

2010 ENGINE PERFORMANCE

Engine Controls and Fuel - 2.8L, 3.0L, 3.2L, or 3.6L - Equinox & Terrain

DTC P069E

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 P069E

Fuel Pump Control Module Requested MIL Illumination

CIRCUIT/SYSTEM DESCRIPTION

The fuel pump control module uses the serial data network to signal the engine control module (ECM) that the fuel pump control module is requesting malfunction indicator lamp (MIL) illumination. A DTC is set in the fuel pump control module, and the request for MIL illumination is sent when the fuel pump control module determines that a failure that affects emissions has occurred in the fuel pump control system. When the ECM receives the message from the fuel pump control module, DTC P069E will set in the ECM.

CONDITIONS FOR RUNNING THE DTC

The ignition is ON, or the engine is running.

CONDITIONS FOR SETTING THE DTC

The fuel pump control module requests the ECM to illuminate the MIL.

ACTION TAKEN WHEN THE DTC SETS

- DTC P069E is a Type A DTC.
- DTC P069E will continue to be current or active as long as the fuel pump control module is requesting MIL illumination.

CONDITIONS FOR CLEARING THE DTC

DTC P069E is a Type A DTC.

DIAGNOSTIC AIDS

Communication codes, U-codes, as well as powertrain codes, P-codes, set in the fuel pump control module will cause the fuel pump control module to request DTC P069E to be set in the ECM.

REFERENCE INFORMATION

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

CIRCUIT/SYSTEM VERIFICATION

NOTE: Correct any engine controls and communication DTCs before diagnosing fuel pump control module DTCs.

1. DTC P069E is an informational DTC. If there are no engine controls or communication DTCs, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for diagnosis of fuel pump control module DTCs.
2. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

REPAIR PROCEDURES

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

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 (TCM) Requested MIL Illumination

CIRCUIT/SYSTEM DESCRIPTION

The diagnostic trouble code (DTC) indicates that an emission related transmission DTC set in the transmission control module (TCM). The engine control module (ECM) receives the TCM information over the serial data

circuit. The ECM turns ON the malfunction indicator lamp (MIL) when the TCM sends a message over the serial data circuit requesting MIL illumination. The DTC information for the ECM will only display DTC P0700, but the Freeze Frame/Failure Records data will display the transmission DTC that 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 requesting the ECM to turn ON the MIL lamp.

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

CIRCUIT/SYSTEM VERIFICATION

NOTE: **Correct any engine controls and communication DTCs before diagnosing TCM DTCs.**

1. DTC P0700 is an informational DTC. If there are no engine controls or communication DTCs, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for diagnosis of TCM DTCs.
2. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

DTC P0856

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 P0856

Traction Control Torque Request Circuit

CIRCUIT/SYSTEM DESCRIPTION

The electronic brake control module (EBCM) and the engine control module (ECM) simultaneously control the traction control. The ECM reduces the amount of torque supplied to the drive wheels and the EBCM actively applies the brakes to the front wheels in order to reduce torque. The EBCM sends a GMLAN serial data message to the engine control module (ECM) indicating the function that has been requested.

CONDITIONS FOR RUNNING THE DTC

- The ignition is ON.
- The DTCs run continuously once the above condition is met.

CONDITIONS FOR SETTING THE DTC

The ECM detects an invalid signal from the EBCM.

ACTION TAKEN WHEN THE DTC SETS

DTC P0856 is a Type C DTC.

CONDITIONS FOR CLEARING THE DTC

DTC P0856 is a Type C DTC.

REFERENCE INFORMATION

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

CIRCUIT/SYSTEM VERIFICATION

1. Observe the Freeze Frame/Failure Records with a scan tool.
2. Clear the DTCs with a scan tool.
3. Ignition OFF for 30 seconds.
4. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 - If DTC P0856 failed this ignition, replace the EBCM.

REPAIR PROCEDURES

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

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

DTC P1248, P1249, P124A, P124B, P124C, OR P124D

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

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 Supply Cylinder 1	P2147	P0201	P2148	P1248
Direct Fuel Injector High Voltage Control Cylinder 1	P0261	P0201	P0262	P1248
Direct Fuel Injector High Voltage Supply Cylinder 2	P2150	P0202	P2151	P1249
Direct Fuel Injector High Voltage Control Cylinder 2	P0264	P0202	P0265	P1249
Direct Fuel Injector High Voltage Supply Cylinder 3	P2153	P0203	P2154	P124A
Direct Fuel Injector High Voltage Control Cylinder 3	P0267	P0203	P0268	P124A
Direct Fuel Injector High Voltage Supply Cylinder 4	P2156	P0204	P2157	P124B
Direct Fuel Injector High Voltage Control Cylinder 4	P0270	P0204	P0271	P124B
Direct Fuel Injector High Voltage Supply Cylinder 5	P216B	P0205	P216C	P124C
Direct Fuel Injector High Voltage Control Cylinder 5	P0273	P0205	P0274	P124C
Direct Fuel Injector High Voltage Supply Cylinder 6	P216E	P0206	P216F	P124D
Direct Fuel Injector High Voltage Control Cylinder 6	P0276	P0206	P0277	P124D

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

- The engine is running.
- The ignition voltage is between 11-18 V.

- The DTCs run continuously when the above conditions are met.

CONDITIONS FOR SETTING THE DTC

P1248, P1249, P124A, P124B, P124C, or P124D

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

ACTION TAKEN WHEN THE DTC SETS

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

CONDITIONS FOR CLEARING THE DTC

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

DIAGNOSTIC AIDS

- Performing the fuel injector coil test may help isolate an intermittent condition. Refer to **Fuel Injector Solenoid Coil Test** .
- 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 Fault 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

Description and Operation

Fuel System Description (LF1)

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. Observe the DTC information with a scan tool. DTC P0685 or P1682 should not set.
 - If a DTC is set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
2. Engine operating, observe the DTC information with a scan tool. DTC P1248, P1249, P124A, P124B, P124C, or P124D should not set.
3. Observe the scan tool Current Misfire Counter parameters. The Current Misfire Counters should not increment.
4. Ignition ON, observe the scan tool Cylinder 1-6 Injector Control Circuit Status parameters. Verify the Injector Control Circuit Status parameters display OK.
5. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

CIRCUIT/SYSTEM TESTING

1. Ignition OFF, disconnect the appropriate multi-way harness connector X108 or X109, at the rear of the intake manifold.
2. Ignition ON, observe the appropriate scan tool Cylinder 1-6 Injector Control Circuit Status. The parameter should display Open.
 - If not the specified value, test the appropriate high voltage supply circuit, ECM side, for a short to ground or the appropriate high voltage control circuit, ECM side, for a short to voltage. If the circuits test normal, replace the K20 ECM.
3. Ignition ON, connect a test lamp between the appropriate high voltage supply circuit and the high voltage control circuit. The Injector Control Circuit Status should transition from Open to OK.
 - If not the specified value, test for the following conditions in the ECM side of the harness:
 - An open/high resistance in the high voltage supply circuit
 - An open/high resistance in the high voltage control circuit
 - A short to ground in the high voltage control circuit
 - A short to voltage in the high voltage supply circuit
 - If the circuits test normal, replace the K20 ECM.

NOTE: **Testing for the following steps is performed on the fuel injector side of the multi-way harness connector. It may be necessary to remove the intake manifold to isolate the condition.**

4. Ignition OFF, measure the resistance between the appropriate high voltage supply circuit and ground. The DMM should display OL ohms.
 - If less than the specified range, test the high voltage supply circuit and the high voltage control circuit for a short to ground. If the circuits/connections test normal, test or replace the appropriate Q17 fuel injector(s).
5. Test for 2-3 ohms between the appropriate high voltage supply circuit and high voltage control circuit.
 - If less than the specified range, test for a short between the high voltage supply circuit and high voltage control circuit. If the circuits/connections test normal, test or replace the appropriate Q17 fuel injector(s).
 - If greater than the specified range, test the high voltage supply circuit and high voltage control circuit for an open/high resistance. If the circuits/connections test normal, test or replace the appropriate Q17 fuel injector.

COMPONENT TESTING

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

1. Remove the intake manifold and disconnect the appropriate Q17 fuel injector.
2. Test for 1.9-2.3 ohms at 20°C (68°F) between the high voltage supply circuit terminal 2 and the high voltage control circuit terminal 1 at the Q17 fuel injector.
 - If not within the specified range, replace the Q17 fuel injector.
3. Measure the resistance between each terminal at the Q17 fuel injector and the Q17 fuel injector housing/case. The DMM should display OL ohms.
 - If less than the specified value, replace the Q17 fuel injector.

