action Taken When the DTC Sets

DTCs P2227, P2228, P2229 and P2230 are Type B DTCs.

Conditions for Clearing the MIL/DTC

DTCs P2227, P2228, P2229 and P2230 are Type B DTCs.

Diagnostic Aids

Inspect the inlet port on the BARO sensor for moisture or debris and attempt to dry or clean the inlet, if contaminated.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool BARO pressure parameter is within the range specified in the **Altitude Versus Barometric Pressure** table.
 - **If the BARO is not within the specified range**

Refer to Circuit/System Testing.
 - **If the BARO is within the specified range**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed in the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 - **If the DTC sets**

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

Circuit/System Testing

1. Verify the conditions listed below do not exist with the B75C Multifunction Intake Air Sensor:
 - Damage
 - Restrictions in the inlet port
 - **If a condition exists**

Repair or replace the B75C Multifunction Intake Air Sensor as necessary.
 - **If none of the conditions exist**
2. Ignition OFF and all vehicle systems OFF, it may take up to 2 minutes for all vehicle systems to power down. Disconnect the harness connector at the B75C Multifunction Intake Air Sensor.
3. Test for less than 5 ohms between the low reference circuit terminal 3 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

-
- If greater than the specified value, repair the open or high resistance in the circuit.
 - If 2 ohms or less replace the K20 Engine Control Module.
 - **If less than 5 ohms**
4. Ignition ON.
 5. Test for 4.8-5.2 V between the 5 V reference circuit terminal 2 and ground.
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the 5 V reference circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8-5.2 V**
 6. Verify the scan tool BARO Sensor parameter is less than 0.2 V.
 - **If 0.2 V or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit terminal 4 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If less than 0.2 V**
 7. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the 5 V reference circuit terminal 2.
 8. Verify the scan tool BARO Sensor parameter is greater than 4.5 V.
 - **If 4.5 V or less**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 ohms in the signal circuit end to end.

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

- **If greater than 4.5 V**

9. Test or replace the B75C Multifunction Intake Air Sensor.

Repair Instructions

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

- **Mass Airflow Sensor with Intake Air Temperature Sensor Replacement** for multifunction intake air sensor replacement.
- **Control Module References** for engine control module replacement, programming and setup.

DTC P2269

Diagnostic Instructions

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

DTC Descriptor

DTC P2269

Water in Fuel

Circuit/System Description

Alcohol content information is supplied to the engine control module (ECM) from the fuel composition sensor. The fuel composition sensor has a battery positive circuit, a signal circuit and a ground circuit. The fuel composition sensor uses a microprocessor inside the sensor to measure the ethanol percentage and changes the output signal accordingly. The signal circuit carries the ethanol percentage via the frequency signal. The ECM provides an internal pull up to 5 V on the signal circuit and the fuel composition sensor pulls the 5 V to ground in pulses. The normal range of operating frequency is between 50-150 Hz. The microprocessor inside the fuel composition sensor is capable of a certain amount of self-diagnosis. An output frequency between 180 Hz and 190 Hz indicates that the fuel is contaminated.

Conditions for Running the DTC

- The ignition voltage is greater than 11 V.
- The DTC runs continuously when the above condition is met.

Conditions for Setting the DTC

The engine control module detects that the fuel composition sensor output frequency is greater than 185 Hz for greater than 6 s.

Action Taken When the DTC Sets

DTC P2269 is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P2269 is a Type B DTC.

Diagnostic Aids

A momentary slug of water in the fuel system may set this DTC.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

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 for scan tool information

Special Tools

- **J 44175-A Fuel Composition Tester**

For equivalent regional tools, refer to **Special Tools (Diagnostic Tools)** .

Circuit/System Verification

1. Engine running.
2. Verify the scan tool Fuel Composition Sensor parameter is between 50-150 Hz.
 - **If not between 50-150 Hz**

Refer to Circuit/System Testing.
 - **If between 50-150 Hz**
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.
 - **If DTC is set**

Refer to Circuit/System Testing.
 - **If DTC is not set**
4. All OK.

Circuit/System Testing

1. Verify that there are no contaminants, water or too high of a concentration of ethanol in the fuel. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis** and the J 44175-A Instruction Manual.
 - **If the fuel tested is not within acceptable levels**

Refer to **Fuel System Cleaning** .
 - **If the fuel tested within acceptable levels**
2. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B198 Fuel Composition Sensor. It may take up to 2 min for all vehicle systems to power down.
3. Test for less than 5 ohms between the ground circuit terminal 2 and ground.
 - **If 5 ohms or greater**
 1. Ignition OFF.
 2. Test for less than 2 ohms in the ground circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, repair the ground connection.
 - **If less than 5 ohms**
4. Ignition ON.
5. Verify that a test lamp illuminates between the B+ circuit terminal 1 and ground.

-
1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 ohms in the B+ circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, verify the fuse is good and voltage is supplied to the fuse.
 - **If the test lamp does not illuminate and the fuse is opened**
 1. Ignition OFF, remove the test lamp.
 2. Test for infinite resistance between the B+ circuit and ground
 - If less than infinite, repair the short to ground in the circuit.
 - If infinite, test all the components connected to the circuit and repair or replace as necessary.
 - **If the test lamp illuminates**
 6. Remove the test lamp.
 7. Ignition ON, test for 4.8-5.2 V between the signal circuit terminal 3 and ground.
 - **If less than 4.8 V**
 - 1. Ignition OFF, disconnect the harness connector X1 at the K20 Engine Control Module.
 - 2. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, test or replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 - 1. Ignition OFF, disconnect the harness connector X1 at the K20 Engine Control Module, ignition ON.
 - 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, test or replace the K20 Engine Control Module.
 - **If between 4.8-5.2 V**
 8. Ignition OFF, connect the red lead of the **J 38522-A** Variable Signal Generator to the signal circuit terminal 3 at the B198 Fuel Composition Sensor harness connector. Connect the battery voltage supply to B+ and the black lead to ground.
 9. Set the **J 38522-A** Variable Signal Generator Signal to 5 V, the Frequency to 60 Hz and the Duty Cycle to Normal, ignition ON.
 10. Verify the scan tool Fuel Composition Sensor parameter is at 60 Hz.
 - **If not 60 Hz**

Test or replace the K20 Engine Control Module.
 - **If 60 Hz**
 11. Test or replace the B198 Fuel Composition Sensor.

