

## 2017 ENGINE PERFORMANCE

### Engine Controls and Fuel - 1.4L (LE2) - Diagnostic Information and Procedures - Encore

## DIAGNOSTIC INFORMATION AND PROCEDURES

### DTC P0325, P0327, OR P0328: KNOCK SENSOR CIRCUIT

#### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

#### DTC Descriptors

#### DTC P0325

Knock Sensor Circuit

#### DTC P0327

Knock Sensor Circuit Low Voltage

#### DTC P0328

Knock Sensor Circuit High Voltage

#### Diagnostic Fault Information

| Circuit                   | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|---------------------------|-----------------|----------------------|------------------|--------------------|
| High Signal               | P0327, P06B6    | P0325                | P0328            | P0324*, P0326**    |
| Low Signal                | P0327           | P0325                | P0328            | P0324*, P0326**    |
| * Signal Performance High |                 |                      |                  |                    |
| ** Signal Performance Low |                 |                      |                  |                    |

#### Circuit/System Description

The knock sensor enables the engine control module (ECM) to control the ignition timing for the best possible performance while protecting the engine from potentially damaging levels of detonation. The knock sensor produces an alternating current (AC) voltage signal that varies depending on the vibration level during engine operation. The ECM adjusts the spark timing based on the amplitude and the frequency of the knock sensor signal. The ECM learns a minimum knock sensor noise level for all of the engine speed ranges and monitors the normal knock sensor signal. The ECM monitors the internal knock sensor processor test circuits which perform the open circuit diagnostic.

#### Conditions for Running the DTCs

#### P0325

- Engine is running for 2 s or greater.
- Engine speed is between 400-5,500 RPM for 75 or more cumulative revolutions.
- Engine air flow is between 20-2000 mg per cylinder.
- The engine coolant temperature (ECT) is -40Â°C (-40Â°F) or warmer.
- The intake air temperature (IAT) sensor 1 is -40Â°C (-40Â°F) or warmer.

#### P0327 or P0328

Engine speed is less than 8,500 RPM.

The DTCs run continuously when the above conditions are met.

### Conditions for Setting the DTCs

#### P0325

The ECM detects that a knock sensor signal circuit is open.

#### P0327

The ECM detects that the knock sensor low signal circuit is out of the calibrated range.

#### P0328

The ECM detects that the knock sensor high signal circuit is out of the calibrated range.

### Action Taken When the DTCs Set

- DTCs P0325, P0327 and P0328 are Type A DTCs.
- The ignition timing is retarded to reduce the potential of engine damaging spark knock.

### Conditions for Clearing the DTCs

DTCs P0325, P0327 and P0328 are Type A DTCs.

### Diagnostic Aids

The following conditions listed below may cause a knock sensor DTC to set:

- Sensor damage.
- Knock sensor and engine mounting surface burrs, casting flash, and foreign material.
- Close proximity of hoses, brackets, and engine wiring.
- Loose brackets.
- Loose or broken accessory drive belts, brackets, components.
- An engine mechanical condition. Refer to [Symptoms - Engine Mechanical](#).

### Reference Information

Schematic Reference

#### [Engine Controls Schematics \(Buick with LE2\)](#)

Connector End View Reference

#### [COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#)

Description and Operation

#### [Electronic Ignition System Description](#)

Electrical Information Reference

- [Testing for Intermittent Conditions and Poor Connections](#)
- [Circuit Testing](#)
- [Wiring Repairs](#)
- [Connector Repairs](#)

DTC Type Reference

#### [Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

**Control Module References** for scan tool information

**Circuit/System Verification**

1. Engine Running
2. Verify DTC P0325, P0327 or P0328 is not set.
  - **If the DTC is set**  
  
Refer to Circuit/System Testing.
  - **If the DTC is not set**
3. Verify the B68 Knock Sensor mounting bolt is properly tightened. Refer to **Fastener Specifications**.
  - **If not tightened to the correct specification**  
  
Repair as necessary.
  - **If tightened to the correct specification**
4. Verify the scan tool parameters listed below display No while moving the related harnesses and connectors of the B68 Knock Sensor.
  - Cylinder 1 Knock Detected
  - Cylinder 2 Knock Detected
  - Cylinder 3 Knock Detected
  - Cylinder 4 Knock Detected
  - **If No is not displayed**  
  
Repair the wiring harness or connectors.
  - **If No is displayed**
5. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
6. Verify the DTC does not set.
  - **If the DTC sets**  
  
Refer to Circuit/System Testing.
  - **If the DTC does not set**
7. All OK.

**Circuit/System Testing**

1. Ignition OFF, disconnect the harness connector at the B68 Knock Sensor, ignition ON.
2. Test for 1-2 V between the low signal circuit terminal 2 and ground.
  - **If less than 1 V**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the low signal circuit terminal 2 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance.
    3. Test for less than 2  $\Omega$  in the low signal circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K20 Engine Control Module.
  - **If greater than 2 V**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the low signal circuit and ground.
  - If 1 V or greater, repair the short to voltage on the circuit.
  - If less than 1 V, replace the K20 Engine Control Module.
  - **If between 1-2 V**
3. Test for 2-4 V between the high signal circuit terminal 1 and ground.
  - **If less than 2 V**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the high signal circuit terminal 1 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance.
    3. Test for less than 2  $\Omega$  in the high signal circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K20 Engine Control Module.
  - **If greater than 4 V**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the high signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K20 Engine Control Module.
  - **If between 2-4 V**
4. Test or replace the B68 Knock Sensor.

### Repair Instructions

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

- Refer to [Knock Sensor Replacement](#)
- Refer to [Control Module References](#) for engine control module replacement, programming, and setup.

## DTC P0335 OR P0336: CRANKSHAFT POSITION SENSOR

### Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptors

#### DTC P0335

Crankshaft Position Sensor Circuit

#### DTC P0336

Crankshaft Position Sensor Performance

### Diagnostic Fault Information

| Circuit       | Short to Ground                   | Open/High Resistance | Short to Voltage    | Signal Performance |
|---------------|-----------------------------------|----------------------|---------------------|--------------------|
| 5 V Reference | P0335, P0557, P057C, P0651, P118C | P0335                | P0558, P0651, P118C | P0336              |
| Signal        | P0335, P0506                      | P0335, P0506         | P0335               | P0336              |
| Low Reference | -                                 | P0335, P0506         | -                   | P0336              |

## Circuit/System Description

The crankshaft position sensor circuits consist of an engine control module (ECM) supplied 5 V reference circuit, low reference circuit, and an output signal circuit. The crankshaft position sensor is a magnetic biased digital output integrated circuit sensing device. The sensor detects magnetic flux changes of invisible magnetic segments on the edge of the crankshaft position reluctor ring mounted on the crankshaft. Each magnetic segment on the ring is spaced at a 60 segment spacing with 2 missing spaces for a reference gap. The crankshaft position sensor produces an ON/OFF DC voltage of varying frequency with 58 output pulses per crankshaft revolution. The frequency of the crankshaft position sensor output depends on the velocity of the crankshaft. The crankshaft position sensor sends a digital signal which represents an image of the crankshaft position reluctor ring to the ECM as each segment on the ring rotates past the crankshaft position sensor. The ECM uses each crankshaft position signal pulse to determine crankshaft speed and decodes the crankshaft position reluctor ring reference gap to identify crankshaft position. This information is then used to determine the optimum ignition and injection points of the engine. The ECM also uses crankshaft position sensor output information to determine the camshaft relative position to the crankshaft to control camshaft phasing and to detect cylinder misfire.

## Conditions for Running the DTC

### P0335 Condition 1

- DTCs P0101, P0102 and P0103 are not set.

OR

- The starter is engaged and the engine control module detects camshaft position sensor pulses.

AND

- The airflow into the engine is greater than 1.5 g/s.

### Condition 2

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

### Condition 3

- DTCs P0365 or P0366 are not set.
- The engine is running or the starter is engaged.

### P0336 Condition 1

- DTCs P0335 is not set.
- The airflow into the engine is greater than 1.5 g/s.
- Engine speed is greater than 450 RPM.

### Condition 2

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

### Condition 3

- DTCs P0101, P0102, and P0103 are not set.
- The airflow into the engine is greater than 1.5 g/s.

OR

- The starter is engaged and the engine control module detects camshaft position sensor pulses.

### Condition 4

- DTCs P0365 or P0366 are not set.
- The engine is running or the starter is engaged.

The DTCs run continuously once the above conditions are met.

### Conditions for Setting the DTC

#### P0335 Condition 1

The ECM does not detect a crankshaft position sensor pulse for greater than 4 s.

#### Condition 2

The ECM does not detect a crankshaft position sensor pulse for greater than 0.3 s.

#### Condition 3

The ECM does not detect a crankshaft position sensor pulse for 2 out of 10 engine revolutions.

#### P0336 Condition 1

The ECM detects that 10 or more crankshaft resynchronizations have occurred within 10 s.

#### Condition 2

The ECM does not detect the synchronization gap on the reluctor ring for greater than 0.4 s.

#### Condition 3

The ECM does not detect the synchronization gap on the reluctor ring for 1.5 s after the starter was engaged.

#### Condition 4

The ECM detects less than 51 or greater than 65 crankshaft position sensor pulses during 1 engine revolution for 8 out of 10 engine revolutions.

### Action Taken When the DTC Sets

- DTCs P0335 and P0336 are Type B DTCs.
- The camshaft position sensor is used to determine engine position.
- The camshaft actuators are commanded to the parked position, if applicable.

### Conditions for Clearing the DTC

DTCs P0335 and P0336 are Type B DTCs.