REPAIR PROCEDURES

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

- **Fuel Injection Fuel Rail Assembly Replacement - Bank 1 (LF1)**
- **Fuel Injection Fuel Rail Assembly Replacement - Bank 2 (LF1)**
- **Control Module References** for ECM replacement, setup, and programming

DTC P1255 OR P064A

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 P064A

Fuel Pump Control Module Performance

DTC P1255

Fuel Pump Control Module Driver Over-temperature

CIRCUIT/SYSTEM DESCRIPTION

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

CONDITIONS FOR RUNNING THE DTC

The engine is running.

CONDITIONS FOR SETTING THE DTC

The fuel pump control module detects an over-temperature fault.

ACTION TAKEN WHEN THE DTC SETS

DTCs P064A and P1255 are Type A DTCs.

CONDITIONS FOR CLEARING THE DTC

DTCs P064A and P1255 are Type A DTCs.

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

Description and Operation

Fuel System Description (LF1)

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

1. Verify that DTC P0231, P0232 or P023F are not set.
 - If any of those codes are set, refer to **DTC P0231, P0232, or P023F** .
2. Ensure that the entire undercarriage of the vehicle is clean, especially around the area where the K27 fuel pump control module is located. Clear all codes from the K27 fuel pump control module and test drive the vehicle. Verify that DTC P1255 or P064A do not set.
 - If DTC P1255 or P064A reset, replace the K27 fuel pump control module.

REPAIR PROCEDURES

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

Control Module References for fuel pump control module replacement, setup, and programming

DTC P135A OR P135B (LF1)

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 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 Coil Supply Voltage Bank 1	P0201, P0203, P0205, P0300, P0351, P0353, P0355, P135A	P0201, P0203, P0205, P0300, P0351, P0353, P0355, P135A	-	-
Ignition Coil Supply Voltage Bank 2	P0202, P0204, P0206, P0300, P0352, P0354, P0356, P135B	P0202, P0204, P0206, P0300, P0352, P0354, P0356, P135B	-	-

CIRCUIT/SYSTEM DESCRIPTION

The ignition system on this engine uses an individual module/coil for each cylinder. The engine control module (ECM) monitors the ignition voltage from the fuse of each bank of coils to the ECM. The ECM uses this information to determine if the misfire is ignition coil voltage related.

CONDITIONS FOR RUNNING THE DTC

- The ignition is ON.
- The ignition module supply voltage is less than 2.5 V.
- The DTCs run continuously when the above condition is met.

CONDITIONS FOR SETTING THE DTC

The ECM detects a fault in an ignition coil control circuit for 50 out of 63 samples. Each sample runs on a 6.25 ms loop.

ACTION TAKEN WHEN THE DTC SETS

DTCs P135A and P135B are Type A DTCs.

CONDITIONS FOR CLEARING THE DTC

DTCs P135A and P135B are Type A DTCs.

REFERENCE INFORMATION

Schematic Reference

Engine Controls Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

- Electronic Ignition System Description
- Engine Control Module Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Engine Control Module Scan Tool Information (LF1,LFW) or Engine Control Module Scan Tool Information (LAF) for scan tool information

CIRCUIT/SYSTEM VERIFICATION

With the ignition ON, observe the following scan tool parameters for each cylinder:

- Ignition Coil Supply Voltage Bank 1
- Ignition Coil Supply Voltage Bank 2
 - Each parameter should display ON.

CIRCUIT/SYSTEM TESTING

NOTE: **The ignition circuit supplies voltage to other components. Make sure you test all circuits for a short to ground or test all components for being shorted that share the ignition circuit.**

1. Ignition OFF, disconnect the harness connector at the appropriate T8 ignition coil.
2. Ignition ON, verify that a test lamp illuminates between the ignition voltage circuit terminal D and ground of each T8 ignition coil.

- If the test lamp does not illuminate, test the circuit for a short to ground or an open/high resistance.
 - If the circuit tests normal, with the ignition OFF, disconnect the harness connector at each T8 ignition coil and monitor the fuse while individually connecting each T8 ignition coil. If the fuse opens, replace the appropriate T8 ignition coil.
3. Ignition OFF, disconnect the K20 ECM harness connector X1.
 4. Ignition ON, connect a test lamp between the following ignition voltage circuits and ground:
 - X1 67
 - X1 62

The test lamp should illuminate on each circuit.

- If the test lamp does not illuminate, test the ignition circuit for an open/high resistance.
5. If all circuits/connections test normal, replace the K20 ECM.

REPAIR PROCEDURES

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

- T8 **Ignition Coil Replacement - Bank 1**
- T8 **Ignition Coil Replacement - Bank 2**
- **Control Module References** for K20 ECM replacement, setup, and programming

DTC P1400 (LF1)

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 catalytic converter must be warmed to efficiently reduce the emissions. The cold start strategy is to reduce the amount of time it takes to warm the catalytic converter. During a cold start, the engine idle speed is elevated and spark timing is retarded to allow the catalyst to warm quickly. This diagnostic monitors the following to build an exhaust energy model:

- Engine speed

- Spark advance
- Throttle position
- Engine coolant temperature
- Engine runtime
- Park/neutral position
- Vehicle speed

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

CONDITIONS FOR RUNNING THE DTC

- The engine is running, and a cold start has been detected.
- Vehicle speed is less than 3 km/h (2 mph).
- The engine is at idle with no input from the accelerator pedal.
- The calculated catalyst temperature is less than 100°C (212°F).
- Engine coolant is greater than 10°C (50°F) and less than 56°C (132°F).
- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0121, P0122, P0123, P0220, P0222, P0223, P0201, P0202, P0203, P0204, P0205, P0206, P0300, P0335, P0336, P0351, P0352, P0353, P0501, P0502, P0506, P0507, P0601, P0602, P0603, P0604, P0606, P0607, P060D, P062F, P0641, P0651, P1101, P1516, P1682, P2101, P2119, P2120, P2122, P2123, P2125, P2127, P2128, P2135, P2138, P2176, P2610 are not set.

This DTC runs for 12 s within the first 17 s of start-up, or until the calculated catalyst temperature is greater than 900°C (1,652°F). 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 MIL/DTC

DTC P1400 is a Type A DTC.

REFERENCE INFORMATION

Description and Operation

Engine Control Module Description

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

DIAGNOSTIC AIDS

Any loading of the engine that lowers engine RPM, such as with partial application of the clutch, A/C cycling etc., during the first 17 s of engine run time may set this DTC.

CIRCUIT/SYSTEM VERIFICATION

1. Allow the engine to cool.
2. Start and idle the engine for at least 2 min.
3. DTC P1400 should run and pass.

CIRCUIT/SYSTEM TESTING

- Inspect the air intake system for the following:
 - Damage, restriction, or modification
 - Dirty or deteriorating air filter element
 - Crankcase ventilation system for correct operation-Refer to **Crankcase Ventilation System Inspection/Diagnosis** .
 - Water intrusion
 - Vacuum leak and other un-metered air downstream of the mass air flow (MAF) sensor
 - Intake manifold leak
- Inspect the exhaust system for the following:
 - Water intrusion
 - Exhaust leak
 - Damaged, restricted, modified or enhanced exhaust system-Refer to **Symptoms - Engine Exhaust** .
- Inspect the engine mechanical for items that could alter the air flow into the combustion chamber. Refer to **Symptoms - Engine Mechanical** .

REPAIR PROCEDURES

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

DTC P150C (LF1)

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

This diagnostic applies to communication integrity between the engine control module (ECM) and the transmission control module (TCM). The ECM determines that the engine speed signal counter is incorrect for the current vehicle operation.

CONDITIONS FOR RUNNING THE DTC

- The ignition switch is in Unlock, Accessory, Run or Crank.
- The system voltage is more than 5.23 V.
- DTCs P0601, P0602, P0603, P0604, P0606, P0607, P062F, P0641, P0651, P2610 and U0101 are not set.

CONDITIONS FOR SETTING THE DTC

The ECM detects that the TCM engine speed request circuit does not match the expected engine speed request circuit. Each test runs in 5 milliseconds. This DTC runs continuously.

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

Engine Control Module Description

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Engine Control Module Scan Tool Information (LF1,LFW) or **Engine Control Module Scan Tool Information (LAF)** for scan tool information

CIRCUIT/SYSTEM VERIFICATION

1. Ignition ON, observe the DTC information with a scan tool. DTC U0101 should not be set.
 - If DTC U0101 is set, repair that DTC first.
2. Observe the DTC information with a scan tool. DTCs P0601, P0603, P0604, P0606, P0607, P0610, P062B, P0630, P167D or P2610 should not set. If a DTC failed this ignition, replace the K20 ECM. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

CIRCUIT/SYSTEM TESTING

Replace the K71 TCM.