Component Testing

1. Test the fuel composition using the **J 44175-A** Fuel Composition Tester and the J 44175-A Instruction Manual. Record the frequency.
2. Compare the special tool test frequency and the scan tool Fuel Composition Sensor frequency parameter.
3. Verify the difference between the tool and the sensor is 12 Hz or less.
 - **If greater than 12 Hz**

Replace the B198 Fuel Composition Sensor.

- **If 12 Hz or less**
4. All OK.

Repair Instructions

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

- for B198 Fuel Composition Sensor replacement.
- **Fuel System Cleaning**
- **Control Module References** for K20 Engine Control Module replacement, programming and setup.

DTC P2544

Diagnostic Instructions

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

DTC Descriptors

DTC P2544

Transmission Torque Request Signal Message Counter Incorrect

Circuit/System Description

To improve shift feel, the transmission control module (TCM) is constantly sending the engine control module (ECM) serial data messages with information regarding it's request for modifying engine speed or torque. The serial data messages are sent through two circuits which are part of a communication network called the controller area network (CAN). The ECM sets DTC P2544 when it detects a discrepancy in the structure of the message causing the integrity of the message to be questioned.

Conditions for Running the DTC

- The engine run time is greater than 0.5 s.
- No other CAN errors are present.

Conditions for Setting the DTC

The ECM detects that the engine speed and torque modification messages from the TCM are either corrupted or intermittently missing for greater than 4 s.

Action Taken When the DTC Sets

- DTC P2544 is a Type B DTC.
- The TCM commands maximum line pressure during shifts, which results in harsh shifts.
- The TCM freezes adaptive functions.

Conditions for Clearing the DTC

DTC P2544 is a Type B DTC.

Diagnostic Aids

An intermittent fault in the CAN circuits will cause the ECM to set DTC P2544.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

NOTE:

- **DTC P2544 is an informational DTC.**
- **Diagnose all other engine control module DTCs prior to DTC P2544.**

1. Verify that no other DTCs are set except for DTC P2544.
 - **If any other DTCs are set**

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

- **If only DTC P2544 is set**
2. Replace the K71 Transmission Control Module.
 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 DTC sets**

Replace the K20 Engine Control Module.

- **If DTC does not set**

5. All OK.

Repair Instructions

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

Control Module References for ECM or control solenoid valve assembly replacement, programming and setup.

DTC P2548

Diagnostic Instructions

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

DTC Descriptor

DTC P2548

Vehicle Dynamics System Torque Request Signal Message Counter Incorrect

Circuit/System Description

The electronic brake control module and the engine control module simultaneously control the vehicle performance launch. During a performance launch the electronic brake control module sends a serial data message to the engine control module requesting torque reduction. If the engine control module receives corrupt data from the electronic brake control module, DTC P2548 will set in the engine control module. The engine control module then sends a serial data message to the electronic brake control module that torque reduction is not allowed.

Conditions for Running the DTC

- The ignition is ON.
- Ignition voltage is greater than 8 V.

Conditions for Setting the DTC

The engine control module detects a corrupted data message from the electronic brake control module.

Action Taken When the DTC Sets

-
- The ABS remains functional.
 - DTC P2548 is a Type B DTC.
 - The traction Off indicator turns ON.
 - The traction/stability control indicator turns ON.
 - The Service Stabilitrak message may be displayed on the driver information center.

Conditions for Clearing the DTC

DTC P2548 is a Type B DTC.

Diagnostic Aids

Inspect the serial data circuits and connections at the engine control module and the electronic brake control module. They should be free from sources of electromagnetic interference and the connections should be clean and tight.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Verify that no other DTCs are set except for DTC P2548.
 - **If any other DTCs are set**

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

- **If only DTC P2548 is set**

2. Replace the K17 Electronic Brake Control Module.
3. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.

- **If DTC sets**

Replace the K20 Engine Control Module.

- **If DTC does not set**

4. All OK.

Repair Instructions

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

Control Module References for Electronic Brake Control Module and Engine Control Module replacement, programming and setup

DTC P2615 OR P2616

Diagnostic Instructions

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

DTC Descriptors

DTC P2615

Camshaft Position Signal Output Circuit Low Voltage

DTC P2616

Camshaft Position Signal Output Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P2615	P2615	P2616	-

Circuit/System Description

The engine control module (ECM) has a dedicated camshaft position sensor signal circuit to the instrument cluster. This output signal is used for tachometer operation.

Conditions for Running the DTC

P2615

- Ignition ON.
- Engine not running.
- ECM camshaft position sensor signal circuit is commanded high.

P2616

- Ignition ON.
- Engine not running.
- ECM camshaft position sensor signal circuit is commanded low.

Conditions for Setting the DTC

P2618

The ECM detects a short to ground or an open in the dedicated camshaft position sensor signal circuit to the instrument cluster.

P2619

The ECM detects a short to voltage in the dedicated camshaft position sensor signal circuit to the instrument cluster.

Action Taken When the DTC Sets

DTCs P2615 and P2616 are Type C DTCs.

Conditions for Clearing the DTC

DTCs P2615 and P2616 are Type C DTCs.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Engine Running.
2. Verify the scan tool parameters listed below do not display Malfunction:
 - Camshaft Position Signal Output Circuit Low Voltage Test Status
 - Camshaft Position Signal Output Circuit Open Test Status
 - Camshaft Position Signal Output Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.
 - **If Malfunction is not displayed**
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.
 - **If the DTC does not set**
5. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the X1 harness connector at the P16 Instrument Cluster, engine

Running.

2. Test for 20-30 Hz DC between the signal circuit terminal 2 and ground.
 - **If not between 20-30 Hz DC**
 1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance.
 4. Test for less than 2 ohms in the signal circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms, replace the K20 Engine Control Module.
 - **If between 20-30 Hz DC**
3. Replace the P16 Instrument Cluster.

Repair Instructions

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

Control Module References for engine control module (ECM) or instrument cluster replacement, programming and setup

DTC P2635

Diagnostic Instructions

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

DTC Descriptor

DTC P2635

Fuel Pump Flow Performance

Circuit/System Description

The engine control module (ECM) supplies voltage to the fuel pump driver control module when the ECM detects that the ignition is on. The voltage from the ECM to the fuel pump driver control module remains active for 2 seconds, unless the engine is in crank or run. While this voltage is being received, the fuel pump driver control module closes the ground switch of the fuel pump. The fuel

pump driver control module maintains correct fuel pressure based on the information from the fuel pressure sensor and varying the PWM controlled current to the fuel pump.