### Reference Information

Schematic Reference

### Engine Controls Schematics (Buick with LE2)

Connector End View Reference

### COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)

Description and Operation

### Electronic Ignition System Description

Electrical Information Reference

- Circuit Testing

- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

### [Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

### Circuit/System Verification

1. Ignition ON.
2. Verify DTC P0651 is not set.
  - **If the DTC is set**  
Refer to [DTC P0641, P0651, P0697, P06A3, or P06D2](#).
  - **If the DTC is not set**
3. Engine Running.
4. Verify the scan tool Crankshaft Position Active Counter parameter increments.
  - **If the counter does not increment**  
Refer to Circuit/System Testing.
  - **If the counter increments**
5. Verify the scan tool Crankshaft Position Resync Counter parameter displays 0 counts and the engine does not stumble or stall while moving the related harness/connectors of the B26 Crankshaft Position Sensor.
  - **If greater than 0 counts and the engine stumbles or stalls**  
Refer to Circuit/System Testing.
  - **If 0 counts and the engine does not stumble or stall**
6. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
7. Verify the DTC does not set.
  - **If the DTC sets**  
Refer to Circuit/System Testing.
  - **If the DTC does not set**
8. All OK.

### Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B26 Crankshaft Position Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5  $\Omega$  between the low reference circuit terminal 2 and ground.
  - **If 5  $\Omega$  or greater**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for less than 2  $\Omega$  in the low reference circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If 2  $\Omega$  or less, replace the K20 Engine Control Module.
  - **If less than 5  $\Omega$**
3. Ignition ON.

4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 1 and ground.

- **If less than 4.8 V**

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

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

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

3. Test for less than 2  $\Omega$  in the 5 V reference circuit end to end.

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

- **If greater than 5.2 V**

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

2. Test for less than 1 V between the 5 V reference and ground.

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

- **If between 4.8-5.2 V**

5. Test for 4.8-5.2 V between the signal circuit terminal 3 and ground.

- **If less than 4.8 V**

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

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

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

3. Test for less than 2  $\Omega$  in the signal circuit end to end.

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

- **If greater than 5.2 V**

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

2. Test for less than 1 V between the signal circuit and ground.

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

- **If between 4.8-5.2 V**

6. Ignition OFF, connect a 3 A fused jumper wire to the signal circuit terminal 3, ignition ON.

**NOTE:** Additional DTCs may set when performing this test.

7. Verify the scan tool Crankshaft Position Active Counter parameter increments while rapidly tapping the fused jumper wire end to ground.

- **If the counter does not increment**

Replace the K20 Engine Control Module.

- **If the counter increments**

8. Verify DTC P0336 is not set.

- **If the DTC is set**

**NOTE:** The crankshaft position reluctor ring is magnetic and may be functionally damaged if any magnetic object comes in contact with it. This type of damage is not visually detectable but will set the DTC.

1. Inspect for the conditions listed below:

- Excessive play or looseness of the B26 Crankshaft Position Sensor or the crankshaft position reluctor ring
- Improper installation of the B26 Crankshaft Position Sensor
- Foreign material passing between the B26 Crankshaft Position Sensor and the crankshaft position reluctor ring
- Damaged crankshaft position reluctor ring
- Excessive air gap between the B26 Crankshaft Position Sensor and the crankshaft position reluctor ring
- Timing chain or belt, tensioner, and sprockets for wear or damage
- If a condition is found

Repair or replace as necessary.

- If a condition is not found
2. Replace the B26 Crankshaft Position Sensor.
  3. Clear the DTC and test drive the vehicle.
  4. Verify the DTC is not set.
    - If the DTC is set, replace the crankshaft position reluctor ring.
    - If the DTC is not set, all OK.
- **If the DTC is not set**
9. Test or replace the B26 Crankshaft Position Sensor.

### Repair Instructions

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

- Refer to [Crankshaft Position Sensor Replacement \(AWD\)](#), [Crankshaft Position Sensor Replacement \(FWD\)](#).
- Refer to [Control Module References](#) for engine control module replacement, programming, and setup

## DTC P0340, P0341, P0365, OR P0366: INTAKE/EXHAUST CAMSHAFT POSITION SENSOR

### Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptors

#### DTC P0340

Intake Camshaft Position Sensor Circuit

#### DTC P0341

Intake Camshaft Position Sensor Performance

#### DTC P0365

Exhaust Camshaft Position Sensor Circuit

#### DTC P0366

Exhaust Camshaft Position Sensor Performance

### Diagnostic Fault Information

|  |  |
|--|--|
|  |  |
|--|--|

| Circuit       | Short to Ground                                        | Open/High Resistance | Short to Voltage                         | Signal Performance |
|---------------|--------------------------------------------------------|----------------------|------------------------------------------|--------------------|
| 5 V Reference | P018C, P0192, P0452, P0522, P0532, P0641, P2227, P2228 | P0340, P0365         | P018D, P0193, P0453, P0523, P0641, P2227 | -                  |
| Signal        | P0340, P0365                                           | P0340, P0365         | P0340, P0365                             | P0341, P0366       |
| Low Reference | -                                                      | P0340, P0365         | P0340, P0365                             | -                  |

### Circuit/System Description

The camshaft position sensors each have 3 circuits consisting of an engine control module (ECM) supplied 5 V reference circuit, low reference circuit, and an output signal circuit. The camshaft position sensor is an internally magnetic biased digital output integrated circuit sensing device. The sensor detects magnetic flux changes of the teeth and slots of a 4-tooth reluctor wheel attached to the camshaft. As each reluctor wheel tooth rotates past the camshaft position sensor, the resulting change in the magnetic field is used by the sensor electronics to produce a digital output pulse. The sensor returns a digital ON/OFF DC voltage pulse of varying frequency with 4 varying width output pulses per camshaft revolution that represent an image of the camshaft reluctor wheel. The frequency of the camshaft position sensor output depends on the velocity of the camshaft. The ECM decodes the narrow and wide tooth pattern to identify camshaft position. This information is then used to determine the optimum ignition and injection points of the engine. The ECM uses the cylinder 1 exhaust camshaft position sensor to determine injector and ignition system synchronization. The intake and exhaust camshaft position sensors are also used to determine camshaft to crankshaft relationship. The ECM also uses camshaft position sensor output information to determine the camshaft relative position to the crankshaft to control camshaft phasing and limp-home operation.

### Conditions for Running the DTC

#### P0340 or P0365 Condition 1

- DTCs P0101, P0102, and P0103 are not set.
- The airflow into the engine is greater than 1.5 g/s.

OR

- The starter is engaged and the engine control module detects camshaft position sensor pulses.

#### Condition 2

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

#### Condition 3

- DTC P0335, P0336, P0641, or P0651 are not set.
- The crankshaft is synchronized.
- The starter is engaged.

#### Condition 4

- DTC P0335, P0336, P0641, or P0651 are not set.
- The crankshaft is synchronized.

#### P0341 or P0366 Condition 1

- DTC P0335, P0336, P0641, or P0651 are not set.
- The crankshaft is synchronized.
- The starter is engaged.

#### Condition 2

- DTC P0335, P0336, P0641, or P0651 are not set.
- The crankshaft is synchronized.

The DTCs run continuously once the above conditions are met.

### Conditions for Setting the DTC

#### P0340 or P0365 Condition 1

- The ECM does not detect a camshaft position sensor pulse for greater than 5.5 s.
- OR
- The ECM does not detect a camshaft position sensor pulse for greater than 4 s since the time the starter has been engaged.

#### Condition 2

The ECM detects less than 4 camshaft position sensor pulse for greater than 3 s.

#### Condition 3

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

#### Condition 4

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

#### P0341 or P0366 Condition 1

- The ECM detects less than 4 camshaft position sensor pulses during 2 engine revolutions.
- OR
- The ECM detects greater than 6 camshaft position sensor pulses during 2 engine revolutions.

#### Condition 2

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

### Action Taken When the DTC Sets

- DTCs P0340, P0341, P0365, and P0366 are Type B DTCs.
- The camshaft position actuator is commanded to the Home or Parked position.
- The ignition system defaults to a failed camshaft position sensor limp home mode.

### Conditions for Clearing the MIL/DTC

DTCs P0340, P0341, P0365, and P0366 are Type B DTCs.

### Diagnostic Aids

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

### Reference Information

Schematic Reference

### Engine Controls Schematics (Buick with LE2)

## COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)

Description and Operation

### Electronic Ignition System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

### Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

### Circuit/System Verification

1. Ignition ON.
2. Verify DTC P0641 or P0651 is not set.
  - **If any of the DTCs are set**  
  
Refer to [DTC P0641, P0651, P0697, P06A3, or P06D2](#).
  - **If none of the DTCs are set**
3. Engine Running.
4. Verify the scan tool parameters listed below increment:
  - Exhaust Camshaft Position Active Counter
  - Intake Camshaft Position Active Counter
  - **If any counter does not increment**  
  
Refer to Circuit/System Testing.
  - **If all counters increment**
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
6. Verify the DTC does not set.
  - **If the DTC sets**  
  
Refer to Circuit/System Testing.
  - **If the DTC does not set**
7. All OK.

### Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate B23 Camshaft Position Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5  $\Omega$  between the low reference circuit terminal 2 and ground.
  - **If 5  $\Omega$  or greater**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for less than 2  $\Omega$  in the low reference circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If 2  $\Omega$  or less, replace the K20 Engine Control Module.
  - **If less than 5  $\Omega$**
3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 1 and ground.
- **If less than 4.8 V**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the 5 V reference circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance.
    3. Test for less than 2  $\Omega$  in the 5 V reference circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K20 Engine Control Module.
  - **If greater than 5.2 V**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the 5 V reference circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K20 Engine Control Module.
  - **If between 4.8-5.2 V**
5. Test for 4.8-5.2 V between the signal circuit terminal 3 and ground.
- **If less than 4.8 V**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance.
    3. Test for less than 2  $\Omega$  in the signal circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K20 Engine Control Module.
  - **If greater than 5.2 V**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K20 Engine Control Module.
  - **If between 4.8-5.2 V**
6. Verify DTC P0341 or P0366 is not set.
- **If any of the DTCs are set**

Inspect for the conditions listed below:

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

- If none of the DTCs are set

7. Test or replace the B23 Camshaft Position Sensor.

### Repair Instructions

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

- Refer to [Camshaft Position Sensor Replacement - Exhaust](#)
- Refer to [Camshaft Position Sensor Replacement - Intake](#)
- Refer to [Control Module References](#) for engine control module replacement, programming, and setup

## **DTC P034A OR P034B: CRANKSHAFT POSITION SENSOR - ENGINE START POSITION INCORRECT/CRANKSHAFT DIRECTION INCORRECT**

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptors

#### **DTC P034A**

Crankshaft Position Sensor - Engine Start Position Incorrect

#### **DTC P034B**

Crankshaft Position Sensor - Crankshaft Direction Incorrect

### Circuit/System Description

These DTCs are used to verify that the crankshaft position has been detected correctly and to monitor the number of crankshaft reversals detected from the bi-directional crankshaft position sensor during an auto-start event.