REPAIR PROCEDURES

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

Control Module References for K71 ECM replacement, setup, and programming

DTC P1516, P2101, P2119, OR P2176 (LF1, LFW)

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

DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Motor Control 1	P1516, P2101, P2176	P1516, P2101, P2176	P1516, P2101, P2176	P0690, P1516, P2101, P2176	P1516, P2101, P2176
Motor Control 2	P1516, P2101, P2176	P1516, P2101, P2176	P1516, P2101, P2176	P1516, P2101, P2176	P1516, P2101, P2176

CIRCUIT/SYSTEM DESCRIPTION

The engine control module (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 throttle position (TP) sensors 1 and 2 to determine the actual throttle valve position.

CONDITIONS FOR RUNNING THE DTC**P1516**

- The ignition voltage is greater than 6 V and reduced power is not active.
- The engine is running.
- DTCs P1516 runs continuously when the above conditions are met.

P2101

- DTC P1682 not set.
- The engine is running.
- The ECM has learned the minimum throttle position.
- The ignition voltage is greater than 6 V and reduced power is not active.
- DTCs P2101 run continuously when the above conditions are met.

P2119

- DTCs P0121, P0122, P0123, P0222, P0223, P0641, P0651, P0697, P06A3, or P2135 are not set.
- The ignition is ON.
- The ignition voltage is greater than 6 V.
- DTC P2119 runs continuously when the above conditions are met.

P2176

- DTCs P0068, P0122, P0123, P0222, P0223 are not set.
- The ignition is ON.
- The ignition voltage is greater than 6 V and reduced power is not active.
- DTC P2176 runs continuously when the above conditions are met.

CONDITIONS FOR SETTING THE DTC

P1516

The ECM detect an inability to maintain a steady state throttle position for 4 s.

P2101

The ECM detects the difference between the actual throttle position, and the desired position is greater than 7 percent.

P2119

- The ECM detects that the throttle blade did not return to the default position, during power down, within a calibrated amount of time.
- or
- The ECM detects the throttle control is driving the throttle in the incorrect direction or exceeds the reduced power limit.

P2176

The ECM detects that both throttle position sensors were greater than 0.95 V during the minimum learn procedure.

ACTION TAKEN WHEN THE DTC SETS

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

CONDITIONS FOR CLEARING THE MIL/DTC

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

DIAGNOSTIC AIDS

- 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

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

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

1. Ignition ON, observe the DTC information with a scan tool. Verify that DTC P0121, P0122, P0123, P0222, P0223, P0562, P0621, P0622, P0625, P0626, or P2135 is not set.
 - If a DTC sets, refer to Diagnostic Trouble Code (DTC) List - Vehicle for further diagnosis.
2. Rapidly depress the accelerator pedal from the rest position to the wide open throttle position (WOT) and release pedal. Repeat the procedure several times. DTCs P1516, P2101, P2119, or P2176 should not set.
3. Slowly depress the accelerator pedal to WOT and then slowly return the pedal to closed throttle. Repeat

the procedure several times. DTCs P1516, P2101, P2119, or P2176 should not set.

4. Engine idling, observe the TAC Command parameter with a scan tool. The reading should display greater than 0 %.
5. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

CIRCUIT/SYSTEM TESTING

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

1. Ignition OFF, verify the following conditions do not exist with the Q38 throttle body assembly:
 - 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, replace the Q38 throttle body assembly.

NOTE: Disconnecting the throttle body harness connector may cause additional DTCs to set.

2. Ignition OFF, disconnect the harness connector at the Q38 throttle body assembly.
3. Ignition ON, verify that a test lamp does not illuminate between each motor control circuit listed below and ground.
 - Motor control circuit terminal A
 - Motor control circuit terminal B
 - If test lamp illuminates, test the motor control circuit for a short to voltage. If the circuit tests normal, replace the K20 ECM.
4. Ignition ON, verify that a test lamp does not illuminate between each motor control circuit listed below and B+.
 - Motor control circuit terminal A
 - Motor control circuit terminal B
 - If the test lamp illuminates, test the motor control circuit for a short to ground. If the circuit tests normal, replace the K20 ECM.
5. Ignition OFF, set the DMM to the 40 V scale, select the Min/Max Recording Mode, and set the Peak Min/Max response time to 1 ms.

NOTE:

- The DMM Min/Max Recording Mode and the response time of 1 ms must be reset after testing each circuit.
- The ignition must be OFF and the ECM completely powered down before testing each circuit.

6. Ignition OFF, measure the voltage using the DMM Min/Max Recording Mode function on each circuit listed below as the ignition is turned ON. The Max voltage should be within 1 V of B+.
 - Motor control circuit terminal A
 - Motor control circuit terminal B
 - If not within the specified range, test the circuit for an open/high resistance. If the circuit tests normal, replace the K20 ECM.
7. If all circuits and connections test normal, replace the Q38 throttle body assembly.

REPAIR PROCEDURES

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

- **Throttle Body Assembly Replacement (LF1)**
- **Control Module References** for ECM replacement, setup, and programming

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 DESCRIPTION

The ECM supplies 5 V reference voltage, through the 5 V reference voltage circuit, to the fuel economy mode switch. The 5 V reference voltage causes current to flow through a series of resistors in the switch to the switch ground circuit. The ECM monitors the reference voltage through a discrete fuel economy mode switch signal circuit. When the switch button is momentarily pressed, the switch contacts allow the 5 V reference voltage to by-pass one of the resistors. The ECM detects the resulting voltage drop as a fuel economy mode request and sends a GMLAN message to the transmission control module (TCM) indicating the request. When the TCM receives the request, throttle progressions and transmission shift points are modified to optimize fuel efficiency. The instrument panel cluster (IPC) also receives the fuel economy mode request message from the ECM and illuminates the fuel economy mode indicator lamp. The fuel economy mode switch must be pressed for between 0.094-1.5 s to activate the fuel economy mode. Voltage on the signal wire is normally between 1.45-3.45 V with the switch depressed. When the switch is released, voltage on the signal wire is normally between 3.65-4.45 V.

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 fuel economy mode switch 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

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 Fuel Economy Mode parameter. The parameter should display Inactive.
2. Ignition ON, command the Fuel Economy ON and OFF with a scan tool. The Fuel Economy Mode parameter should display Active and Inactive as commanded.
3. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

CIRCUIT/SYSTEM TESTING

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

1. Ignition OFF, disconnect the X1 harness connector at the Fuel Economy Mode switch.
2. Test for less than 5 ohms between the ground circuit terminal 1 of the harness connector and ground.
 - If greater than the specified range, test the ground circuit for a open/high resistance and repair as necessary.
3. Ignition ON, test for 4.8-5.2 V between the 5 V reference circuit terminal 3 of the harness connector and ground.
 - If less than the specified range, test the 5 V reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the K20 ECM.
 - If greater than the specified range, test the 5 V reference circuit for a short to voltage. If the circuit tests normal, replace the K20 ECM.
4. Observe the scan tool Fuel Economy Mode Switch parameter. The parameter should display Circuit Low Voltage.
 - If the parameter does not display the specified value, test the signal circuit for a short to voltage. If the circuit tests normal, replace the K20 ECM.
5. Connect a 3 A fused jumper wire between 5 V reference circuit terminal 3 of the harness connector and signal circuit terminal 4 of the harness connector. Verify the scan tool Fuel Economy Mode Switch parameter displays Circuit High Voltage.
6. If all scan tool parameter displays are normal, test or replace the S87 fuel economy mode switch.

COMPONENT TESTING

1. Disconnect the fuel economy mode switch and measure between the 5 V reference voltage circuit terminal 3 of the switch and signal circuit terminal 4 of the switch for 266-294 ohms with a DMM.
 - If the DMM does not measure between 266-294 ohms, replace the S87 fuel economy mode switch.
2. Measure between the 5 V reference voltage circuit terminal 3 of the switch and the ground circuit terminal 1 of the switch for 1,414-1,562 ohms with a DMM.
 - If the DMM does not measure between 1,414-1,562 ohms, replace the S87 fuel economy mode switch.
3. With the fuel economy mode switch button depressed, measure between the 5 V reference voltage circuit terminal 3 of the switch and the ground circuit terminal 1 of the switch for 486ohms538 ohms with a DMM.
 - If the DMM does not measure between 486-538 ohms, replace the S87 fuel economy mode switch.

REPAIR PROCEDURES

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

- **Fuel Economy Indicator Switch Replacement**
- **Control Module References** for ECM replacement, setup and programming

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 DESCRIPTION

The ECM supplies 5 V reference voltage, through the 5 V reference voltage circuit, to the fuel economy mode switch. This 5 V reference voltage causes current to flow through a series of resistors in the switch to the switch ground circuit. The ECM monitors the 5 V reference voltage through a discrete fuel economy mode switch signal circuit. When the switch button is momentarily pressed, the switch contacts allow the 5 V reference voltage signal to by-pass one of the resistors. The ECM detects the resulting voltage drop as a fuel economy mode request and sends a GMLAN message to the transmission control module (TCM) indicating the request. When the TCM receives the request, throttle progressions and transmission shift points are modified to optimize fuel efficiency. The instrument panel cluster (IPC) also receives the fuel economy mode request message from the ECM and illuminates the fuel economy mode indicator lamp. The fuel economy mode switch must be pressed for between 0.094-1.5 s to activate the fuel economy mode. Voltage on the signal wire is normally between 1.45-3.45 V with the switch depressed. When the switch is released, voltage on the signal wire is normally between 3.65-4.45 V.