Conditions for Running the DTC

- DTC P018B, P018C, P018D, P0231, P0232, P023F, P0641, P0606, P1255, P129E or P12A6 are not active.
- Fuel pump control is enabled and the fuel pump control state is normal.
- The ignition voltage is between 11-32 V.
- The engine has been running for more than 30 seconds.
- The engine fuel flow is not 0.
- Low fuel level warning not present.
- The DTC runs continuously when the conditions above are met.

Conditions for Setting the DTC

The fuel pump driver control module detects a difference of ± 60 kPa at 400 kPa request or ± 45 kPa at 300 kPa request between the desired fuel pressure and the actual fuel pressure for approximately 10 s.

Action Taken When the DTC Sets

DTC P2635 is a Type B DTC.

Conditions for Clearing the DTC

DTC P2635 is a Type B DTC.

Diagnostic Aids

Using the Failure Records data may help locate an intermittent condition. If you cannot duplicate the DTC, the information in the Failure Records can help determine how many miles since the DTC set. The Fail Counter and Pass Counter can help determine how many ignition cycles that the diagnostic test reported a pass and/or a fail.

On vehicles equipped with a high pressure mechanical pump on Direct Fuel Injection engines, the vehicle may continue to run even though the pump in the fuel tank is not operating.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

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 for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC P018B, P018C, P018D, P0231, P0232, P023F, P0641, P0606, P1255, P129E or P12A6 is not set.

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

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

- **If none of the DTCs are set**

3. Verify the scan tool Short Term Fuel Pump Trim and the Long Term Fuel Pump Trim when multiplied together are less than 1.5.

- **If greater than 1.5**

Refer to Circuit/System Testing.

- **If less than 1.5**

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.

4. Verify the scan tool Fuel Pressure Sensor and the Desired Fuel Pressure are within 45 kPa (6.5

psi) at 300 kPa (43.5 psi) request or 60 kPa (8.7 psi) at 400 kPa (58 psi) request of each other while operating the vehicle through varying loads.

- **If greater than 45 kPa (6.5 psi)/60 kPa (8.7 psi)**

Refer to Circuit/System Testing.

- **If less than 45 kPa (6.5 psi)/60 kPa (8.7 psi)**

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.

- **If the DTC does not set**

7. All OK.

Circuit/System Testing

NOTE: Do not replace the Fuel Pump Driver Control Module based on a history DTC P2635. DTC P2635 may be stored but that does not indicate a failure of the Fuel Pump Driver Control Module. Refer to Strategy Based Diagnosis for further history DTC diagnostics.

1. Verify the proper fuel system pressure. Refer to Fuel System Diagnosis .

- **If the fuel pressure is not normal**

Repair the fuel system as necessary.

- **If the fuel pressure is normal**

2. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Fuel Feed Pipe Replacement
- Fuel Injector Replacement
- Fuel Pump Replacement
- Fuel Tank Fuel Pump Module Replacement
- Perform the Fuel Pump Trim Reset procedure with a scan tool after the repair.

Repair Verification

NOTE: Perform the Fuel Pump Trim Reset procedure with a scan tool after the repair.

1. Install any components that have been removed or replaced during diagnosis.
2. Perform any adjustments, programming or setup procedures that are required when a component is removed or replaced.
3. Clear the DTCs with a scan tool.
4. Turn OFF the ignition for 60 s.
5. Operate the vehicle within the Conditions for Running the DTC.
6. Verify the scan tool Short Term Fuel Pump Trim and the Long Term Fuel Pump Trim when multiplied together are less than 1.5.

- **If greater than 1.5**

Refer to Circuit/System Testing.

- **If less than 1.5**

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. Verify the scan tool Fuel Pressure Sensor and the Desired Fuel Pressure are within 45 kPa (6.5 psi) at 300 kPa (43.5 psi) request or 60 kPa (8.7 psi) at 400 kPa (58 psi) request of each other while operating the vehicle through varying loads.

- **If greater than 45 kPa (6.5 psi)/60 kPa (8.7 psi)**

Refer to Circuit/System Testing.

- **If less than 45 kPa (6.5 psi)/60 kPa (8.7 psi)**

8. All OK.

DTC P2636

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.

DTC Descriptor

DTC P2636

Fuel Pump 2 Flow Insufficient

Circuit/System Description

The primary fuel level sender and the secondary fuel level sender changes resistance based on fuel level. The engine control module (ECM) monitors the signal circuits of the primary fuel level sender and the secondary fuel level sender in order to determine the fuel level. When the fuel tank is full, the resistances of both fuel level senders are low and the ECM senses a low signal voltage on both the signal circuits of the primary fuel level sender and the secondary fuel level sender. When the fuel tanks are empty, the resistances of the fuel level senders are high and the ECM senses a high signal voltage. The ECM uses the signal circuits of the primary fuel level sender and the secondary fuel level sender in order to calculate the percentage of remaining fuel in the tank. The ECM sends the fuel level percentage via serial data circuit to the instrument cluster in order to control the fuel gauge. The ECM also monitors the fuel level signals to verify the operation of the fuel tank fuel pump module jet pump.

Conditions for Running the DTC

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

Conditions for Setting the DTC

The ECM detects that the primary fuel tank is less than 27.8 L (7.3 gal) and the secondary fuel tank is more than 3 L (.79 gal) and the condition is present for 30.5 minutes.

Action Taken When the DTC Sets

- DTC P2636 is a Type C DTC.
- The fuel gauge defaults to empty

Conditions for Clearing the MIL/DTC

DTC P2636 is a Type C DTC.

Diagnostic Aids

- A sticking, binding or obstructed fuel level sensor may cause this DTC to set.
- A fuel level sensor that does not read 100 % full may cause this DTC to set.
- Fuel tank module jet transfer pump is faulty.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

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 for scan tool information

Circuit/System Verification

1. Verify that DTC P0461, P0462, P0464, P2067 or P2068 is not set.
 - **If DTC P0461, P0462, P0464, P2067 or P2068 is set**

Refer to **DTC P0461-P0464, P2066, P2067 or P2068**

- **If DTC P0461, P0462, P0464, P2067 or P2068 is not set**
2. 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.
 3. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**
4. All OK.