### Conditions for Running the DTC

#### **P034A**

- DTC P0335, P0336, or P0651 is not set.
- The engine has started rotating during an auto-start event.
- The crankshaft position is being verified.

The DTC runs each time the engine is started once the above conditions are met.

#### **P034B**

- DTC P0335, P0336, or P0651 is not set.
- Engine speed is between 400-2000 RPM.
- The airflow into the engine is greater than 1.5 g/s.
- The engine control module (ECM) detects crankshaft position sensor pulses.

The DTCs run continuously once the above conditions are met.

### Conditions for Setting the DTC

#### **P034A**

- The crankshaft position is incorrect by greater than 2 crankshaft reluctor wheel teeth during 2 out of 3 auto-start events.

- The crankshaft position is incorrect by at least 1 crankshaft reluctor wheel tooth during 4 out of 5 auto-start events.

## P034B

The crankshaft position sensor detects 3 or more engine rotation reversals within 10 s or less.

### Action Taken When the DTC Sets

DTC P034A and P034B are Type B DTCs.

### Conditions for Clearing the DTC

DTC P034A and P034B are Type B DTCs.

### Diagnostic Aids

These DTCs do not necessarily indicate there is a condition with the crankshaft position sensor or the engine control module (ECM).

### Reference Information

DTC Type Reference

### Powertrain Diagnostic Trouble Code (DTC) Type Definitions

#### Circuit/System Verification

1. Ignition ON.
2. Verify DTC P0335, P0336, or P0651 is not set.
  - **If any of the DTCs are set**  
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).
  - **If none of the DTCs are set**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
  - **If the DTC sets**  
Replace the B26 Crankshaft Position Sensor.
  - **If the DTC does not set**
5. All OK.

#### Repair Instructions

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

Refer to [Crankshaft Position Sensor Replacement \(AWD\)](#), [Crankshaft Position Sensor Replacement \(FWD\)](#).

## **DTC P0351-P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, OR P2310: IGNITION COIL CONTROL CIRCUITS**

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptors

**DTC P0351**

Ignition Coil 1 Control Circuit

**DTC P0352**

Ignition Coil 2 Control Circuit

**DTC P0353**

Ignition Coil 3 Control Circuit

**DTC P0354**

Ignition Coil 4 Control Circuit

**DTC P2300**

Ignition Coil 1 Control Circuit Low Voltage

**DTC P2301**

Ignition Coil 1 Control Circuit High Voltage

**DTC P2303**

Ignition Coil 2 Control Circuit Low Voltage

**DTC P2304**

Ignition Coil 2 Control Circuit High Voltage

**DTC P2306**

Ignition Coil 3 Control Circuit Low Voltage

**DTC P2307**

Ignition Coil 3 Control Circuit High Voltage

**DTC P2309**

Ignition Coil 4 Control Circuit Low Voltage

**DTC P2310**

Ignition Coil 4 Control Circuit High Voltage

**Diagnostic Fault Information**

| Circuit                                     | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|---------------------------------------------|-----------------|----------------------|------------------|--------------------|
| Ignition Coil 1 Control                     | P0300, P2300    | P0300, P0351         | P0300, P2301     | P0300, P0351       |
| Ignition Coil 2 Control                     | P0300, P2303    | P0300, P0352         | P0300, P2304     | P0300, P0352       |
| Ignition Coil 3 Control                     | P0300, P2306    | P0300, P0353         | P0300, P2307     | P0300, P0353       |
| Ignition Coil 4 Control                     | P0300, P2309    | P0300, P0354         | P0300, P2310     | P0300, P0354       |
| Ground - Terminal 1/A @ T8A Ignition Coil 1 | -               | P0300, P0351         | -                | P0300              |
| Ground - Terminal 1/A @ T8B Ignition Coil 2 | -               | P0300, P0352         | -                | P0300              |
| Ground - Terminal 1/A @ T8C Ignition Coil 3 | -               | P0300, P0353         | -                | P0300              |

| Circuit                                     | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|---------------------------------------------|-----------------|----------------------|------------------|--------------------|
| Ground - Terminal 1/A @ T8D Ignition Coil 4 | -               | P0300, P0354         | -                | P0300              |

### Circuit/System Description

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

### Conditions for Running the DTC

- The engine is cranking or running.
- Ignition voltage greater than 11 V.

The DTCs run continuously when the above conditions are met.

### Conditions for Setting the DTC

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

### Action Taken When the DTC Sets

DTCs P0351, P0352, P0353, P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, and P2310 are Type B DTCs.

### Conditions for Clearing the MIL/DTC

DTCs P0351, P0352, P0353, P0354, P2300, P2301, P2303, P2304, P2306, P2307, P2309, and P2310 are Type B DTCs.

### Reference Information

Schematic Reference

### Engine Controls Schematics (Buick with LE2)

Connector End View Reference

### COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)

Description and Operation

### Electronic Ignition System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

### Powertrain Diagnostic Trouble Code (DTC) Type Definitions

[Control Module References](#) for scan tool information

## Special Tools

### EL 26792 HEI Spark Tester

For equivalent regional tools, refer to [Special Tools \(Mechanical Tools\)](#).

## Circuit/System Verification

1. Engine Running.
2. Verify the scan tool parameters listed below do not display Malfunction:
  - Ignition Coil 1-4 Control Circuit High Voltage Test Status
  - Ignition Coil 1-4 Control Circuit Low Voltage Test Status
  - Ignition Coil 1-4 Control Circuit Open Test Status
  - **If Malfunction is displayed**  
  
Refer to Circuit/System Testing.
  - **If Malfunction is not displayed**
3. Operate the vehicle within the Conditions for Running the DTCs. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
  - **If the DTC sets**  
  
Refer to Circuit/System Testing.
  - **If the DTC does not set**
5. All OK.

## Circuit/System Testing

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

1. Ignition/Vehicle & All vehicle systems Off
2. Disconnect the appropriate electrical connector: T8 Ignition Coil
3. Test for less than 10  $\Omega$  between the test points: Ground circuit terminal 1/A & Ground
  - **If 10  $\Omega$  or greater**
    1. Disconnect the ground connection: Ground terminal
    2. Test for less than 2  $\Omega$  between the test points: Ground circuit terminal 1/A @ Component harness & The other end of the circuit
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , repair the open/high resistance in the ground connection.
  - **If less than 10  $\Omega$**
4. Engine Running
5. Verify the appropriate scan tool Ignition Coil Control Circuit Low Voltage Test Status does not display Malfunction.
  - **If Malfunction is displayed**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the control circuit.
      - If infinite resistance, replace the K20 Engine Control Module.

- **If Malfunction is not displayed**

6. Verify the appropriate scan tool Ignition Coil Control Circuit High Voltage Test Status does not display Malfunction.

- **If Malfunction is displayed**

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

- **If Malfunction is not displayed**

7. Ignition OFF, install a 10 A fused jumper wire between the control circuit terminal 3 or C and ground, engine Running.

8. Verify the appropriate scan tool Ignition Coil Control Circuit Low Voltage Test Status displays Malfunction.

- **If Malfunction is not displayed**

1. Ignition OFF, remove the fused jumper, and disconnect the harness connector at the K20 Engine Control Module.
2. Test for less than 2  $\Omega$  in the control circuit end to end.
  - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than 2  $\Omega$ , replace the K20 Engine Control Module.

- **If Malfunction is displayed**

9. Test or replace the T8 Ignition Coil.

### Component Test

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

1. Ignition OFF, connect the EL 26792 HEI spark tester to the appropriate T8 Ignition Coil.
2. Engine Running.
3. Verify the spark output of the T8 Ignition Coil.

- **If no output or the output is weak**

Replace the T8 Ignition Coil.

- **If the output is normal**

4. All OK.

### Repair Instructions

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

- Refer to [Ignition Coil Replacement](#)
- Refer to [Control Module References](#) for engine control module replacement, programming, and setup

## DTC P0420: CATALYST SYSTEM LOW EFFICIENCY

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptor

#### DTC P0420

### Circuit/System Description

A 3-way catalyst controls emissions of hydrocarbons, carbon monoxide (CO) and nitrogen oxide (NO<sub>x</sub>). The catalyst within the converter promotes a chemical reaction, which oxidizes the hydrocarbons and the CO that are present in the exhaust gas. This process converts the hydrocarbons and the CO into water vapor and carbon dioxide (CO<sub>2</sub>), and reduces the NO<sub>x</sub>, converting the NO<sub>x</sub> into nitrogen. The catalyst also stores oxygen. The engine control module (ECM) monitors this process by using heated oxygen sensors (HO<sub>2</sub>S) that are in the exhaust stream before and after the 3- way catalyst. The HO<sub>2</sub>S produces an output signal that the ECM uses to calculate the oxygen storage capacity of the catalyst. This indicates the ability of the catalyst to convert the exhaust emissions efficiently. The ECM monitors the efficiency of the catalyst by monitoring the HO<sub>2</sub>S during an off-idle, decel fuel cut off (DFCO) event. When the catalyst is functioning properly, the post catalyst HO<sub>2</sub>S response to the fuel conditions during the DFCO event is slow compared to the response of the pre catalyst HO<sub>2</sub>S. When the post HO<sub>2</sub>S response is near that of the pre HO<sub>2</sub>S, the oxygen storage capability and efficiency of the catalyst may be degraded below an acceptable threshold.