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 fuel economy mode switch signal wire is in an indeterminate range.

ACTION TAKEN WHEN THE DTC SETS

DTC P15A1 is a Type B DTC.

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

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. If you cannot duplicate the condition, refer to **Testing for Intermittent Conditions and Poor Connections**.
2. Verify that DTCs P159F and P015A0 are not set.
 - If either or both of the DTCs are set, refer to **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**.
3. Engine running, observe the DTC information with a scan tool. DTC P15A1 should not set.
4. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

CIRCUIT/SYSTEM TESTING

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

1. Ignition OFF, disconnect the X1 harness connector at the Fuel Economy Mode switch.
2. Test for less than 5 ohms between the ground circuit terminal 1 of the harness connector and ground.
 - If greater than the specified range, test the ground circuit for a high resistance and repair as necessary.
3. Measure between the 5 V reference voltage circuit terminal 3 of the switch and signal circuit terminal 4 of the switch for 266-294 ohms with a DMM.
 - If the DMM does not measure between 266-294 ohms, replace the S87 fuel economy mode switch.
4. Measure between the 5 V reference voltage circuit terminal 3 of the switch and the ground circuit terminal 1 of the switch for 1,414-1,562 ohms with a DMM.
 - If the DMM does not measure between 1,414-1,562 ohms, replace the S87 fuel economy mode switch.
5. With the fuel economy mode switch button depressed, measure between the 5 V reference voltage circuit terminal 3 of the switch and the ground circuit terminal 1 of the switch for 486-538 ohms with a DMM.
 - If the DMM does not measure between 486-538 ohms, replace the S87 fuel economy mode switch.
6. Disconnect the X2 harness connector at the ECM.
7. Measure the 5 V reference voltage circuit, between terminal 14 of the ECM harness connector and

terminal 3 of the fuel economy mode switch harness connector, for less than 5 ohms.

- If greater than the specified range, repair or replace the 5 V reference voltage circuit as necessary.
8. Measure the signal circuit, between terminal 50 of the ECM harness connector and terminal 4 of the fuel economy mode switch harness connector, for less than 5 ohms.
 - If greater than the specified range, repair or replace the signal circuit as necessary.
 9. If all circuits test normal, replace the K20 ECM.

REPAIR PROCEDURES

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

- **Fuel Economy Indicator Switch Replacement**
- **Control Module References** for ECM replacement, setup and programming

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

- The engine is running or cranking.
- The ignition voltage is between 8-18 V.
- DTC P163A runs continuously when the conditions are met for greater than 500 mS.

CONDITIONS FOR SETTING THE DTC

The ECM detects a condition with the integrated circuits of the high pressure fuel pump actuator driver module or the ECM detects that the current used to drive the high pressure fuel pump actuator is out of range for greater than 4 s.

ACTION TAKEN WHEN THE DTC SETS

DTC P163A is a Type C DTC.

CONDITIONS FOR CLEARING THE DTC

DTC P163A is a Type C DTC.

REFERENCE INFORMATION

Schematic Reference

Engine Controls Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Engine Control Module Description

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

CIRCUIT/SYSTEM 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 9-11 ohms at 25°C (77°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.

3. Measure the resistance between each terminal and the high pressure fuel pump housing. The DMM should display OL.
 - If less than the specified value, replace the G18 high pressure fuel pump.
4. Ignition OFF, verify that a test lamp does not illuminate between B+ and the low control circuit terminal 1.
 - If the test lamp illuminates, test the low control circuit for a short to ground. If the circuit tests normal, replace the K20 ECM.
5. Ignition ON, verify that a test lamp does not illuminate between ground and the high control circuit terminal 2.
 - If the test lamp illuminates, test the high control circuit for a short to voltage. If the circuit tests normal, replace the K20 ECM.
6. Ignition ON, command the Fuel Pressure Regulator ON with a scan tool. Verify that the test lamp illuminates.
 - If the test lamp does not illuminate, test the high control circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the K20 ECM.
7. Ignition OFF, connect a test lamp between the low control circuit terminal 1 and B+.
8. Ignition ON, command the Fuel Pressure Regulator ON with a scan tool. Verify that the test lamp illuminates.
 - If the test lamp does not illuminate, test the low control circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the K20 ECM.
9. If all circuits and the high pressure fuel pump test normal, replace the K20 ECM.

REPAIR PROCEDURES

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

- **Fuel Pump Replacement**
- **Control Module References** for engine control module replacement, setup, and programming

DTC 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 DESCRIPTOR

DTC P1682

Ignition 1 Switch Circuit 2

DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Engine Controls Ignition Relay Feedback Signal, Engine Control Module Relay	P1682	P1682	P0690
Ignition 1 Signal, Run/Crank Relay	1	1	2
1. A short to ground or open/high resistance will cause a No Crank condition. 2. A short to voltage will cause the engine to continue to run with ignition OFF.			

TYPICAL SCAN TOOL DATA

Ignition 1 Signal

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON, engine OFF, and ignition Run/Crank and engine control module relays are commanded ON			
Ignition 1 Signal, Run/Crank Relay	0 V	0 V	B+
Engine Controls Ignition Relay Feedback Signal, Engine Control Module Relay	0 V	0 V	B+

CIRCUIT/SYSTEM DESCRIPTION

There are 2 ignition voltage circuits supplied to the engine control module (ECM). The first ignition circuit is provided by the engine control module relay through a fuse. This ignition voltage circuit supplies power to all the internal ECM circuits associated with the throttle actuator control (TAC) operation. The second ignition voltage circuit is supplied by the ignition Run/Crank relay through a fuse, and is used to power the remaining internal ECM circuits. If the ECM detects a voltage difference between the 2 ignition voltage circuits, DTC P1682 will set.

CONDITIONS FOR RUNNING THE DTC

- The ignition is ON.
- System voltage is more than 6 V.
- The engine control module relay is commanded ON.
- DTC P1682 runs continuously.

CONDITIONS FOR SETTING THE DTC

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

ACTION TAKEN WHEN THE DTC SETS

DTC P1682 is a Type A DTC.

CONDITIONS FOR CLEARING THE DTC

DTC P1682 is a Type A DTC.

REFERENCE INFORMATION

Schematic Reference

- Engine Controls Schematics
- Power Distribution Schematics

Connector End View Reference

Component Connector End Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Electrical Center Identification Views
- Probing Electrical Connectors
- 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: On the scan tool, the engine control module relay is referred to as the engine controls ignition relay.

1. Ignition ON, observe the DTC information with a scan tool. If DTCs P0685 or P0690 are set, diagnose those DTCs first. DTC P1682 should not set.
2. Ignition ON, observe the scan tool Ignition 1 Voltage signal and the Engine Controls Ignition Relay Feedback signal parameters. There should be no more than 3 V difference between the two parameters.
3. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

CIRCUIT/SYSTEM TESTING

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

1. Ignition ON, observe the scan tool Ignition 1 Signal and the Engine Controls Ignition Relay Feedback parameters to determine which is more than 3 V lower than the other.

NOTE: The Ignition 1 Signal is supplied by the ignition run/crank relay. The Engine Controls Ignition Relay Feedback Signal is supplied by the engine control module relay.

2. Ignition OFF, remove the relay that corresponds to the scan tool parameter that is more than 3 V lower.

NOTE: A resistance of 6 ohms or greater in the circuit/underhood fuse block will cause the DTC to set.

3. Connect a 20 A fused jumper wire between B+ and the applicable ignition voltage circuit terminal 30 leading to the K20 ECM. Ignition ON, verify that the applicable scan tool parameter displays between 9-14 V.
 - If the applicable scan tool parameter is less than the specified value, test the ignition voltage circuit for an open/high resistance. If the circuit tests normal, replace the K20 ECM.
4. Ignition OFF, connect a DMM set to the diode setting between the control circuit terminal 85 and ground. Verify the DMM displays OL.
 - If not the specified value, test the control circuit for a short to ground. If the circuit tests normal, replace the K20 ECM.
5. Ignition ON, verify the DMM displays less than 1 V.
 - If not the specified range, test the control circuit for a short to voltage or an open/high resistance. If the circuit tests normal, replace the K20 ECM.
6. If all circuits test normal, replace the applicable relay.