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. Verify the scan tool Fuel Level Sensor Right Tank and Fuel Level Sensor Left Tank voltage parameters increase with vehicle operation.

- **If the Fuel Level Sensor Left Tank parameter does not increase**

Test or replace the B46 Fuel Level Sensor.

- **If the Fuel Level Sensor Right Tank parameter does not increase**

1. Verify the fuel tank crossover tube is not pinched, binding or improperly routed.
 - If a condition is present, repair as necessary.
 - If a condition is not present
2. Test the B46B Fuel Level Sensor - Secondary, refer to Component Testing.
 - If the test failed, replace the B46B Fuel Level Sensor - Secondary.
 - If the test passed, test or replace the A7 Fuel Pump and Level Sensor Assembly.

Component Testing

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

Replace the appropriate fuel level sensor.

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

Repair Instructions

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

- **Fuel Tank Fuel Pump Module Replacement** for A7 Fuel Pump and Level Sensor Assembly replacement.
- **Fuel Level Sensor Replacement (Fuel Sender)** , **Fuel Level Sensor Replacement (Fuel Tank Fuel Pump Module)**

DTC P26C8

Diagnostic Instructions

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

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

DTC Descriptor

DTC P26C8

Chassis Control Module Requested MIL Illumination

Circuit/System Description

The chassis control module constantly monitors the chassis control system for any condition which may adversely affect vehicle emissions. If a condition is detected, the chassis control module sets a DTC and sends a serial data message to the engine control module (ECM). The ECM sets DTC P26C8 to inform the technician that the chassis control module has set the emission related DTC. The serial data message sent by the chassis control module also contains a request for the ECM to illuminate the malfunction indicator lamp (MIL).

The technician can observe the DTC that was set by the chassis control module by reviewing the ECM Freeze Frame records on the scan tool. The ECM Freeze Frame records also contain the engine operating conditions present when the chassis control module DTC set.

Conditions for Running the DTC

The ignition is ON or the engine is running for greater than 3 s.

Conditions for Setting the DTC

The ECM receives a serial data message from the chassis control module indicating that an emission related DTC has set in the chassis control module.

Action Taken When the DTC Sets

- DTC P26C8 is a Type A DTC.
- DTC P26C8 will continue to be current or active as long as the chassis control module is requesting MIL illumination.

Conditions for Clearing the DTC

DTC P26C8 is a Type A DTC.

Diagnostic Aids

Communication codes, U-codes, as well as powertrain codes, P-codes, set in the chassis control module will cause the chassis control module to request DTC P26C8 to be set in the ECM.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- Do not replace the engine control module for this DTC. DTC P26C8 is an informational DTC.
- Correct any engine control and communication DTCs before diagnosing chassis control module DTCs.

1. Verify there are no engine control or communication DTCs set.

- If a DTC is set

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

- If a DTC is not set

2. Verify there are no chassis control module DTCs set.

- If a DTC is set

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

- If a 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.

4. Verify the DTC does not set.

- If the DTC sets

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

- If the DTC does not set

5. All OK.

Repair Instructions

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

DTC P3400

Diagnostic Instructions

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

DTC Descriptor

DTC P3400

Cylinder Deactivation System

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition 1 Voltage	P3400, P3403, P3427, P3443, P3451	P3400, P3401, P3425, P3441, P3449	-	P3400
Cylinder 1 Deactivation Solenoid Valve Control Circuit 1	P3403	P3401	P3404	P3400
Cylinder 4 Deactivation Solenoid Valve Control Circuit 2	P3427	P3425	P3428	P3400
Cylinder 6 Deactivation Solenoid Valve Control Circuit 2	P3443	P3441	P3444	P3400
Cylinder 7 Deactivation Solenoid Valve Control Circuit 2	P3451	P3449	P3452	P3400

Typical Scan Tool Data

Cylinder 1, 4, 6 or 7 Deactivation Solenoid Valve Control Circuit Test Status - Component Commanded OFF

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Component Commanded OFF Parameter Normal Range: The following illustrates the normal parameter state with no circuit conditions:			
• Component OFF - OK for Open/Short to Gnd Test and Not Run for Short to Volts Test • Component ON - Not Run for Open/Short to Gnd Test and OK for Short to Volts Test			
Ignition Voltage	Malfunction	Malfunction	-

Solenoid Control	Malfunction	Malfunction	Not Run
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Cylinder 1, 4, 6 or 7 Deactivation Solenoid Valve Control Circuit Test Status - Component Commanded ON

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Component Commanded ON Parameter Normal Range: The following illustrates the normal parameter state with no circuit conditions: • Component OFF - OK for Open/Short to Gnd Test and Not Run for Short to Volts Test • Component ON - Not Run for Open/Short to Gnd Test and OK for Short to Volts Test			
Ignition Voltage	Not Run	Not Run	-
Cylinder 1, 4, 6 or 7 Deactivation Solenoid Control	Not Run	Not Run	Malfunction

Circuit/System Description

The cylinder deactivation system is used to deactivate 4 cylinders of the engine under light load driving conditions. The engine control module (ECM) commands the cylinder deactivation solenoid valves ON to deactivate engine cylinders 1, 7, 6 and 4, switching to 4 cylinders or V4 mode. The cylinder deactivation solenoid valves control the oil flow to the appropriate valve lifters. The engine operates on 8 cylinders or V8 mode, during engine starting, engine idling and medium to heavy throttle conditions.

Ignition voltage is supplied directly to the cylinder deactivation solenoid valves. The ECM controls the cylinder deactivation solenoid valves by grounding the control circuit with a solid state device called a driver.

The Cylinder Deactivation System Performance diagnostic is a test of the internal mechanical condition of the engine, during operation in V4 mode. The ECM determines the internal mechanical condition of the engine through the actual measured values of the mass airflow (MAF) sensor, the intake manifold absolute pressure (MAP) sensor and the throttle position sensor. The actual measured values of the 3 sensors are then compared to the calculated values for V4 mode, stored in the ECM. If the measured values are incorrect for V4 mode, the ECM may set DTC P3400 and return to V8 mode operation.