### Conditions for Running the DTC

- DTC P0030, P0031, P0032, P0036, P0037, P0038, P0053, P0054, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0117, P0118, P0119, P0121, P0122, P0123, P0128, P0131, P0132, P0133, P0135, P0137, P0138, P0141, P0171, P0172, P0201, P0202, P0203, P0204, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0300, P0301, P0302, P0303, P0304, P16F3, P2101, P2135, P2270, or P2271 is not set.
- Ignition voltage is between 10-32 V.
- HO<sub>2</sub>S heater resistance is learned.
- Accelerator pedal position is no more than 3%.
- Mass air flow (MAF) is between 2-20 g/s.
- Fuel level is greater than 10%.
- Fuel system is in closed loop.
- Evaporative emissions (EVAP) diagnostics are not in control of purge.
- Predicted catalyst temperature is between 550-910Â°C (1,022-1,670Â°F).
- HO<sub>2</sub>S heater is commanded On for greater than 60 s.
- Engine speed is between 1,900-3,500 RPM to initially enable the test.
- Engine speed is between 1,850-3,650 RPM to keep the test enabled.
- Vehicle speed is between 66-125 km/h (41-78 mph) to initially enable the test.
- Vehicle speed is between 58-128 km/h (36-80 mph) to keep the test enabled.
- Engine is operating in decel fuel cut off (DFCO).

This diagnostic attempts one test during each valid decel fuel cut off period once the above conditions have been met. This diagnostic attempts up to 3 tests during each drive cycle.

### Conditions for Setting the DTC

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

### Action Taken When The DTC Sets

DTC P0420 is a Type A DTC.

### Conditions for Clearing the MIL/DTC

DTC P0420 is a Type A DTC.

### Diagnostic Aids

Inspect for the conditions listed below, which may cause a catalyst to degrade:

- Engine misfire

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

## Reference Information

### Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)
- [Heated Oxygen Sensor Wiring Repairs](#)

### DTC Types Reference

### [Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

### Scan Tool Reference

### [Control Module References](#) for scan tool information

### Circuit/System Verification

1. Ignition On.
2. Verify there are no other DTCs set.
  - **If other DTCs are set**  
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
  - **If no other DTCs are set**
3. Operate the vehicle within the Conditions for Running the DTC.
4. Verify the scan tool Catalyst Monitor Not At Idle Test Conditions Met parameter changes to Yes.
  - **If Yes is not displayed**  
Refer to step 3.
  - **If Yes is displayed**
5. When the conditions are safe, stop and idle the vehicle in gear if equipped with automatic transmission or neutral if equipped with manual transmission.
6. Verify the Catalyst Monitor Test Result parameter displays Passed when performing the steps listed below:
  1. Apply the service brake.
  2. Monitor the scan tool Catalyst Monitor Test State parameter. When the parameter indicates Active, the Catalyst Monitor Test is running.

#### **NOTE:**

**When the test has completed, the Catalyst Monitor Test Counter parameter will increment by one and the Catalyst Monitor Test Result parameter will indicate Passed, Failed or No Result.**

3. Continue to monitor the parameter. When the parameter indicates Inactive, the Catalyst Monitor Test has completed.
  - **If No Result is displayed**

Repeat steps 3-6 until the Test Result parameter indicates Passed or Failed

- **If Failed is displayed**

Refer to Circuit/System Testing

- **If Passed is displayed**

7. All OK.

### Circuit/System Testing

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

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

- **If a condition is found**

Replace the catalytic converter.

- **If no condition is found**

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

- Leaks
- Physical damage
- Loose or missing hardware

- **If a condition is found**

Repair or replace the component as necessary.

- **If no condition is found**

3. Verify the conditions listed below do not exist with the B52B Heated Oxygen Sensor 2:

- Incorrect torque
- Damage

- **If a condition is found**

Replace the B52B Heated Oxygen Sensor 2 or repair the condition as necessary.

- **If no condition is found**

4. Replace the catalytic converter.

### Repair Instructions

- Refer to [Catalytic Converter Replacement \(LE2\)](#)
- Refer to [Exhaust Leakage](#)
- Refer to [Heated Oxygen Sensor Replacement - Sensor 2](#)
- Perform the HO2S Heater Learn procedure with a scan tool after replacing a heated oxygen sensor.
- Refer to [Restricted Exhaust](#)

### Repair Verification

1. Install any components that have been removed or replaced during diagnosis.
2. Perform any adjustments, programming or setup procedures that are required when a component is removed or replaced.
3. Clear the DTCs with a scan tool.
4. Turn Off the ignition for 60 s

5. Operate the vehicle within the Conditions for Running the DTC.

6. Verify the scan tool Catalyst Monitor Not At Idle Test Conditions Met parameter changes to Yes.

- **If Yes is not displayed**

Refer to step 5.

- **If Yes is displayed**

7. When the conditions are safe, stop and idle the vehicle in gear if equipped with automatic transmission or neutral if equipped with manual transmission.

8. Verify the Catalyst Monitor Test Result parameter displays Passed when performing the steps listed below:

1. Apply the service brake.

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

**NOTE:**

**When the test has completed, the Catalyst Monitor Test Counter parameter will increment by one and the Catalyst Monitor Test Result parameter will indicate Passed, Failed or No Result.**

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

- **If No Result is displayed**

Repeat steps 5-8 until the Test Result parameter indicates Passed or Failed

- **If Failed is displayed**

Refer to Circuit /System Testing

- **If Passed is displayed**

9. All OK.

## **DTC P0442: EVAPORATIVE EMISSION (EVAP) SYSTEM SMALL LEAK DETECTED**

### **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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### **DTC Descriptor**

#### **DTC P0442**

Evaporative Emission (EVAP) System Small Leak Detected

### **Circuit/System Description**

The engine off natural vacuum (EONV) test is the small leak detection diagnostic for the evaporative emission (EVAP) system. This diagnostic tests the EVAP system for a small leak when the key is turned OFF and the correct conditions are met. Heat from the exhaust system is transferred into the fuel tank while the vehicle is operating. When the vehicle is turned OFF and the EVAP system is sealed a change in the fuel tank vapor temperature occurs which results in a corresponding pressure change in the fuel tank vapor space. This change is monitored by the engine control module (ECM) using the fuel tank pressure sensor input. With a leak in the system, the amount of pressure change will be less than that of a sealed system.

### **Conditions for Running the DTC**

- DTCs P010B, P012B, P012C, P012D, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0121, P0122, P0123, P0128, P012B, P012C, P012D, P0222, P0223, P0236, P0237, P0238, P0443, P0446, P0449, P0452, P0453, P0455, P0458, P0459, P0461, P0462, P0463, P0496, P0498, P0499, P0502, P0503, P0722, P0723, P111E, P117D, P017C, P017D, P017B, P117B, P117F, P117E, P117C, P2066, P2067, P2068, P1221, P222B, P222C, P222D, P222E, P262B. are not set.
- The barometric pressure (BARO) is greater than 70 kPa.
- The engine coolant sensor (ECT) is greater than 63Â°C (145Â°F)
- The fuel level is between 10-90%.
- The start-up engine coolant temperature (ECT) and the start-up intake air temperature (IAT) are within 8Â°C (14Â°F).
- The engine run time before shut-off was greater than 10 min.
- The drive distance before engine shut-off was greater than 5 km (3 mi).
- The ambient air temperature at the end of the drive cycle is between 0-34Â°C (32-93Â°F).
- DTC P0442 runs once per drive cycle during the hot soak period after the ignition is turned OFF and may require up to 40 min to complete. The control module will not make more than 2 test attempts per day. The time since the last completed engine off natural vacuum test must be at least 17 h if passed or 10 h if failed.

### Conditions for Setting the DTC

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

### Action Taken When the DTC Sets

DTC P0442 is a Type A DTC.

### Conditions for Clearing the DTC

DTC P0442 is a Type A DTC.

### Diagnostic Aids

- The EVAP system can be filled with smoke more quickly and completely by opening the system opposite the end where the smoke is injected. When injecting smoke at the service port tool temporarily leave the EVAP Vent Solenoid Valve open until smoke is observed then close the system and continue testing.
- To help locate intermittent leaks using the **GE-41413-A** , move all EVAP components while observing smoke with the **GE-41413-SPT** .
- Individual components can be isolated and tested using adapters in the **GE-41413-300** .
- When servicing the EVAP system, test pressure must not exceed 13 in H<sub>2</sub>O (0.5 PSI) as pressure in excess of this could cause system components to perform inaccurately.
- A condition may exist where a leak in the EVAP system only exists under a vacuum condition. This type of leak may be detected by using the scan tool Purge/Seal function to create a vacuum in the EVAP system and then observe the Fuel Tank Pressure Sensor parameter for vacuum decay.

### Reference Information

Schematic Reference

### Engine Controls Schematics (Buick with LE2)

Connector End View Reference

### COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)

Powertrain Component View

## Powertrain Component Views (Buick)

Description and Operation

### Evaporative Emission Control System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

### Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

- **CH-48096** EVAP Service Port Access Tool
- **GE-41413-A** Evaporative Emissions System Tester
- **GE-41413-SPT** High Intensity White Light
- **GE-41413-300** EVAP Cap and Plug Kit

For equivalent regional tools, refer to [Special Tools \(Mechanical Tools\)](#).

### Circuit/System Testing

#### **NOTE:**

- Refer to the **GE-41413-A** operation manual for detailed instructions in [Evaporative Emission Control System Diagnosis](#).
- Larger volume fuel tanks and/or those with lower fuel levels may require several minutes for the floating indicator to stabilize or produce smoke from a leak.
- Ensure that the underbody temperature of the vehicle and the tester are similar.