REPAIR PROCEDURES

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

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

DTC P2122, P2123, P2127, P2128, OR P2138 (LF1, LFW)

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) Sensor 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-Volt Reference Circuit	P06A3, P2122, P2135	P2138	P2122	P06A3, P2135	P2138
Accelerator Pedal Position (APP) Sensor 1 Signal	P2122	P2138	P2122	P2123	P2138
Accelerator Pedal Position (APP) Sensor 1 Low Reference	-	P2138	P2123	-	P2138
Accelerator Pedal Position (APP) Sensor 2 5-Volt Reference Circuit	P0106, P0107, P0697	P2138	P2127	P0106, P0108, P0697	P2138
Accelerator Pedal Position (APP) Sensor 2 Signal	P2127	P2138	P2127	P06A3, P2123, P2128, P2138	P2138
Accelerator Pedal Position (APP) Sensor 2 Low Reference	-	P2138	P2128	-	P2138

TYPICAL SCAN TOOL DATA

APP Sensor 1 and 2

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 Parameter Normal Range: APP Sensor 2 0.39-0.59 V			
APP Sensor 1 5-Volt Reference	0.00 V	0.00 V	2-3 V
APP Sensor 1 Signal	0.00 V	0.00 V	4.98 V
APP Sensor 1 Low Reference	-	4.94 V	-
APP Sensor 2 5-Volt Reference	0.00 V	0.00 V	1.35 V
APP Sensor 2 Signal	0.00 V	0.00 V	2-5 V
APP Sensor 2 Low Reference	-	4.92 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 changes relative to pedal position. The engine control module (ECM) supplies each APP sensor with a 5-volt 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 V.
- The ECM is not commanding reduced power.
- 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 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 4.7 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

- If a shared 5-volt reference circuit is shorted to ground or shorted to a voltage, other 5-volt reference circuits may be affected.
- The scan tool 5 volt reference parameter should display between 4.8-5.2 V.
- A high resistance condition on the accelerator pedal position circuits could cause a DTC to set.

REFERENCE INFORMATION**Schematic Reference****Engine Controls Schematics**

Connector End View Reference

Component Connector End Views

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, observe the DTC information with a scan tool. Verify DTCs P0697 or P06A3 are not set.
 - If a DTC is set, refer to **DTC P0641, P0651, P0697, or P06A3 (ECM)** for further diagnosis.
2. Ignition ON, observe the scan tool Accelerator Pedal Position percentage parameter. The scan tool should display 0 percent.
3. Observe the scan tool APP Sensor 1 and 2 Agree/Disagree parameter while performing the following tests:
 - 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.

The APP Sensor 1 and 2 Agree/Disagree parameter should display Agree.

4. Observe the DTC information with a scan tool. DTCs P2122, P2123, P2127, P2128, or P2138 should not set.
5. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

CIRCUIT/SYSTEM TESTING

1. Ignition OFF, disconnect the harness connector at the B107 accelerator pedal assembly.
2. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Test for less than 5 ohms between the low reference circuit terminals listed below and ground.
 - Low reference circuit terminal 4 or A
 - Low reference circuit terminal 5 or D
 - If greater than the specified range, test the appropriate low reference circuit for a short to voltage, or an open/high resistance. If the circuit tests normal, replace the K20 ECM.
3. Ignition ON, test for 4.8-5.2 V between both 5-volt reference circuit terminals listed below and ground.
 - 5 volt reference circuit terminal 1 or C
 - 5 volt reference circuit terminal 2 or F
 - If less than the specified range, test the appropriate 5-volt reference circuit for a short to ground or open/high resistance. If the circuit tests normal, replace the K20 ECM.
 - If greater than the specified range, test the 5-volt reference circuit for a short to voltage. If the circuit tests normal, replace the K20 ECM.
4. Verify the appropriate APP sensor voltage parameter is at 0 V.
 - If greater than the specified range, test the appropriate signal circuit terminal listed below for a short to voltage. If the circuit tests normal, replace the K20 ECM.
 - APP sensor 1 signal circuit terminal 3 or E
 - APP sensor 2 signal circuit terminal 6 or B
5. Install a 3 A fused jumper wire between the appropriate signal circuit listed below and the 5-volt reference circuit terminal 1. Verify the appropriate APP sensor voltage parameter is greater than 4.8 V.
 - APP sensor 1 signal circuit terminal 3 or E
 - APP sensor 2 signal circuit terminal 6 or B
 - If less than the specified range, test the appropriate signal circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the K20 ECM.
6. If all circuits test normal, replace the B107 accelerator pedal assembly.

REPAIR PROCEDURES

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

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

DTC P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216B, P216C, P216E, OR P216F

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

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 Supply Cylinder 1	P2147	P0201	P2148	P1248
Direct Fuel Injector High Voltage Control Cylinder 1	P0261	P0201	P0262	P1248
Direct Fuel Injector High Voltage Supply Cylinder 2	P2150	P0202	P2151	P1249
Direct Fuel Injector High Voltage Control Cylinder 2	P0264	P0202	P0265	P1249
Direct Fuel Injector High Voltage Supply Cylinder 3	P2153	P0203	P2154	P124A
Direct Fuel Injector High Voltage Control Cylinder 3	P0267	P0203	P0268	P124A
Direct Fuel Injector High Voltage Supply Cylinder 4	P2156	P0204	P2157	P124B
Direct Fuel Injector High Voltage Control Cylinder 4	P0270	P0204	P0271	P124B
Direct Fuel Injector High Voltage Supply Cylinder 5	P216B	P0205	P216C	P124C
Direct Fuel Injector High Voltage Control Cylinder 5	P0273	P0205	P0274	P124C
Direct Fuel Injector High Voltage Supply Cylinder 6	P216E	P0206	P216F	P124D
Direct Fuel Injector High Voltage Control Cylinder 6	P0276	P0206	P0277	P124D

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

- The engine is running.

- The ignition voltage is between 11-18 V.
- The DTCs run continuously when the above conditions are met.

CONDITIONS FOR SETTING THE DTC

P2147, P2150, P2153, P2156, P216B, or P216E

The ECM detects the injector high voltage supply circuit is shorted to ground for greater than 2 s.

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

The ECM detects the 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, and P216F are Type A DTCs.

CONDITIONS FOR CLEARING THE DTC

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

DIAGNOSTIC AIDS

- Performing the fuel injector coil test may help isolate an intermittent condition. Refer to **Fuel Injector Solenoid Coil Test**.
- 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 Fault 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

Description and Operation

Fuel System Description (LF1)

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. Observe the DTC information with a scan tool. DTC P0685 or P1682 should not set.
 - If a DTC is set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
2. Engine operating, observe the DTC information with a scan tool. DTC P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216B, P216C, P216E, or P216F should not set.
3. Observe the scan tool Current Misfire Counter parameters. The Current Misfire Counters should not increment.
4. Ignition ON, observe the scan tool Cylinder 1-6 Injector Control Circuit Status parameters. Verify the Injector Control Circuit Status parameters display OK.
5. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

CIRCUIT/SYSTEM TESTING

1. Ignition OFF, disconnect the appropriate multi-way harness connector X108 or X109, at the rear of the intake manifold.
2. Ignition ON, observe the appropriate scan tool Cylinder 1-6 Injector Control Circuit Status. The parameter should display Open.
 - If not the specified value, test the appropriate high voltage supply circuit, ECM side, for a short to ground or the appropriate high voltage control circuit, ECM side, for a short to voltage. If the circuits test normal, replace the K20 ECM.
3. Ignition ON, connect a test lamp between the appropriate high voltage supply circuit and the high voltage control circuit. The Injector Control Circuit Status should transition from Open to OK.
 - If not the specified value, test for the following conditions in the ECM side of the harness:
 - An open/high resistance in the high voltage supply circuit
 - An open/high resistance in the high voltage control circuit
 - A short to ground in the high voltage control circuit
 - A short to voltage in the high voltage supply circuit

- If the circuits test normal, replace the K20 ECM.

NOTE: **Testing for the following steps is performed on the fuel injector side of the multi-way harness connector. It may be necessary to remove the intake manifold to isolate the condition.**

4. Ignition OFF, measure the resistance between the appropriate high voltage supply circuit and ground. The DMM should display OL ohms.
 - If less than the specified range, test the high voltage supply circuit and the high voltage control circuit for a short to ground. If the circuits/connections test normal, test or replace the appropriate Q17 fuel injector(s).
5. Test for 2-3 ohms between the appropriate high voltage supply circuit and high voltage control circuit.
 - If less than the specified range, test for a short between the high voltage supply circuit and high voltage control circuit. If the circuits/connections test normal, test or replace the appropriate Q17 fuel injector(s).
 - If greater than the specified range, test the high voltage supply circuit and high voltage control circuit for an open/high resistance. If the circuits/connections test normal, test or replace the appropriate Q17 fuel injector.

COMPONENT TESTING

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

1. Remove the intake manifold and disconnect the appropriate Q17 fuel injector.
2. Test for 1.9-2.3 ohms at 20°C (68°F) between the high voltage supply circuit terminal 2 and the high voltage control circuit terminal 1 at the Q17 fuel injector.
 - If not within the specified range, replace the Q17 fuel injector.
3. Measure the resistance between each terminal at the Q17 fuel injector and the Q17 fuel injector housing/case. The DMM should display OL ohms.
 - If less than the specified value, replace the Q17 fuel injector.