Conditions for Running the DTC

- DTCs P0102, P0103, P0107, P0108, P0112, P0113, P0117, P0119, P0335 and P0336 are not set.
- The engine speed is between 450-5, 400 RPM.
- The IAT Sensor is between -7 to +129°C (19-264°F).
- The ECT Sensor parameter is between 70-129°C (158-264°F).
- Time in V8 mode is more than 2 s.
- Time in V4 mode is more than 2 s.

-
- This DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

The engine control module detects that the actual measured values from the MAF sensor, MAP sensor and throttle position sensor, are not within the range of the calculated values for V4 mode.

Action Taken When the DTC Sets

- DTC P3400 is a Type B DTC.
- The engine will return to V8 mode.

Conditions for Clearing the DTC

DTC P3400 is a Type B DTC.

Diagnostic Aids

- This DTC will not set during engine idling conditions. The vehicle will need to be driven for the DTC to set.
- A restricted valve lifter oil filter may cause DTC P3400 to set. Inspect the valve lifter oil filter for a restriction or blockage. Refer to **Valve Lifter Oil Filter Replacement** .
- The valve lifter oil manifold solenoid valves are assigned to the following engine cylinders:
 - Cylinder Deactivation Solenoid Valve #1 = Cylinder #1
 - Cylinder Deactivation Solenoid Valve #2 = Cylinder #4
 - Cylinder Deactivation Solenoid Valve #3 = Cylinder #6
 - Cylinder Deactivation Solenoid Valve #4 = Cylinder #7

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

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**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EN-46999 Displacement On Demand Tester

For equivalent regional tools, refer to **Special Tools (Diagnostic Tools)** .

Circuit/System Verification

1. Verify the engine oil level is within the specified level.

- **If not within the specified level**

Repair as necessary.

- **If within the specified level**

2. Verify the engine oil pressure is within the specified range, refer to **Oil Pressure Diagnosis and Testing** .

- **If not within the specified range**

Repair as necessary.

- **If within the specified range**

3. Ignition ON, observe the scan tool DTC information.

4. Verify with a scan tool that DTC P0201-P0208, P0351-P0358, P3401, P3403, P3404, P3425, P3427, P3428, P3441, P3443, P3444, P3449, P3451 or P3452 is not set.

- **If a DTC is set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for further diagnosis.

- **If a DTC is not set**

5. Engine idling at the normal operating temperature.

6. Verify there is no abnormal engine noise.

- **If there is an abnormal engine noise**

Refer to **Symptoms - Engine Mechanical** for further diagnosis.

- **If no abnormal engine noise**

7. Verify the **Cylinder Deactivation (Active Fuel Management) System Compression Test** passes the compression test.

- **If compression test failed**

Test the Q43 Valve Lifter Oil Manifold Assembly, refer to **Cylinder Deactivation (Active Fuel Management) Valve Lifter Oil Manifold Diagnosis and Testing** .

- **If compression test passes**

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 is not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC is not set**

10. All OK.

Circuit/System Testing

1. Ignition OFF, all vehicle systems OFF, remove the Q43 Valve Lifter Oil Manifold Assembly ignition fuse from the underhood fuse block. It may take up to 2 min for all vehicle systems to power down.

NOTE: **Probe each terminal at the underhood fuse block with a test lamp connected to ground to determine what terminal to connect the DMM. The test lamp should not illuminate on the circuit that needs to be tested.**

2. Connect a DMM between the ignition circuit fuse terminal going to the Q43 Valve Lifter Oil Manifold Assembly and the K20 Engine Control Module housing.

3. Ignition ON, command the Cylinder Deactivation System ON and OFF with the scan tool.

4. Verify the resistance of each cylinder deactivation solenoid valve is between 11-18 ohms with the solenoid valves commanded ON.

- **If greater than 18 ohms for all cylinder deactivation solenoid valves** , test the ignition circuit for an open/high resistance.

1. Ignition OFF.

2. Test for less than 2 ohms on the ignition circuit end to end.

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

- If less than 2 ohms, refer to **Cylinder Deactivation (Active Fuel Management) Valve Lifter Oil Manifold Diagnosis and Testing** .

- **If greater than 18 ohms for one or more but not all cylinder deactivation solenoid valves**
- 1. Ignition OFF.
- 2. Test for less than 2 ohms on the appropriate control circuit end to end.
 - If 2 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 2 ohms
- 3. Test for 11-18 ohms between the ignition circuit and the appropriate control circuit at the Q43 Valve Lifter Oil Manifold Assembly.
 - If not within the specified value, test or replace the Q43 Valve Lifter Oil Manifold Assembly.
 - If within the specified value, test or replace the K20 Engine Control Module.
- **If between 11-18 ohms**
- 5. Refer to **Cylinder Deactivation (Active Fuel Management) Valve Lifter Oil Manifold Diagnosis and Testing** for further mechanical diagnosis of Q43 Valve Lifter Oil Manifold Assembly.

Component Testing

Static Test

1. Ignition OFF, disconnect the harness connector at the Q43 Valve Lifter Oil Manifold Assembly.
2. Connect the harness that is labeled resistance from the Displacement On Demand (DOD) Tester to the Q43 Valve Lifter Oil Manifold Assembly connector.
3. Connect the power leads from the DOD tester to B+ and ground.
4. Test for 11-18 ohms on each valve lifter oil manifold solenoid.
 - **If not between 11-18 ohms**

Replace the Q43 Valve Lifter Oil Manifold Assembly.
 - **If between 11-18 ohms**
5. Test for infinite resistance between each valve lifter oil manifold circuit terminal and the valve lifter oil manifold housing.
 - **If less than infinite resistance**

Replace the Q43 Valve Lifter Oil Manifold Assembly.
 - **If infinite resistance**
6. All OK.

Dynamic Test

1. Ignition OFF, disconnect the harness connector at the Q43 Valve Lifter Oil Manifold Assembly.

connector.

3. Connect the power leads from the DOD tester to B+ and ground.
4. Command each valve lifter oil manifold solenoid ON and OFF using the DOD tester.
5. Verify and audible click is heard for each solenoid turn when commanded ON and OFF.

- **If no audible click is heard**

Replace the Q43 Valve Lifter Oil Manifold Assembly.

- **If audible click is heard**

6. All OK.

Repair Instructions

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

- **Valve Lifter Oil Manifold Replacement**
- **Control Module References** for K20 Engine Control Module replacement, programming and setup.