1. Disconnect the purge tube at the quick connector on the EVAP canister side of the Q12 Evaporative Emission Canister Purge Solenoid Valve and install the **CH-48096**.
2. Connect the **GE-41413-A** to the **CH-48096**.
3. Command the EVAP Purge/Seal function to Not Venting or System Seal with a scan tool to seal the EVAP system.
4. Use the flow meter on the **GE-41413-A** calibrated to 0.51 mm (0.020 in) to determine if there is a leak.
  - **If a leak is detected**
    1. Use the **GE-41413-A** to apply smoke to the EVAP system at the purge tube service port until the leak is located using the **GE-41413-SPT**.
      - If leak is detected, repair or replace the affected component as necessary.
  - **If no leak is detected**
5. All OK.

### Repair Instructions

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

## **DTC P0443, P0458, OR P0459: EVAPORATIVE EMISSION (EVAP) PURGE SOLENOID VALVE CONTROL CIRCUIT**

### **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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### **DTC Descriptors**

#### **DTC P0443**

Evaporative Emission (EVAP) Purge Solenoid Valve Control Circuit

#### **DTC P0458**

Evaporative Emission (EVAP) Purge Solenoid Valve Control Circuit Low Voltage

#### **DTC P0459**

Evaporative Emission (EVAP) Purge Solenoid Valve Control Circuit High Voltage

### **Diagnostic Fault Information**

| <b>Circuit</b> | <b>Short to Ground</b> | <b>Open/High Resistance</b> | <b>Short to Voltage</b> | <b>Signal Performance</b> |
|----------------|------------------------|-----------------------------|-------------------------|---------------------------|
| Ignition       | P0443, P0458           | P0443                       | P0690                   | -                         |
| Control        | P0443, P0458           | P0443, P0458                | P0459, P0690            | -                         |

### **Circuit/System Description**

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

### **Conditions for Running the DTC**

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

### **Conditions for Setting the DTC**

#### **P0443**

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

#### **P0458**

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

#### **P0459**

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

### **Action Taken When the DTC Sets**

DTC P0443, P0458 and P0459 are Type B DTCs.

### **Conditions for Clearing the DTC**

DTC P0443, P0458 and P0459 are Type B DTCs.

## **Reference Information**

Schematic Reference

### **Engine Controls Schematics (Buick with LE2)**

Connector End View Reference

### **COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)**

Powertrain Component View

### **Powertrain Component Views (Buick)**

Description and Operation

### **Evaporative Emission Control System Description**

Electrical Information Reference

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

DTC Type Reference

### **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

**Control Module References** for scan tool information

## **Circuit/System Verification**

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

1. Ignition ON, verify DTC P0690 is not set.

- **If the DTC is set**

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

- **If the DTC is not set**

2. Verify the EVAP Purge Solenoid Valve control circuit status parameters do not display Malfunction while commanding the solenoid from 0% to 50% and back to 0% with a scan tool:

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

Refer to Circuit/System Testing

- **If Malfunction is not displayed**

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

- **If Malfunction is displayed**

- **If Malfunction is not displayed**

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

Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing

- **If the DTC does not set**

5. All OK.

### Circuit/System Testing

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

7. Verify the scan tool EVAP Purge Solenoid Valve Control Circuit High Voltage Test Status parameter is Malfunction when commanding the EVAP Purge Solenoid Valve to 50% with a scan tool.

- **If Malfunction is not displayed**

1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.
2. Test for less than 2  $\Omega$  in the control circuit end to end.
  - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than 2  $\Omega$  replace the K20 Engine Control Module.

- **If Malfunction is displayed**

8. Test or replace the Q12 Evaporative Emission Purge Solenoid Valve.

## Component Testing

### Static Test

1. Ignition OFF, disconnect the harness connector at the Q12 Evaporative Emission Purge Solenoid Valve.
2. Test for 10-30  $\Omega$  between the control terminal 2/B and the ignition circuit terminal 1/A.
  - **If not between 10-30  $\Omega$**   
  
Replace the Q12 Evaporative Emission Purge Solenoid Valve.
  - **If between 10-30  $\Omega$**
3. All OK.

### Dynamic Test

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

## Repair Instructions

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

- Refer to [Evaporative Emission Canister Purge Solenoid Valve Replacement](#)
- Refer to [Control Module References](#) for ECM replacement, programming and setup

## DTC P0446: EVAPORATIVE EMISSION (EVAP) VENT SYSTEM PERFORMANCE

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptor

### DTC P0446

Evaporative Emission (EVAP) Vent System Performance

| Fuel Tank Pressure Sensor Signal Voltage | Fuel Tank Pressure          |
|------------------------------------------|-----------------------------|
| 1.5 V                                    | Atmospheric Pressure / BARO |
| Less than 1.5 V                          | Positive Pressure           |
| More than 1.5 V                          | Negative Pressure / Vacuum  |

### Circuit/System Description

This DTC tests the evaporative emission (EVAP) system for a restricted or blocked EVAP vent path that would cause excess amounts of vacuum to be developed in the EVAP system. The engine control module (ECM) uses the fuel tank pressure sensor to monitor EVAP system vacuum. With the purge valve and vent valve open, if the EVAP system vacuum goes above a calibrated threshold, P0446 will set.

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

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

### Conditions for Running the DTC

- DTCs P0068, P00C8, P00C9, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0121, P0122, P0123, P0128, P0191, P0192, P0193, P0222, P0223, P0443, P0601, P0604, P0606, P16A0, P16A1, P16A2, P16F3, P2101, P2135, P2176, are not set.
- The ignition voltage is between 11-32 V.
- The barometric pressure (BARO) is more than 70 kPa.
- The fuel level is between 10-90%.
- The startup engine coolant temperature (ECT) is less than 35Â°C (95Â°F).
- The startup intake air temperature (IAT) is between 4-30Â°C (39-86Â°F).
- DTC P0446 runs once per cold start, for up to 17 min, when the above conditions are met.

### Conditions for Setting the DTC

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

- If fuel tank pressure sensor reading is greater than 2.5 in H<sub>2</sub>O of pressure or less than -5 in H<sub>2</sub>O of vacuum for 60 s.
- OR
- If fuel tank pressure sensor reading is less than -12 in H<sub>2</sub>O of vacuum for 5 s before 10 L (2.6 gal) of purge volume.
  - After setting the DTC for the first time, 2 L (0.5 gal) of fuel must be consumed before setting the DTC for the second time.

### Action Taken When the DTC Sets

DTC P0446 is a Type B DTC.

### Conditions for Clearing the MIL/DTC

DTC P0446 is a Type B DTC.

### Diagnostic Aids

- An intermittent condition could be caused by a damaged EVAP vent housing, a temporary blockage at the EVAP vent solenoid valve inlet, or a pinched vent hose. A blockage in the vent

system may also cause a poor fuel fill condition.

- An EVAP canister filter that is restricted can cause this DTC to set.

## Reference Information

Schematic Reference

### Engine Controls Schematics (Buick with LE2)

Connector End View Reference

### COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)

Powertrain Component View

### Powertrain Component Views (Buick)

Description and Operation

### Evaporative Emission Control System Description

Electrical Information Reference

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

DTC Type Reference

### Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

### Control Module References for scan tool information

Special Tools

- **CH-41415-30** Fuel Tank Cap Adapter
- **GE-41413-A** Evaporative Emissions System Tester

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

## Circuit/System Verification

1. Ignition ON.
2. Verify DTC P0443 is not set.

- **If the DTC is set**

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

- **If the DTC is not set**

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

Refer to P0452, P0453 within DTC P0451-P0454.

- **If between the 1.3-1.7 V**

5. Install the fuel tank filler cap. Engine idling at operating temperature for 5 min.

6. Verify the scan tool Fuel Tank Pressure Sensor parameter does not increase to greater than 2.5 V when commanding the EVAP Purge Solenoid Valve to 50%.

- **If greater than 2.5 V**

Refer to Circuit/System Testing.

- **If 2.5 V or less**

7. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the freeze frame/failure records data.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

8. All OK.

### Circuit/System Testing

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

1. Test for a blockage or restrictions in the EVAP system components listed below and repair as necessary.

- Evaporative Emission Vent System Hoses
- Evaporative Emission Canister
- Q13 Evaporative Emission Vent Solenoid Valve
- Evaporative Emission Vent Filter

2. Reconnect all previously disconnected EVAP hardware.

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

3. Remove the fuel fill cap and connect the CH-41415-30 to the fuel tank filler neck. Connect the GE-41413-A to the CH-41415-30.

4. Command the EVAP Purge/Seal function to System Seal with a scan tool to seal the EVAP system.

5. Turn the nitrogen/smoke valve on the GE-41413-A to nitrogen.

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

6. Use the remote switch to activate the GE-41413-A and pressurize the fuel tank to 5.0 in H<sub>2</sub>O.

7. Verify the scan tool Fuel Tank Pressure Sensor parameter is 0 in H<sub>2</sub>O when commanding the EVAP Vent Solenoid Valve to OFF.

- **If not 0 in H<sub>2</sub>O**

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

- **If 0 in H<sub>2</sub>O**

8. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the freeze frame/failure records data.

- **If the DTC sets**

Refer to step 1 above.

- **If the DTC does not set**

9. All OK.

## Repair Instructions

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

- Refer to [Evaporative Emission Canister Replacement \(FWD\)](#), [Evaporative Emission Canister Replacement \(AWD\)](#)
- Refer to [Evaporative Emission Canister Vent Solenoid Valve Replacement](#)
- Refer to [Fuel Tank Pressure Sensor Replacement](#)

## DTC P0449, P0498, OR P0499: EVAPORATIVE EMISSION (EVAP) VENT SOLENOID VALVE CONTROL CIRCUIT

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptors

#### DTC P0449

Evaporative Emission (EVAP) Vent Solenoid Valve Control Circuit

#### DTC P0498

Evaporative Emission (EVAP) Vent Solenoid Valve Control Circuit Low Voltage

#### DTC P0499

Evaporative Emission (EVAP) Vent Solenoid Valve Control Circuit High Voltage

### Diagnostic Fault Information

| Circuit | Short to Ground | Open/High Resistance | Short to Voltage |
|---------|-----------------|----------------------|------------------|
| B+      | P0449, P0498    | P0449                | -                |
| Control | P0449, P0498    | P0449                | P0499            |

### Circuit/System Description

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

### Conditions for Running the DTC

The DTCs run continuously.