REPAIR PROCEDURES

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

- **Fuel Injection Fuel Rail Assembly Replacement - Bank 1 (LF1)**
- **Fuel Injection Fuel Rail Assembly Replacement - Bank 2 (LF1)**
- **Control Module References** for ECM replacement, setup, and programming

DTC P219A OR P219B (LF1, LFW)

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 P219A

Air Fuel Imbalance Bank 1

DTC P219B

Air Fuel Imbalance Bank 2

CIRCUIT/SYSTEM DESCRIPTION

The Air Fuel Imbalance diagnostic detects a rich or lean cylinder to cylinder air/fuel ratio imbalance in each bank. 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 P0053, P0059, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0116, P0117, P0118, P0125, P0128, P0131, P0132, P0133, P0134, P0135, P0151, P0152, P0153, P0154, P0155, P0178, P0179, P0201-P0208, P0300, P0301-P0308, P0411, P0442, P0443, P0446, P0449, P0452, P0453, P0455, P0496, P0606, P1133, P1153, P1516, P2101, P2135, P2176, P2269, P2440, P2444, P2A00, P2A03 are not set.
- The device control is not active.
- The intrusive diagnostics are not active.
- The engine overspeed protection is not active.
- Reduced power mode, ETC DTC, is not active.
- The power take-off (PTO) is not active.
- The traction control is not active.
- The fuel control is in air-fuel Closed Loop.
- The system voltage is more than 10 V, or less than 18 V.
- The engine coolant temperature (ECT) is greater than -20°C (-4°F).
- The engine speed is greater than 350 RPM, but less than 6,000 RPM.
- The mass air flow is greater than 11 g/s, but less than 510 g/s.
- Percent ethanol is less than 87 %.

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 B DTCs.

CONDITIONS FOR CLEARING THE MIL/DTC

DTCs P219A and P219B are Type B DTCs.

DIAGNOSTIC AIDS

- The air fuel imbalance diagnostic is very sensitive to heated oxygen sensor (HO2S) design. A non-OE sensor or an incorrect part number may set a false DTC.
- Monitoring the misfire current counters, or misfire graph, may help to isolate the cylinder that is causing the condition.
- E85 compatible engine only-Over-estimation of the ethanol content will result in a rich shift of fuel trim values, and under-estimation will result in a lean shift of fuel trim values. A fuel trim DTC may set if the learned alcohol content, Fuel Alcohol Content parameter on the scan tool, is different than the measured alcohol content in the vehicle such that fuel trim values exceed failure threshold values. Refer to **Fuel Composition Diagnosis** .

REFERENCE INFORMATION

Schematic Reference

Engine Controls Schematics

Connector End View Reference

Component Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Troubleshooting with a Test Lamp**
- **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

1. Read and record the Freeze Frame/Failure Records data taking note of the speed and load at which the DTC set.
2. Diagnose any other DTCs that are set. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
3. With the engine idling and the transmission in the Park or Neutral position, observe the manifold absolute pressure (MAP) sensor parameter. The MAP sensor parameter should be between 20-48 kPa.
 - If the MAP sensor parameter is not between 20-48 kPa, refer to **DTC P0106 (LF1)** or **DTC P0107 or P0108 (w/LF1)** .
4. Inspect the air induction system for modified, damaged, leaking, or restricted components.
5. Inspect the crankcase ventilation system for improper operation.
6. Inspect the vacuum hoses for splits, kinks, and improper connections.
7. Inspect for vacuum leaks at the intake manifold, the throttle body, and the injector O-rings.
8. Test for a restricted, damaged, leaking, or modified exhaust system from the catalytic converter forward. Refer to **Symptoms - Engine Exhaust** .
9. Test the fuel injectors for improper operation. Refer to **Fuel Injector Solenoid Coil Test** .
10. Test for fuel contamination. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis** for gasoline or **Fuel Composition Diagnosis** for E85.
11. Test for excessive fuel in the crankcase due to leaking injectors.
12. Test the ignition system for improper operation. Refer to **Electronic Ignition System Diagnosis** .
13. 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 PROCEDURES

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure. Verify the repair under the same speed and load as noted in the Freeze Frame/Failure Records data recorded during testing.

DTC P2227-P2229, OR P2230 (LF1)

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	P2228	P0641, P2229	P2227
Signal	P2227, P2228	P2227, P2228	P2227, P2229	P2227
Low Reference	-	P2227, 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)	127 kPa (18.4 psi)
Signal	0 kPa (0 psi)	0 kPa (0 psi)	127 kPa (18.4 psi)
Low Reference	-	127 kPa (18.4 psi)	-

CIRCUIT/SYSTEM DESCRIPTION

The barometric pressure (BARO) sensor responds to changes in altitude and atmospheric conditions. This gives the engine control module (ECM) an indication of barometric pressure. The ECM uses this information to calculate fuel delivery. The BARO sensor provides a voltage signal to the ECM relative to the atmospheric pressure changes. The ECM monitors the BARO sensor signal for a voltage outside of the normal range.

CONDITIONS FOR RUNNING THE DTC

P2227

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0121, P0122, P0123, P0222, P0223, P1516, P2135, P2228 and P2229 are not set.
- Engine is running.

OR

- DTCs P0106, P0107, P0108, P2228, P2229 and P2230 are not set and are not pending.
- Ignition ON, engine OFF.
- DTC P2227 runs continuously when the above conditions are met.

P2228 or P2229

- The engine is running.
- The DTCs run continuously when the above condition is met.

P2230

- The engine is running.
- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0121, P0122, P0123, P0222, P0223, P1516, P2135, P2228 and P2229 are not set.
- DTC P2230 runs continuously when the above conditions are met.

CONDITIONS FOR SETTING THE DTC

P2227

- Engine running, the ECM detects that the difference between the BARO signal and the calculated BARO is greater than 15 kPa (2.2 psi) when the vehicle has traveled no more than 0.5 km (0.31 mi) since the last calculated BARO update, or if the difference is greater than 25 kPa (3.6 psi) when the vehicle has traveled greater than 0.5 km (0.31 mi) since the last calculated BARO update.
- 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 1.95 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 difference between the current BARO sensor reading and the previous BARO sensor reading is greater than 10 kPa (1.5 psi) for less than 1 s.

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 B17 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

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 DTC information with a scan tool. Verify that DTC P0641 is not set.
 - If the above DTC is set, refer to **DTC P0641, P0651, P0697, or P06A3 (ECM)** .
2. Ignition ON, observe the scan tool BARO parameter. Compare the parameter to the **Altitude Versus Barometric Pressure** table. The BARO parameter should be within the specified range indicated in the table.
3. Engine running observe the DTC information with a scan tool. DTCs P2227, P2228, P2229, or P2230 should not set.
4. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure

Records data.

CIRCUIT/SYSTEM TESTING

1. Ignition OFF, disconnect the harness connector at the B17 BARO sensor.
2. Ignition OFF for 90 s, test for less than 5 ohms between the low reference circuit terminal 2 and ground.
 - If greater than the specified range, test the low reference circuit for an open/high resistance. If the circuit tests normal, replace the K20 ECM.
3. Ignition ON, test for 4.8-5.2 V between the 5 V reference circuit terminal 1 and ground.
 - If less than the specified range, test the 5 V reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the K20 ECM.
 - If greater than the specified range, test the 5 V reference circuit for a short to voltage. If the circuit tests normal, replace the K20 ECM.
4. Verify the scan tool BARO Sensor parameter is less than 1 kPa (0.2 psi).
 - If greater than the specified range, test the signal circuit terminal 3 for a short to voltage. If the circuit tests normal, replace the K20 ECM.
5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the 5 V reference circuit terminal 1. Verify the scan tool BARO Sensor parameter is greater than 127 kPa (18.4 psi).
 - If less than the specified range, test the signal circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the K20 ECM.
6. If the circuits test normal, replace the B17 BARO sensor.