DTC P3401, P3403, P3404, P3425, P3427, P3428, P3441, P3443, P3444, P3449, P3451 OR P3452

Diagnostic Instructions

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

DTC Descriptors

DTC P3401

Cylinder 1 Deactivation Solenoid Valve Control Circuit Open

DTC P3403

Cylinder 1 Deactivation Solenoid Valve Control Circuit Low Voltage

DTC P3404

Cylinder 1 Deactivation Solenoid Valve Control Circuit High Voltage

DTC P3425

Cylinder 4 Deactivation Solenoid Valve Control Circuit Open

DTC P3427

Cylinder 4 Deactivation Solenoid Valve Control Circuit Low Voltage

DTC P3428

Cylinder 4 Deactivation Solenoid Valve Control Circuit High Voltage

DTC P3441

Cylinder 6 Deactivation Solenoid Valve Control Circuit Open

DTC P3443

Cylinder 6 Deactivation Solenoid Valve Control Circuit Low Voltage

DTC P3444

Cylinder 6 Deactivation Solenoid Valve Control Circuit High Voltage

DTC P3449

Cylinder 7 Deactivation Solenoid Valve Control Circuit Open

DTC P3451

Cylinder 7 Deactivation Solenoid Valve Control Circuit Low Voltage

DTC P3452

Cylinder 7 Deactivation Solenoid Valve Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition 1 Voltage	P3400, P3403, P3427, P3443, P3451	P3400, P3401, P3425, P3441, P3449	-	P3400
Cylinder 1 Deactivation Solenoid Valve Control Circuit 1	P3403	P3401	P3404	P3400
Cylinder 4 Deactivation	P3427	P3425	P3428	P3400

Circuit 2				
Cylinder 6 Deactivation Solenoid Valve Control Circuit 2	P3443	P3441	P3444	P3400
Cylinder 7 Deactivation Solenoid Valve Control Circuit 2	P3451	P3449	P3452	P3400

Typical Scan Tool Data

Typical Scan Tool Data

Circuit	Short to Ground	Open	Short to Voltage
Ignition Voltage	OK/Not Run	Malfunction	-
Cylinder 1, 4, 6 or 7 Deactivation Solenoid Valve Control Circuit Open Test Status	OK/Not Run	Malfunction	OK/Not Run
Cylinder 1, 4, 6 or 7 Deactivation Solenoid Valve Control Circuit Low Voltage Test Status	Malfunction	OK/Not Run	OK/Not Run
Cylinder 1, 4, 6 or 7 Deactivation Solenoid Valve Control Circuit High Voltage Test Status	OK/Not Run	OK/Not Run	Malfunction

Circuit/System Description

The cylinder deactivation system is used to deactivate 4 cylinders of the engine under light load driving conditions. The engine control module (ECM) commands the cylinder deactivation solenoid valves ON to deactivate engine cylinders 1, 4, 6 and 7, switching to 4 cylinders or V4 mode. The cylinder deactivation solenoid valves control the oil flow to the appropriate valve lifters. The engine operates on 8 cylinders or V8 mode, during engine starting, engine idling in gear and medium to heavy throttle conditions.

Ignition voltage is supplied directly to the cylinder deactivation solenoid valves. The ECM controls the cylinder deactivation solenoid valves by grounding the control circuit with a solid state device called a driver.

Conditions for Running the DTC

- Engine speed is greater than 400 RPM.
- Ignition voltage is greater than 11 V.
- DTC P3401, P3403, P3404, P3425, P3427, P3428, P3441, P3443, P3444, P3449, P3451 and P3452 run continuously when the above conditions are met.

DTC P3401, P3425, P3441 and P3449

The engine control module detects an open in the appropriate cylinder deactivation solenoid valve control circuit for greater than 5 s..

DTC P3403, P3427, P3443 and P3451

The engine control module detects an short to ground in the appropriate cylinder deactivation solenoid valve control circuit for greater than 5 s..

DTC P3404, P3428, P3444 and P3452

The engine control module detects an short to voltage in the appropriate cylinder deactivation solenoid valve control circuit for greater than 5 s..

Action Taken When the DTC Sets

- DTCs P3401, P3403, P3404, P3425, P3427, P3428, P3441, P3443, P3444, P3449, P3451 and P3452 are Type B DTCs.
- The engine will return to V8 mode.

Conditions for Clearing the DTC

DTCs P3401, P3403, P3404, P3425, P3427, P3428, P3441, P3443, P3444, P3449, P3451 and P3452 are Type B DTCs.

Diagnostic Aids

The valve lifter oil manifold solenoid valves are assigned to the following engine cylinders:

- Cylinder Deactivation Solenoid Valve #1 = Cylinder #1
- Cylinder Deactivation Solenoid Valve #2 = Cylinder #4
- Cylinder Deactivation Solenoid Valve #3 = Cylinder #6
- Cylinder Deactivation Solenoid Valve #4 = Cylinder #7

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

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**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EN-46999 Displacement On Demand Tester

For equivalent regional tools, refer to **Special Tools (Diagnostic Tools)** .

Circuit/System Verification

NOTE: DTC P3401, P3425, P3441 and P3449 set with an open ignition circuit fuse.

1. Engine idling.
2. Verify the follow parameters display OK or Not Run.
 - Cylinder 1, 4, 6 or 7 Deactivation Solenoid Valve Control Circuit High Voltage Test Status
 - Cylinder 1, 4, 6 or 7 Deactivation Solenoid Valve Control Circuit Open Test Status
 - Cylinder 1, 4, 6 or 7 Deactivation Solenoid Valve Control Circuit Low Voltage Test Status
 - **If any parameter displays Malfunction**

Refer to Circuit/System Testing.

- **If each parameter displays OK or Not Run**
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 P3401, P3403, P3404, P3425, P3427, P3428, P3441, P3443, P3444, P3449, P3451 or P3452 does not set.
 - **If a DTC set**

Refer to Circuit/System Testing

- If a DTC does not set
5. All OK.

Circuit/System Testing

NOTE: If any of the scan tool circuit status parameters displayed "Malfunction" during the Circuit/System Verification, inspect the wiring harness for signs of binding, chaffing or pinching before intake manifold removal.