### Conditions for Setting the DTC

#### P0449

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

#### P0498

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

#### P0499

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

### **Action Taken When the DTC Sets**

DTC P0449, P0498 and P0499 are Type B DTCs.

### **Conditions for Clearing the DTC**

DTC P0449, P0498 and P0499 are Type B DTCs.

### **Reference Information**

Schematic Reference

### **Engine Controls Schematics (Buick with LE2)**

Connector End View Reference

### **COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)**

Powertrain Component View

### **Powertrain Component Views (Buick)**

Description and Operation

### **Evaporative Emission Control System Description**

Electrical Information Reference

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

DTC Type Reference

### **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

**Control Module References** for scan tool information

### **Circuit/System Verification**

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

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

Refer to Circuit/System Testing

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

- **If Malfunction is not displayed**

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

- **If the DTC sets**

Refer to Circuit/System Testing

- **If the DTC does not set**

6. All OK.

### Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the Q13 Evaporative Emission Vent Solenoid Valve, ignition ON.
2. Verify that a test lamp illuminates between the B+ circuit terminal A or 2 and ground.
  - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF, remove the test lamp.
    2. Test for less than 2  $\Omega$  in the B+ circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , verify the fuse is not open and there is voltage at the fuse.
  - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition OFF, remove the test lamp.
    2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, test all components connected to the B+ circuit for a short and replace as necessary.
  - **If the test lamp illuminates**
3. Verify that a test lamp does not illuminate between the B+ circuit terminal A or 2 and the control circuit terminal B or 1.
  - **If the test lamp illuminates**
    1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K20 Engine Control Module.
  - **If the test lamp does not illuminate**
4. Remove the test lamp.
5. Verify the scan tool EVAP Vent Solenoid Valve Control Circuit High Voltage Test Status parameter is OK when commanding the EVAP Vent Solenoid Valve to ON (Not Venting) with a scan tool.
  - **If OK is not displayed**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K20 Engine Control Module.
  - **If OK is displayed**
6. Install a 3 A fused jumper wire between the control circuit terminal B or 1 and the B+ circuit terminal A or 2.

7. Verify the scan tool EVAP Vent Solenoid Valve Control Circuit High Voltage Test Status parameter is Malfunction when commanding the EVAP Vent Solenoid Valve to ON (Not Venting) with a scan tool.

- **If Malfunction is not displayed**

1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module.
2. Test for less than 2  $\Omega$  in the control circuit end to end.
  - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than 2  $\Omega$  replace the K20 Engine Control Module.

- **If Malfunction is displayed**

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

### Component Testing

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

Replace the Q13 Evaporative Emission Vent Solenoid Valve.

- **If between 10-30  $\Omega$**

3. All OK.

### Repair Instructions

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

- Refer to [Evaporative Emission Canister Vent Solenoid Valve Replacement](#)
- Refer to [Control Module References](#) for ECM replacement, programming and setup

## DTC P0451-P0454: FUEL TANK PRESSURE SENSOR

### Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptors

#### DTC P0451

Fuel Tank Pressure Sensor Performance

#### DTC P0452

Fuel Tank Pressure Sensor Circuit Low Voltage

#### DTC P0453

Fuel Tank Pressure Sensor Circuit High Voltage

#### DTC P0454

Fuel Tank Pressure Sensor Circuit Intermittent

### Diagnostic Fault Information

| Circuit | Short to Ground | High Resistance | Open | Short to Voltage | Signal Performance |
|---------|-----------------|-----------------|------|------------------|--------------------|
|         |                 |                 |      |                  |                    |

| Circuit                   | Short to Ground | High Resistance | Open     | Short to Voltage | Signal Performance |
|---------------------------|-----------------|-----------------|----------|------------------|--------------------|
| 5 V Reference             | P0452, *        | P0451           | P0452, * | P0453, *         | -                  |
| Signal                    | P0452           | P0451           | P0452    | P0453            | P0451, P0454       |
| Low Reference             | -               | P0446, P0451    | P0453, * | -                | P0451              |
| * Additional DTCs may set |                 |                 |          |                  |                    |

### Typical Scan Tool Data

#### Fuel Tank Pressure Sensor Voltage

| Circuit                                                                                          | Short to Ground | Open  | Short to Voltage |
|--------------------------------------------------------------------------------------------------|-----------------|-------|------------------|
| <b>Operating Conditions:</b> Ignition ON, Engine OFF<br><b>Parameter Normal Range:</b> 1.3-1.7 V |                 |       |                  |
| 5 V Reference                                                                                    | 0 V             | 0 V   | 4.2-5 V          |
| Signal                                                                                           | 0 V             | 0 V   | 5 V              |
| Low Reference                                                                                    | -               | 4.5 V | -                |

### Circuit/System Description

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

### Conditions for Running the DTC

#### P0451

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

#### P0452 and P0453

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

#### P0454

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

### Conditions for Setting the DTC

#### P0451

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

#### P0452

The fuel tank pressure sensor voltage is less than 0.15 V for greater than 10 s.

#### P0453

The fuel tank pressure sensor voltage is greater than 4.9 V for greater than 10 s.

#### P0454

If, during the engine-off natural vacuum small leak test, P0442, the ECM detects an abrupt fuel tank pressure signal change, other than a refueling event, this DTC will set. An abrupt change is defined as a change of greater than 0.45 in H<sub>2</sub>O (0.11 kPa) in the span of 1 s but less than 1 in H<sub>2</sub>O (0.25 kPa) in 12.5 ms. This test must fail twice to set this DTC.

### Action Taken When the DTC Sets

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

### Conditions for Clearing the MIL/DTC

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

### Diagnostic Aids

#### P0451 and P0454

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

### Reference Information

Schematic Reference

#### Engine Controls Schematics (Buick with LE2)

Connector End View Reference

#### COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)

Powertrain Component View

#### Powertrain Component Views (Buick)

Description and Operation

#### Evaporative Emission Control System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

#### Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

## Special Tools

- **GE-41413-A** Evaporative Emission System Tester
- **GE-41415-60** Engine Induction System Leak Test Adapter/Capless Fuel Fill Adapter

For equivalent regional tools, refer to [Special Tools \(Mechanical Tools\)](#).

### Circuit/System Verification

1. Ignition ON.
2. Verify DTC P0641, P0651, P0697, P06A3, or P06D2 is not set.

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

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.

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

3. Remove the fuel cap or install **GE-41415-60** for capless fuel fill, if equipped.
4. Ignition ON, engine OFF.
5. Verify the scan tool Fuel Tank Pressure sensor parameter is between 1.3 and 1.7 V.

- **If not between 1.3-1.7 V**

Refer to Circuit/System Testing.

- **If between 1.3-1.7 V**

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

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

8. All OK.

### Circuit/System Testing

1. Ignition OFF, all vehicle systems OFF, this may take up to 2 min, for all vehicle systems to power down. Disconnect the harness connector at the B150 Fuel Tank Pressure Sensor.
2. Test for less than 5  $\Omega$  of resistance between the low reference circuit terminal 2 and ground.

- **If 5  $\Omega$  or greater**

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

- **If less than 5  $\Omega$**

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

- **If less than 4.8 V**

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

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

### Repair Instructions

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

- Refer to [Fuel Tank Pressure Sensor Replacement](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup

## DTC P0455: EVAPORATIVE EMISSION (EVAP) SYSTEM LARGE LEAK DETECTED

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptor

#### DTC P0455

Evaporative Emission (EVAP) System Large Leak Detected

### Circuit/System Description

The engine control module (ECM) tests the evaporative emission (EVAP) system for a large leak or restrictions to the purge path in the EVAP system. When the enabling criteria has been met, the ECM commands the EVAP vent solenoid valve and purge solenoid valve ON, allowing vacuum into the EVAP

system. The ECM monitors the fuel tank pressure sensor voltage to verify that the system is able to reach a predetermined level of vacuum within a set amount of time.

### Conditions for Running the DTC

- DTCs P00C8, P00C9, P010C, P010D, P16A0, P16A1, P16A2, P160E, P160D, P16F3, P0068, P0101, P0102, P0103, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0122, P0123, P0125, P0128, P0191, P0192, P0193, P0222, P0223, P0443, P0449, P0452, P0453, P0454, P0502, P0503, P0601, P0604, P0606, P0722, P0723, P1104, P1682, P2100, P2101, P2102, P2103, P2135, P2176, P2227, P2228, P2229, P2230 are not set.
- The ignition voltage is between 11-32 V.
- The barometric pressure (BARO) is greater than 70 kPa.
- The fuel level is between 10-90%.
- The cold startup engine coolant temperature (ECT) and the startup intake air temperature (IAT) are within 8Â°C (14Â°F).
- The startup engine coolant temperature (ECT) is less than 35Â°C (95Â°F).
- The startup intake air temperature (IAT) is between 4-34Â°C (39-93Â°F).
- DTC P0455 runs once per cold start, shortly after purge is enabled followed by vent system performance test P0446.

### Conditions for Setting the DTC

- The EVAP system is not able to achieve or maintain a calibrated level of vacuum before a calibrated amount of purge volume has passed through the system.
- After setting the DTC for the first time, 2 L (0.5 gal) of fuel must be consumed before setting the DTC for the second time.
- With a DTC P0455 detected a weak vacuum follow-up test (fuel cap replacement test) will run and pass if tank vacuum is greater than 2.74 kPa (11 in H<sub>2</sub>O). This test will run for a maximum of 21 min. This test runs until it passes.