REPAIR PROCEDURES

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

- **Throttle Inlet Absolute Pressure Sensor Replacement** for BARO sensor replacement
- **Control Module References** for engine control module replacement, setup, and programming

DTC P2270 OR P2272 (W/LF1)

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 P2270

HO2S Signal Stuck Lean Bank 1 Sensor 2

DTC P2272

DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
HO2S High Signal	P0131, P0137, P0151, P0157	P0132, P0134, P0138, P0140, P0152, P0154, P0158, P0160	P0132, P0134, P0138, P0140, P0152, P0154, P0158, P0160	P0132, P0134, P0138, P0140, P0152, P0154, P0158, P0160	P0133, P013A, P013B, P013C, P013D, P013E, P013F, P014A, P014B, P0153, P1133, P1153, P2A00, P2A03
HO2S Low Signal	P0131, P0137, P0151, P0157	P0132, P0134, P0138, P0140, P0152, P0154, P0158, P0160	P0132, P0134, P0138, P0140, P0152, P0154, P0158, P0160	P0132, P0134, P0138, P0140, P0152, P0154, P0158, P0160	P0133, P013A, P013B, P013C, P013D, P013E, P013F, P014A, P014B, P0153, P1133, P1153, P2A00, P2A03
HO2S Heater Voltage Supply	P0030, P0036, P0050, P0056, P0132, P0135, P0138, P0140, P0141, P0152, P0155, P0158, P0161, *	P0030, P0036, P0050, P0056, P0132, P0134, P0135, P0138, P0140, P0141, P0152, P0154, P0155, P0158, P0160, P0161	P0030, P0036, P0050, P0056, P0132, P0134, P0135, P0138, P0140, P0141, P0152, P0154, P0155, P0158, P0160, P0161	P0690	P0135, P0141, P0155, P0161
HO2S Heater Control	P0030, P0036, P0050, P0053, P0054, P0056, P0059,	P0030, P0036, P0050, P0056, P0132, P0134, P0135, P0138, P0140,	P0030, P0036, P0050, P0056, P0132, P0134, P0135, P0138, P0140,	P0030, P0036, P0050, P0056, P0132, P0134, P0135, P0138, P0140,	P0135, P0141, P0155, P0161

	P0060, P0135, P0141, P0155, P0161	P0141, P0152, P0154, P0155, P0158, P0160, P0161	P0141, P0152, P0154, P0155, P0158, P0160, P0161	P0141, P0152, P0154, P0155, P0158, P0160, P0161	
* Opens Fuse					

TYPICAL SCAN TOOL DATA

HO2S Sensor 1 Voltage, HO2S Sensor 2 Voltage

Circuit	Short to Ground	Open	Short to Voltage
Parameter Normal Range: 200-800 mV			
HO2S High Signal	0.00 V	Approximately 1.27 V	Approximately 1.27 V
HO2S Low Signal	0.00 V	Approximately 1.27 V	Approximately 1.27 V

CIRCUIT/SYSTEM DESCRIPTION

The heated oxygen sensors (HO2S) are used for fuel control and catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content of the exhaust stream. When the engine is started, the control module operates in an Open Loop mode, ignoring the HO2S signal voltage while calculating the air-to-fuel ratio. While the engine runs, the HO2S heats up and begins to generate a voltage within a range of 0-1,275 mV. Once sufficient HO2S voltage fluctuation is observed by the control module, Closed Loop is entered. The control module uses the HO2S voltage to determine the air-to-fuel ratio. An HO2S voltage that increases toward 1,000 mV indicates a rich fuel mixture. An HO2S voltage that decreases toward 0 mV indicates a lean fuel mixture.

The heating elements inside each HO2S heat the sensor to bring the sensor up to operating conditions faster. This allows the system to enter Closed Loop earlier and the control module to calculate the air-to-fuel ratio sooner.

CONDITIONS FOR RUNNING THE DTC

- DTCs P0036, P0037, P0038, P0137, P0138, P0140, P0141, P0443, P0458, P0459, P2232 are not set.
- The ignition voltage is between 10-32 V.
- The engine speed is between 1,225-2,100 RPM.
- The mass air flow (MAF) is between 4-13 g/s.
- The vehicle speed is between 64-125 km/h (40-78 mph).
- The fuel level is greater than 10 %.
- The fuel system is in Closed Loop.
- The predicted catalytic converter temperature is between 615-980°C (1,139-1,796°F).

- The HO2S is ON for more than 180 s.
- The DTCs run once per ignition cycle when the above conditions are met.

CONDITIONS FOR SETTING THE DTC

P2270

The ECM does not detect a HO2S voltage greater than 800 mV before accumulated mass air flow exceeds 62 grams.

P2272

The ECM does not detect a HO2S voltage greater than 800 mV before the accumulated mass air flow exceeds 62 grams.

ACTION TAKEN WHEN THE DTC SETS

DTCs P2270 and P2272 are Type B DTCs.

CONDITIONS FOR CLEARING THE DTC

DTCs P2270 and P2272 are Type B DTCs.

REFERENCE INFORMATION

Schematic Reference

Engine Controls Schematics

Connector End View Reference

Component Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Heated Oxygen Sensor 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 DTC information with a scan tool. Verify no B52 HO2S heater DTCs are set.
 - If a B52 HO2S heater DTC is set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
2. Engine running, observe the appropriate scan tool B52 HO2S voltage parameter. The reading should be within the range of 50-1,050 mV.
3. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

CIRCUIT/SYSTEM TESTING

1. Ignition OFF, disconnect the appropriate B52 HO2S harness connector.
2. Ignition ON, observe the appropriate scan tool HO2S voltage parameter. The parameter should display 1.27 V.
 - If less than the specified range, test the high and low signal circuits for a short to ground. If both signal circuit test normal, replace the K20 ECM.
3. Ignition ON, test for 2.5-3.0 V between the high signal circuit terminal B and ground.
 - If less than the specified range, test the high signal circuit for an open/high resistance. If the circuit tests normal, replace the K20 ECM.
 - If greater than the specified range, test the high signal circuit for a short to voltage. If the circuit tests normal, replace the K20 ECM.
4. Ignition OFF, connect a 3 A fused jumper wire between the high signal circuit terminal B and the low signal circuit terminal A.

NOTE: **The low signal circuit is tied to a pull-up circuit within the ECM. A voltage of 0.90-1.10 V on the low signal circuit is normal.**

5. Ignition ON, verify the scan tool HO2S parameter displays 0.0 V.
 - If greater than the specified range, test the low signal circuit for an open/high resistance or for a short to voltage. If the circuit tests normal, replace the K20 ECM.
6. If all circuits test normal, test or replace the appropriate B52 HO2S.

REPAIR PROCEDURES

CAUTION: Refer to **Heated Oxygen Sensor Resistance Learn Reset Caution** .

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

- **Heated Oxygen Sensor Replacement - Bank 1 Sensor 2 (LF1)**

- **Heated Oxygen Sensor Replacement - Bank 2 Sensor 2**
- **Control Module References** for ECM replacement, setup, and programming

DTC P2271 OR P2273 (W/LF1)

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 P2271

HO2S Signal Stuck Rich Bank 1 Sensor 2

DTC P2273

HO2S Signal Stuck Rich Bank 2 Sensor 2

DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
HO2S High Signal	P0131, P0137, P0151, P0157	P0132, P0134, P0138, P0140, P0152, P0154, P0158, P0160	P0132, P0134, P0138, P0140, P0152, P0154, P0158, P0160	P0132, P0134, P0138, P0140, P0152, P0154, P0158, P0160	P0133, P013A, P013B, P013C, P013D, P013E, P013F, P014A, P014B, P0153, P1133, P1153, P2A00, P2A03
HO2S Low Signal	P0131, P0137, P0151, P0157	P0132, P0134, P0138, P0140, P0152, P0154, P0158, P0160	P0132, P0134, P0138, P0140, P0152, P0154, P0158, P0160	P0132, P0134, P0138, P0140, P0152, P0154, P0158, P0160	P0133, P013A, P013B, P013C, P013D, P013E, P013F, P014A, P014B, P0153, P1133, P1153, P2A00, P2A03
	P0030, P0036,	P0030, P0036, P0050, P0056,	P0030, P0036, P0050, P0056,		

HO2S Heater Voltage Supply	P0050, P0056, P0132, P0135, P0138, P0141, P0152, P0155, P0158, P0161, *	P0132, P0134, P0135, P0138, P0140, P0141, P0152, P0154, P0155, P0158, P0160, P0161	P0132, P0134, P0135, P0138, P0140, P0141, P0152, P0154, P0155, P0158, P0160, P0161	P0690	P0135, P0141, P0155, P0161
HO2S Heater Control	P0030, P0036, P0050, P0053, P0054, P0056, P0059, P0060, P0135, P0141, P0155, P0161	P0030, P0036, P0050, P0056, P0132, P0134, P0135, P0138, P0140, P0141, P0152, P0154, P0155, P0158, P0160, P0161	P0030, P0036, P0050, P0056, P0132, P0134, P0135, P0138, P0140, P0141, P0152, P0154, P0155, P0158, P0160, P0161	P0030, P0036, P0050, P0056, P0132, P0134, P0135, P0138, P0140, P0141, P0152, P0154, P0155, P0158, P0160, P0161	P0135, P0141, P0155, P0161
* Opens Fuse					

TYPICAL SCAN TOOL DATA

HO2S Sensor 1 Voltage, HO2S Sensor 2 Voltage

Circuit	Short to Ground	Open	Short to Voltage
Parameter Normal Range: 200-800 mV			
HO2S High Signal	0.00 V	Approximately 1.27 V	Approximately 1.27 V
HO2S Low Signal	0.00 V	Approximately 1.27 V	Approximately 1.27 V

CIRCUIT/SYSTEM DESCRIPTION

The heated oxygen sensors (HO2S) are used for fuel control and catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content of the exhaust stream. When the engine is started, the control module operates in an Open Loop mode, ignoring the HO2S signal voltage while calculating the air-to-fuel ratio. While the engine runs, the HO2S heats up and begins to generate a voltage within a range of 0-1,275 mV. Once sufficient HO2S voltage fluctuation is observed by the control module, Closed Loop is

entered. The control module uses the HO2S voltage to determine the air-to-fuel ratio. An HO2S voltage that increases toward 1,000 mV indicates a rich fuel mixture. An HO2S voltage that decreases toward 0 mV indicates a lean fuel mixture.