1. Ignition OFF, disconnect the harness connector at the Q43 Valve Lifter Oil Manifold Assembly, ignition ON.
2. Verify that a test lamp illuminates between the ignition circuit terminal 4 and ground.
 - If the test lamp does not illuminate and the fuse is good.
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 5 ohms between the ignition circuit terminal 4 and the fuse.
 - If 5 ohms or greater, repair the open/high resistance in the circuit.
 - If less than 5 ohms, verify there is voltage at the fuse and the fuse is good.
 - If the test lamp does not illuminate and the fuse is open
 1. Ignition OFF, remove the test lamp.
 2. Test for infinite resistance between the ignition circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test all the components connected to the ignition circuit and repair or replace as necessary.
 - If the test lamp illuminates
3. Verify that a test lamp does not illuminate between the ignition circuit terminal 4 and the appropriate cylinder deactivation solenoid valve control circuit terminal listed below.
 - Cylinder 1 Deactivation Solenoid Valve 1 terminal 3
 - Cylinder 4 Deactivation Solenoid Valve 2 terminal 1
 - Cylinder 6 Deactivation Solenoid Valve 3 terminal 2
 - Cylinder 7 Deactivation Solenoid Valve 4 terminal 5
 - If the test lamp illuminates
 1. Ignition OFF, remove the test lamp, disconnect the harness connector X3 at the K20 Engine Control Module.
 2. Test for infinite resistance between the appropriate cylinder deactivation solenoid valve control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - If the test lamp does not illuminate
4. Verify that a test lamp does not illuminate between ground and the appropriate cylinder deactivation solenoid valve control circuit terminal listed below.

- Cylinder 1 Deactivation Solenoid Valve 1 terminal 3
- Cylinder 4 Deactivation Solenoid Valve 2 terminal 1
- Cylinder 6 Deactivation Solenoid Valve 3 terminal 2
- Cylinder 7 Deactivation Solenoid Valve 4 terminal 5

- **If the test lamp illuminates**

1. Ignition OFF, remove the test lamp, disconnect the harness connector X3 at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the appropriate cylinder deactivation solenoid valve control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.

- **If the test lamp does not illuminate**

5. Ignition OFF, remove the test lamp, disconnect the harness connector X3 at the K20 Engine Control Module.
6. Test the appropriate cylinder deactivation solenoid valve control circuit for less than 5 ohms end to end.
 - **If 5 ohms or greater**

Repair the open/high resistance in the circuit.

- **If less than 5 ohms**

7. Test the Q43 Valve Lifter Oil Manifold test using the **EN-46999** Displacement On Demand Tester, refer to Component Testing.

- **If the test failed**

Replace the Q43 Valve Lifter Oil Manifold Assembly.

- **If the test passed**

8. Test or replace the K20 Engine Control Module.

Component Testing

Static Test

1. Ignition OFF, disconnect the harness connector at the Q43 Valve Lifter Oil Manifold Assembly.
2. Connect the harness that is labeled resistance from the Displacement On Demand (DOD) Tester to the Q43 Valve Lifter Oil Manifold Assembly connector.
3. Connect the power leads from the DOD tester to B+ and ground. Test for 11-18 ohms on each cylinder deactivation solenoid valve.
 - **If not between 11-18 ohms for each solenoid valve**

Replace the Q43 Valve Lifter Oil Manifold Assembly.

- **If between 11-18 ohms for each solenoid valve**
- 4. Test for infinite resistance between each valve lifter oil manifold circuit terminal and the valve lifter oil manifold housing.
 - **If less than infinite resistance**

Replace the Q43 Valve Lifter Oil Manifold Assembly.

- **If infinite resistance**
- 5. Perform the Dynamic Test.

Dynamic Test

1. Ignition OFF, disconnect the harness connector at the Q43 Valve Lifter Oil Manifold Assembly.
2. Connect the cable that is labeled power from the Displacement On Demand (DOD) Tester to the connector.
3. Connect the power leads from the DOD tester to B+ and ground.
4. Command each valve lifter oil manifold solenoid ON and OFF using the DOD tester.
5. Verify and audible click is heard for each solenoid when commanded ON and OFF.
 - **If no audible click is heard**

Replace the Q43 Valve Lifter Oil Manifold Assembly.

- **If audible click is heard**
- 6. All OK.

Repair Instructions

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

- **Valve Lifter Oil Manifold Replacement**
- **Control Module References** for K20 Engine Control Module replacement, programming and setup.

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 cover conditions that are not covered DTCs. Certain conditions can cause multiple

symptoms. These conditions are listed together under Symptoms Testing. Conditions that may only cause certain symptoms are listed separately under Additional Symptoms Test. Perform the Symptoms Testing before using the Additional Symptoms Tests. Poor Fuel Fill Quality test may be performed separately from the Symptoms Testing and Additional Symptoms Tests procedures.

Symptoms Definition

Backfire

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 1500 RPM or 48 km/h (30 mph). The exhaust has a steady spitting sound at idle or at low speed.

Engine Control Module (ECM) 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.

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.

Hard Start

Engine cranks OK, but does not start for a long time. The vehicle does eventually run or may start but immediately stalls.

Hesitation, Sag, Stumble

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 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 may vary in speed. Either condition may be severe enough to stall the engine.

Surges/Chuggles

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 engine control module (ECM) and malfunction indicator lamp (MIL) are operating correctly.
- Verify there are no DTCs that are stored.
- Verify the scan tool data is within a normal operating range.
- 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

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- 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, as shown on the Vehicle Emission Control Information label.
- 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 following conditions:
 - Collapsed
 - Damaged areas
 - Looseness
 - Incorrect installation
 - Leaking
- 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, Fuel Odor, 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:
 - Correct fuel system operation and pressure-Refer to **Fuel System Diagnosis**

- Fuel injectors incorrectly connected. Verify each injector is connected to the correct fuel injector harness connector.
- Improperly operating or leaking fuel injectors-Refer to **Fuel Injector Diagnosis** .
- Poor fuel quality condition-Refer to **Alcohol/Contaminants-in-Fuel Diagnosis** .
- Test the ignition system for the following conditions:
 - Spark plugs with incorrect heat range or an abnormal condition-Refer to **Spark Plug Inspection** and **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 water. 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:
 - Improperly operating transmission torque converter clutch (TCC)-The scan tool should indicate an engine speed drop when the TCC is commanded ON.
 - Improperly operating A/C compressor
 - Items that can cause an engine to run rich or lean-Refer to **DTC P0171, P0172, P0174 or P0175** for more information.
 - Slow responding heated oxygen sensors (HO2S). The HO2S should respond quickly to different throttle positions-Refer to **DTC P0133, P013A-P013F, P014A, P014B, P0153, P015A-P015D or P2270-P2273** for more information.