### Action Taken When the DTC Sets

DTC P0455 is a Type B DTC.

### Conditions for Clearing the MIL/DTC

DTC P0455 is a Type B DTC.

### Diagnostic Aids

- Inspect for a loose, missing, damaged, or incorrect fuel fill cap.
- Inspect for a damaged fuel filler neck seal surface.
- A blockage or restriction in the EVAP purge solenoid valve, purge pipe, EVAP canister, or vapor pipe, can cause this DTC to set.
- The EVAP system can be filled with smoke more quickly and completely by opening the system opposite the end where the smoke is injected. For example, when injecting smoke at the service port remove the fuel fill cap, or temporarily leave the vent open, until smoke is observed, then close the system and continue testing. If using a fuel cap adapter at the filler neck, use the **J-41413-VLV** at the service port to allow the system to fill faster.
- To help locate intermittent leaks using the **GE-41413-A** move all EVAP components while observing smoke with the **GE-41413-SPT**.
- Individual components can be isolated and tested using adapters in the **J-41413-300**.
- When servicing the EVAP system, test pressure must not exceed 13 in H<sub>2</sub>O (0.5 PSI) as pressure in excess of this could cause system components to perform inaccurately.
- A condition may exist where a leak in the EVAP system only exists under a vacuum condition. This type of leak may be detected by using the scan tool Purge/Seal function to create a vacuum in the EVAP system and then observe the fuel tank pressure sensor parameter for vacuum decay.

### Reference Information

Schematic Reference

### [Engine Controls Schematics \(Buick with LE2\)](#)

Connector End View Reference

### [COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#)

Powertrain Component View

### [Powertrain Component Views \(Buick\)](#)

Description and Operation

### [Evaporative Emission Control System Description](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

### [Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

### [Control Module References](#) for scan tool information

Special Tools

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

For equivalent regional tools, refer to [Special Tools \(Mechanical Tools\)](#).

### [Circuit/System Testing](#)

#### **NOTE:**

- **Larger volume fuel tanks and/or those with lower fuel levels may require several minutes for the floating indicator to stabilize or produce smoke from a leak.**
- **Refer to the GE-41413-A operation manual for detailed instructions in [Evaporative Emission Control System Diagnosis](#).**

1. Disconnect the purge tube at the quick connector on the EVAP canister side of the purge solenoid valve and install the **CH-48096** .
2. Connect the **GE-41413-A** to the vehicle EVAP service port adapter.
3. Ignition ON, command the EVAP Purge/Seal function to Not Venting or System Seal with a scan tool to seal the EVAP system.
4. Verify that there is no leak in the EVAP system using the flow meter on the **GE-41413-A** , calibrated to 0.51 mm (0.020 in).

- **If a leak is detected**

1. Apply smoke to the EVAP system at the service access port adapter with the **GE-41413-A** .
2. Locate the leak using the **GE-41413-SPT** .

- When the leak is located, repair or replace the affected component as necessary.
- **If no leak detected**

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

5. Connect the **GE-41413-A** nitrogen/smoke hose to the **J-41413-311** .
6. Disconnect the hose at the fuel cap end of the **GE-41415-30** and connect to the **J-41413-311** .
7. Install the **GE-41415-30** , filler neck end only, to the vehicle.
8. Engine idling, command the Purge/Seal function to Not Venting or System Seal with a scan tool to seal the system.

**NOTE:**            **The scan tool will abort purge when a predetermined value is reached. This is to prevent damage to the fuel tank.**

9. Command the EVAP Purge Solenoid Valve to 10-30% with a scan tool.
10. Verify the vacuum/pressure gauge on the **GE-41413-A** and the scan tool Fuel Tank Pressure Sensor parameter both show vacuum.
  - **If the vacuum/pressure gauge shows vacuum but the Fuel Tank Pressure Sensor parameter does not show vacuum**  
  
Replace the B150 Fuel Tank Pressure Sensor.
  - **If both do not show vacuum**  
  
Repair the restriction in the purge path.
  - **If both show vacuum**
11. Verify that the Fuel Tank Pressure Sensor parameter increases to greater than 3.2 V, and the pressure values are similar between the scan tool Fuel Tank Pressure Sensor and the vacuum/pressure gauge on the **GE-41413-A** .
  - **If not within the specified range**  
  
Replace the B150 Fuel Tank Pressure Sensor.
  - **If within the specified range**
12. All OK

### Repair Instructions

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

- Refer to [Fuel Tank Pressure Sensor Replacement](#)
- Refer to [Control Module References](#) for control module replacement, programming and setup.

## **DTC P0496: EVAPORATIVE EMISSION (EVAP) SYSTEM FLOW DURING NON-PURGE**

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptor

## **DTC P0496**

Evaporative Emission (EVAP) System Flow During Non-Purge

### Circuit/System Description

This DTC tests for undesired intake manifold vacuum flow to the evaporative emission (EVAP) system. The engine control module (ECM) seals the EVAP system by commanding the EVAP purge solenoid valve OFF and the vent solenoid valve ON. The ECM monitors the fuel tank pressure sensor to determine if a vacuum is being drawn on the EVAP system. If vacuum in the EVAP system is more than a predetermined value within a predetermined time, this DTC sets.

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

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

### Conditions for Running the DTC

- DTCs P00C8, P00C9, P010C, P010D, P16A0, P16A1, P16A2, P160E, P160D, P16F3, P0068, P0101, P0102, P0103, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0122, P0123, P0125, P0128, P0191, P0192, P0193, P0222, P0223, P0443, P0449, P0452, P0453, P0454, P0502, P0503, P0601, P0604, P0606, P0722, P0723, P1104, P1682, P2100, P2101, P2102, P2103, P2135, P2176, P2227, P2228, P2229, P2230 are not set.
- The ignition voltage is between 11-32 V.
- The engine OFF time is greater than 8 h.
- The barometric pressure (BARO) is greater than 70 kPa.
- The fuel level is between 10-90%.
- The startup engine coolant temperature (ECT) is less than 35Â°C (95Â°F).
- The startup intake air temperature (IAT) is between 4-30Â°C (39-86Â°F).
- DTC P0496 runs once per cold start, for up to 17 min, when the above conditions are met.

### Conditions for Setting the DTC

The ECM detects more than 10 in H<sub>2</sub>O vacuum for 5 s during a non-purge condition.

### Action Taken When the DTC Sets

DTC P0496 is a Type B DTC.

### Conditions for Clearing the MIL/DTC

DTC P0496 is a Type B DTC.

### Diagnostic Aids

An intermittent condition could be caused by an improperly installed or damaged EVAP purge solenoid valve or by a temporary blockage or restriction in the EVAP purge solenoid valve.

### Reference Information

Schematic Reference

### Engine Controls Schematics (Buick with LE2)

Connector End View Reference

### COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)

Powertrain Component View

### Powertrain Component Views (Buick)

Description and Operation

## Evaporative Emission Control System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

### Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

#### **Circuit/System Verification**

1. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the freeze frame/failure records data.
2. Verify the DTC does not set.
  - **If the DTC sets**  
  
Refer to Circuit/System Testing
  - **If the DTC does not set**
3. All OK

#### **Circuit/System Testing**

1. Ignition ON, engine OFF.
2. Seal the EVAP system using the Purge/Seal function with a scan tool.
3. Start the engine.
4. Observe the fuel tank pressure sensor with a scan tool. The Fuel Tank Pressure Sensor parameter should be less than 1.7 V after 90 s.
  - **If not within specifications**  
  
Replace the Q12 Evaporative Emission Purge Solenoid Valve
  - **If within Specifications**
5. All OK

#### **Repair Instructions**

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

Refer to [Evaporative Emission Canister Purge Solenoid Valve Replacement](#)

### **DTC P0506 OR P0507: IDLE SPEED LOW/HIGH**

#### **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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

#### **DTC Descriptors**

#### **DTC P0506**

**DTC P0507**

Idle Speed High

**Circuit/System Description**

The throttle actuator control (TAC) motor is a DC motor that is part of the throttle body assembly. The TAC motor drives the throttle valve. The engine control module (ECM) controls the TAC motor based on throttle position sensor input. The idle speed is controlled by the ECM based on various inputs. The ECM commands the TAC motor to open or close the throttle valve in order to maintain the desired idle speed.

**Conditions for Running the DTC**

- DTCs P0068, P0101, P0102, P0103, P0112, P0113, P0117, P0118, P0121, P0122, P0123, P0171, P0172, P0174, P0175, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0300-P0306, P0351-P0356, P0461-P0464, P0496, P0627, P0628, P0629, P0722, P1516, P2066-P2068, are not set.
- The barometric pressure (BARO) is greater than 70 kPa.
- The engine coolant temperature (ECT) is warmer than 60°C (140°F).
- The engine run time is greater than 60 s.
- The ignition voltage is between 11-32 V.
- The transmission is not changing gears.
- The torque converter clutch (TCC) is not changing states.
- The intake air temperature (IAT) is warmer than -20°C (-4°F).
- The vehicle speed is less than 3 km/h (2 mph).
- The commanded engine speed is steady within 25 RPM.
- The engine is idling for greater than 5 s.
- The DTCs run when the above conditions are met.

**Conditions for Setting the DTC****P0506**

The actual engine speed is 94 RPM less than the desired idle speed for 10 s.

**P0507**

The actual engine speed is 188 RPM greater than the desired idle speed for 10 s.

**Action Taken When the DTC Sets**

DTCs P0506 and P0507 are Type B DTCs.

**Conditions for Clearing the DTC**

DTCs P0506 and P0507 are Type B DTCs.