The heating elements inside each HO2S heat the sensor to bring the sensor up to operating conditions faster. This allows the system to enter Closed Loop earlier and the control module to calculate the air-to-fuel ratio sooner.

CONDITIONS FOR RUNNING THE DTC

- Before the ECM can report DTC P2271, or P2273 failed, DTCs P013A, P013C, P013E, P014A, P2270, and P2272 must run and pass.
- DTCs P0036, P0037, P0038, P0137, P0138, P0140, P0141, P0443, P0458, P0459, P2232 are not set.
- The ignition voltage is between 10-32 V.
- The engine speed is between 1,225-2,100 RPM.
- The mass air flow (MAF) is between 4-13 g/s.
- The vehicle speed is between 64-125 km/h (40-78 mph).
- The fuel level is greater than 10 %.
- The fuel system is in Closed Loop.
- The predicted catalytic converter temperature is between 615-980°C (1,139-1,796°F).
- The HO2S heater is ON for more than 180 s.
- The DTCs run once per ignition cycle, during decel fuel cut-off, when the above conditions are met.

CONDITIONS FOR SETTING THE DTC

P2271

The ECM does not detect an HO2S voltage less than 100 mV before accumulated mass air flow exceeds 36 grams.

P2273

The ECM does not detect an HO2S voltage less than 100 mV before the accumulated mass air flow exceeds 36 grams.

ACTION TAKEN WHEN THE DTC SETS

DTCs P2271 or P2273 are Type B DTCs.

CONDITIONS FOR CLEARING THE DTC

DTCs P2271 or P2273 are Type B DTCs.

REFERENCE INFORMATION

Schematic Reference

Engine Controls Schematics

Connector End View Reference

Component Connector End Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs
- Heated Oxygen Sensor 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 DTC information with a scan tool. Verify no B52 HO2S heater DTCs are set.
 - If a B52 HO2S heater DTC is set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
2. Engine running, observe the appropriate scan tool B52 HO2S voltage parameter. The reading should be within the range of 50-1,050 mV.
3. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

CIRCUIT/SYSTEM TESTING

1. Ignition OFF, disconnect the appropriate B52 HO2S harness connector.
2. Ignition ON, observe the appropriate scan tool HO2S voltage parameter. The parameter should display 1.27 V.
 - If less than the specified range, test the high and low signal circuits for a short to ground. If both signal circuit test normal, replace the K20 ECM.
3. Ignition ON, test for 2.5-3.0 V between the high signal circuit terminal B and ground.
 - If less than the specified range, test the high signal circuit for an open/high resistance. If the circuit tests normal, replace the K20 ECM.

- If greater than the specified range, test the high signal circuit for a short to voltage. If the circuit tests normal, replace the K20 ECM.
- 4. Ignition OFF, connect a 3 A fused jumper wire between the high signal circuit terminal B and the low signal circuit terminal A.

NOTE: **The low signal circuit is tied to a pull-up circuit within the ECM. A voltage of 0.90-1.10 V on the low signal circuit is normal.**

- 5. Ignition ON, verify the scan tool HO2S parameter displays 0.0 V.
 - If greater than the specified range, test the low signal circuit for an open/high resistance or for a short to voltage. If the circuit tests normal, replace the K20 ECM.
- 6. If all circuits test normal, test or replace the appropriate B52 HO2S.

REPAIR PROCEDURES

CAUTION: Refer to Heated Oxygen Sensor Resistance Learn Reset Caution .

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Heated Oxygen Sensor Replacement - Bank 1 Sensor 2 (LF1)
- Heated Oxygen Sensor Replacement - Bank 2 Sensor 2
- Control Module References for ECM replacement, setup, and programming

DTC P2534

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 P2534

Ignition 1 Switch Circuit Low Voltage

DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	Open or High Resistance	Short to Voltage	Signal Performance
IGN Voltage	P2534	P2534	-	-

CIRCUIT/SYSTEM DESCRIPTION

The fuel pump 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 engine is running.

CONDITIONS FOR SETTING THE DTC

The FPCM detects that the IGN voltage is less than 6.0 V.

ACTION TAKEN WHEN THE DTC SETS

DTC P2534 is a Type A DTC.

CONDITIONS FOR CLEARING THE DTC

DTC P2534 is a Type A DTC.

REFERENCE INFORMATION

Schematic Reference

Engine Controls Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Fuel System Description (LF1)

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

1. Verify that DTC P0562 is not set.
 - If DTC P0562 is set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
2. Ignition OFF, disconnect the harness connector of the K27 fuel pump control module.
3. Ignition ON, test for greater than 11 V between the IGN voltage circuit terminal 21 and ground.
 - If less than the specified voltage, test the IGN voltage circuit for a short to ground or an open/high resistance. If the circuit tests normal and the CCM/RUN/CRK fuse is open, test the voltage circuit for a short to ground. If the circuit tests normal, test or replace the Run/Crank relay.
4. If all circuits test normal, replace the K27 fuel pump control module.

REPAIR PROCEDURES

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

- **Relay Replacement (Attached to Wire Harness)** or **Relay Replacement (Within an Electrical Center)**
- **Control Module References** for fuel pump control module replacement, setup, and programming

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 Circuit

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 its 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.

An intermittent fault in the CAN circuits will cause the ECM to set DTC P2544.

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.

REFERENCE INFORMATION

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

CIRCUIT/SYSTEM VERIFICATION

1. DTC P2544 is an informational DTC. Diagnose all other engine control DTCs prior to DTC P2544. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**.
2. If there are no other engine controls DTCs, diagnosis is accomplished by looking for an intermittent CAN circuit fault. Refer to **Scan Tool Does Not Communicate with High Speed GMLAN Device**.

REPAIR PROCEDURES

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

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

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

DIAGNOSTIC FAULT INFORMATION

Circuit	Short to Ground	Open or High Resistance	Short to Voltage	Signal Performance
Control	P0231	P023F	P0232	P023F, P2635
Low Reference	-	P023F	-	P023F, P2635

CIRCUIT/SYSTEM DESCRIPTION

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

CONDITIONS FOR RUNNING THE DTC

- DTC P018B, P018C, P018D, P0231, P0232, P023F, P064A, P1255 or P06A6 are not active.
- DTC P0641 has not failed this ignition cycle.
- Fuel pump control is enabled and the fuel pump control state is normal.
- The system voltage is greater than 11 V.
- The engine has been running for more than 30 seconds.

CONDITIONS FOR SETTING THE DTC

This DTC sets when the fuel pump control module detects a predetermined fuel pressure performance degradation between the desired fuel rail pressure and the current estimated fuel rail pressure.

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.

REFERENCE INFORMATION

Schematic Reference

Engine Controls Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Fuel System Description (LF1)

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

1. Verify that DTCs P018C, P018D, P0231, P0232, or P023F are not set.
 - If the DTC is set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
2. Ignition OFF, disconnect the harness connector at the G12 fuel pump.
3. Ignition ON, test for less than 5.0 ohms between the G12 fuel pump low reference circuit terminal 2 and ground.
 - If greater than the specified range, test the G12 fuel pump low reference circuit for a high

resistance. If the circuit tests normal, replace the K27 fuel pump control module.

4. Ignition OFF, install a test lamp between the control circuit terminal 1 and the low reference circuit terminal 2.
5. Ignition ON, command the Fuel Pump Relay ON and OFF with a scan tool. The test lamp should turn ON and OFF when changing between the commanded states.
 - If the test lamp is always ON, test the control circuit for a short to voltage. If the circuit tests normal, replace the K27 fuel pump control module.
 - If the test lamp is always OFF, test the control circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the K27 fuel pump control module.
6. Perform the **Fuel System Diagnosis** to verify proper fuel pressure.
 - If the fuel pressure is not normal, replace the G12 fuel pump
7. If all circuits test normal, replace the K27 fuel pump control module.

REPAIR PROCEDURES

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

- **Fuel Tank Fuel Pump Module Replacement**
- **Control Module References** for fuel pump control module replacement, setup, and programming