CAUTION: Refer to Heated Oxygen and Oxygen Sensor Caution .

- Water intrusion in the HO2S connector
- Improperly operating cylinder deactivation system, if equipped. Refer to **Cylinder Deactivation (Active Fuel Management) System Diagnosis** .

NOTE: **The embossed arrows on the mass airflow (MAF) sensor indicate the direction of the intake air flow. The arrows must point toward the engine.**

- Improper MAF sensor installation. A MAF sensor that is incorrectly installed may cause a hard start. Install the MAF in the proper direction. Refer to **Mass Airflow Sensor with Intake Air Temperature Sensor Replacement** .
- Improper MAF sensor connections.
- Engine oil contaminated by fuel
- Split or kinked vacuum hoses-Verify that the routing and connections are as shown on the

- Excessive knock sensor system spark retard activity-Observe the Knock Retard parameter on the scan tool for activity more than 0°. Refer to **DTC P0324, P0326, P0331, P06B6 or P06B7** and **DTC P0325, P0327, P0328, P0330, P0332 or P0333** for additional information.
- Electromagnetic interference (EMI) on the reference circuit, which can cause a misfire condition. You can usually detect EMI 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 EMI 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 remain at 0 counts during all operating conditions and when moving the related harnesses and connectors between the crankshaft position sensor and the ECM.
- Improperly operating crankcase ventilation valve-Refer to **Crankcase Ventilation System Inspection/Diagnosis** .
- A stuck open evaporative emission (EVAP) canister purge solenoid-Refer to **Evaporative Emission Control System Description** and **Evaporative Emission System Diagnosis** .
- 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 cooling system for the following conditions:
 - A thermostat with incorrect heat range. Refer to **Thermostat Diagnosis** .
 - Improper engine coolant level-Refer to **Cooling System Draining and Filling (Static Fill)** , **Cooling System Draining and Filling (GE 47716)** .
- Inspect the engine for the following mechanical conditions:
 - Excessive oil in the combustion chamber or leaking valve seals
 - 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

For more information, refer to **Symptoms - Engine Mechanical** .

- If the above conditions do not address the symptom, refer to the additional symptoms tests.

Additional Symptoms Tests

Detonation/Spark Knock

- Test the engine for an overheating condition. Refer to **Symptoms - Engine Cooling** .
- 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.

Engine Control Module (ECM) Commanded Reduced Engine Power

Under certain conditions the ECM 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 ECM will illuminate the reduced engine power lamp on the instrument panel cluster, however a DTC may not be set. Observe the scan tool Reduced Engine Power History parameter or refer to **K20 Engine Control Module: Scan Tool Information** to determine the reason for the reduced engine power event.

Verify or inspect for the following:

- Vehicle being driven inappropriately. Towing heavy loads up an incline for an extended period of time or operating the vehicle at sustained, excessively high engine speeds may cause the engine oil or coolant to overheat. A repair may not be necessary. 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 or conditions 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.
- Reduced engine power due to OnStar® remote command. A repair may not be necessary. Verify the vehicle is not in the OnStar® initiated Stolen Vehicle Slowdown mode. Refer to **Remote Vehicle Speed Limiting Description and Operation** and **OnStar Stolen Vehicle Slowdown Active** .
- Fuel temperature out of range too high.
- High pressure fuel system malfunction. Refer to **Fuel System Diagnosis** and **Fuel System Description** to verify high pressure fuel system operation.
- Maximum recommended engine oil life exceeded. Refer to the Owners manual for scheduled maintenance recommendations.
- Intake air temperature out of range too high. Engine running, observe the scan tool IAT sensor parameter. The readings should be between -40° C and +149° C (-40° F and +300° F. Refer to for additional information.
- If equipped with manual transmission, excessively hot manual transmission fluid. Under severe operating conditions the fluid may become overheated, which may result in ECM commanded reduced engine power. Allow the transmission and fluid to cool down. Review the maintenance recommendation in the owners manual to determine if the transmission fluid is due to be serviced.

Fuel Odor

- Inspect for a saturated EVAP canister-Refer to **Evaporative Emission Control System Description** and **Evaporative Emission System Diagnosis** .
- Inspect for damaged, deteriorated or leaking fuel lines and components.
- 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 bore and clean, if necessary. Refer to **Throttle Body Cleaning** .
- 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 $\pm 3^{\circ}\text{C}$ (5°F). If the ECT sensor is out of range with the IAT sensor, test the resistance of the ECT sensor. Refer to **Temperature Versus Resistance** , 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 circuits for a high resistance.
- Verify that the fuel pump operates and provides adequate pressure for engine startup. The fuel pump should turn ON for 2 s when the ignition is turned to ON. Refer to **Fuel System Diagnosis** for fuel pressure specifications and testing procedures.

Hesitation, Sag, Stumble

- Test the fuel pressure. Refer to **Fuel System Diagnosis** for fuel pressure specifications and testing procedures..
- Test the generator. Refer to **Symptoms - Engine Electrical** . Repair the charging system if the generator output voltage is less than 9 volts or more than 16 volts.
- 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 manifold absolute pressure (MAP) sensor. Refer to **DTC P0106** .
- 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** .

Poor Fuel Economy

- Inspect for heavy loads being carried or towed.
- Inspect for acceleration rate too much or too often.
- Inspect for incorrect operation of the speedometer.
- Inspect the mass air flow (MAF) sensor for obstruction, contamination and damage. Refer to **Mass Airflow Sensor with Intake Air Temperature Sensor Replacement** .

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- 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 bore and clean, if necessary. Refer to **Throttle Body Cleaning** .
 - Inspect the brake system for brake drag.

Rough, Unstable or Incorrect Idle and Stalling

- 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 bore and clean, if necessary. Refer to **Throttle Body Cleaning** .
- 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** .
- 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.
- 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 **DTC P0101** .
- 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 ECM reduces the amount of fuel delivered to the engine, causing a driveability condition-Refer to **DTC P0133, P013A-P013F, P014A, P014B, P0153, P015A-P015D or P2270-P2273** for more information.