**Reference Information**

Schematic Reference

**Engine Controls Schematics (Buick with LE2)**

Connector End View Reference

**COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)**

Description and Operation

## Throttle Actuator Control (TAC) System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

### Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

#### Circuit/System Verification

1. Ignition ON.
2. Verify there are no other DTCs set.
  - **If any other DTCs are set**  
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.
  - **If no other DTCs are set**
3. Verify the scan tool Throttle Body Idle Airflow Compensation parameter is less than 90%.
  - **If 90% or greater**  
Refer to [Throttle Body Inspection and Cleaning](#).
  - **If less than 90%**
4. Engine Idling at the normal operating temperature.
5. Verify the actual Engine Speed is not 100 RPM less than the Desired Idle Speed.
  - **If 100 RPM less than the Desired Idle Speed**  
Refer to Circuit/System Testing.
  - **If 100 RPM greater than the Desired Idle Speed**
6. Verify the actual Engine Speed is not 200 RPM greater than the Desired Idle Speed.
  - **If 200 RPM greater than the Desired Idle Speed**  
Refer to Circuit/System Testing.
  - **If 200 RPM less than the Desired Idle Speed**
7. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
8. Verify the DTC does not set.
  - **If the DTC sets**  
Refer to Circuit/System Testing.
  - **If the DTC does not set**
9. All OK

#### Circuit/System Testing

#### **P0506**

1. Verify the conditions listed below do not exist.

- Restricted exhaust
- Mechanical conditions that limits engine speed
- Parasitic load on the engine - For example, a transmission condition, a belt driven accessory condition.
- **If a condition is found**

Repair as necessary.

- **If a condition is not found**

2. All OK.

## P0507

1. Verify the conditions listed below do not exist.

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

- **If a condition is found**

Repair as necessary.

- **If a condition is not found**

2. All OK.

### Repair Instructions

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

Refer to [Throttle Body Assembly Replacement](#)

## DTC P050D: COLD START ROUGH IDLE

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptor

## DTC P050D

Cold Start Rough Idle

### Circuit/System Description

During a cold start, the engine control module (ECM) commands dual-pulse mode during Open Loop operation to improve cold start emissions. In dual-pulse mode, the injectors are energized twice during each injection event. As with misfire diagnosis, in dual-pulse mode the ECM monitors the crankshaft position sensor and the camshaft position sensors to calculate crankshaft rotation speed. In normal operation, optimum fuel delivery during dual-pulse mode produces a steady crankshaft rotation speed. If the variations exceed a calibrated value, the code will be set.

### Conditions for Running the DTC

- DTCs P0010, P0011, P0013, P0014, P0020, P0021, P0023, P0024, P0090, P0091, P0092, P00C8, P00C9, P00CA, P0101-P0103, P0106-P0108, P010B, P010C, P010D, P0112, P0113, P0117,

P0118, P0119, P0122, P0123, P0128, P0192, P0193, P0201-P0204, P0205, P0206, P0207, P0208, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0279, P0280, P0282, P0283, P0335, P0336, P0351-P0354, P0355, P0356, P0357, P0358, P0502, P0503, P0506, P0507, P05CC, P05CD, P05CE, P05CF, P0627, P0628, P0629, P0697, P06A3, P0722, P0723, P0806, P0807, P0808, P111E, P1248, P1249, P124A, P127C, P127D, P124B, P128A, P128B, P128F, P16A0, P16A1, P16A2, P16E4, P16E5, P16F3, P182E, P1824, P182A, P182B, P182C, P182D, P182F, P1838, P1839, P1840, P1841, P18B5, P18B6, P18B7, P18B8, P18B9, P18BA, P18BB, P18BC, P18BD, P18BE, P18BF, P18C0, P18C1, P18C2, P18C3, P1915, P2088, P2089, P2090, P2091, P2092, P2093, P2094, P2095, P2122, P2123, P2127, P2128, P2135, P2138, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216B, P216C, P216E, P216F, P217B, P217C, P217E, P217F, P1248, P1249, P124A, P124B, P124C, P124D, P124E, P124F, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, P2316, P2318, P2319, P2321, P2322 are not set.

- The catalyst temperature is less than 350Â°C (662Â°F).
- The engine coolant temperature is between -15-56Â°C (5-132.8Â°F).
- The barometric pressure is greater than 76 kPa.
- The engine speed is between 450-2200 RPM.
- The accelerator pedal position is less than 110%.
- The engine is running for less than 30 s and a cold start has been detected.
- DTC P050D runs once per cold start.

### Conditions for Setting the DTC

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

### Action Taken When the DTC Sets

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

### Conditions for Clearing the DTC

DTC P050D is a Type B DTC.

### Diagnostic Aids

- This DTC may be set with a misfire DTC, however the existence of this DTC is a higher priority and indicates the condition to diagnose is related to fuel and/or injectors, not the ignition/spark system.
- A restricted fuel injector may cause this DTC to set.
- High resistance in the circuits of the injectors could set this DTC without setting an injector DTC. Test the injector circuits of the affected cylinders for a high resistance if you suspect a condition.
- A drop in system voltage during cold start may set this DTC.

### Reference Information

Schematic Reference

### Engine Controls Schematics (Buick with LE2)

Connector End View Reference

### COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)

Powertrain Component View

### Powertrain Component Views (Buick)

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

1. Engine Cranking, start the engine and verify that the scan tool Cylinder 1-4 Current Misfire Counters are not incrementing during first 500 engine cycles.
  - **If Cylinder 1-4 Current Misfire Counters are incrementing**  
Refer to Circuit/System Testing.
  - **If Cylinder 1-4 Current Misfire Counters are not incrementing**
2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
3. Verify the DTC does not set.
  - **If the DTC sets**  
Refer to Circuit/System Testing.
  - **If the DTC does not set**
4. All OK.

### [Circuit/System Testing](#)

1. Verify that the fuel pressure is not too low or too high - Refer to [Fuel System Diagnosis](#).
  - **If a condition is found**  
Repair or replace components as necessary
  - **If the fuel pressure is OK**
2. Verify that the fuel is not contaminated - Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#).
  - **If the fuel is contaminated**  
Clean the fuel system - Refer to [Fuel System Cleaning](#).
  - **If the fuel is not contaminated**
3. Replace fuel injectors as indicated by high misfire counts.

### [Repair Instructions](#)

Refer to [Fuel Injector Replacement](#)

### [Repair Verification](#)

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

1. Install any components or connectors that have been removed or replaced during diagnosis.

2. Perform any adjustment, programming or setup procedures that are required when a component or module is removed or replaced.
3. Clear the DTCs.
4. Turn OFF the ignition for 60 s.
5. If the repair was related to a DTC, duplicate the Conditions for Running the DTC and use the Freeze Frame/Failure Records, if applicable, in order to verify the DTC does not reset. If the DTC resets or another DTC is present, refer to the [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) and perform the appropriate diagnostic procedure.

## DTC P057B-P057E: BRAKE PEDAL POSITION SENSOR

### Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptors

#### DTC P057B

Brake Pedal Position Sensor Performance

#### DTC P057C

Brake Pedal Position Sensor Circuit Low Voltage

#### DTC P057D

Brake Pedal Position Sensor Circuit High Voltage

#### DTC P057E

Brake Pedal Position Sensor Circuit Erratic

### Diagnostic Fault Information

| Circuit       | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|---------------|-----------------|----------------------|------------------|--------------------|
| Signal        | P057C           | P057C                | P057D            | P057B, P057E       |
| 5 V Reference | P057C<br>P0651  | P057C                | P0651            | -                  |
| Low Reference | -               | P057D                | P057D            | -                  |

### Typical Scan Tool Data

#### Brake Pedal Position Sensor

| Circuit                                                                       | Short to Ground | Open | Short to Voltage |
|-------------------------------------------------------------------------------|-----------------|------|------------------|
| <b>Operating Conditions:</b> Ignition ON.<br><b>Normal Range:</b> 0.25-4.75 V |                 |      |                  |
| 5 V Reference                                                                 | 0 V             | 0 V  | -                |
| Signal                                                                        | 0 V             | 0 V  | 5 V              |
| Low Reference                                                                 | -               | 5 V  | -                |

### Circuit/System Description

The brake pedal position (BPP) sensor is part of the engine brake pedal override feature. The engine control module (ECM) continuously monitors the vehicle speed and the position of the brake pedal. These two main inputs, along with other ECM inputs are used to determine if the vehicle is decelerating

at the proper speed and rate with the brake pedal applied. When the engine brake pedal override system is active, the ECM reduces engine torque to assist in reducing vehicle speed.

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

For information on the Stop Lamps side of the BPP Sensor, refer to [Exterior Lighting Systems Description and Operation](#) .

#### Conditions for Running the DTC

##### P057B

- DTCs P057C, or P057D are not set.
- Ignition voltage is greater than 10 V.
- Shift lever has been in Park at least once during key ON.
- Shift lever is not in Park.
- Vehicle speed is greater than 8 Km/h (5 mph).
- Accelerator Pedal Position is less than 5%.
- DTC runs once per key cycle when above conditions are met.

##### P057C, P057D, or P057E

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

#### Conditions for Setting the DTC

##### P057B

ECM detects the BPP sensor signal is stuck in a range for greater than 1 s.

##### P057C

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

##### P057D

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

##### P057E

ECM detects the BPP sensor value varies greater than a calibrated value.

#### Action Taken When the DTC Sets

- P057B, P057C, P057D, and P057E are Type A DTCs.
- Brake Pedal Position Sensor parameter defaults to 0%.

#### Conditions for Clearing the DTC

P057B, P057C, P057D, and P057E are Type A DTCs

#### Reference Information

Schematic Reference

- [Engine Controls Schematics \(Buick with LE2\)](#)

- [Exterior Lights Schematics \(Buick\)](#).

#### Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX \(ENCORE\)](#)

#### 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:** The Brake Pedal Position sensor scan tool data is located in the ECM automatic transmission data list.

1. Ignition ON.
2. Verify DTC P0641, P0651, P0697, or P06A3 is not set.
  - **If any of the DTCs are set**  
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
  - **If none of the DTCs are set**
3. Transmission in Park, and service brake pedal released.
4. Verify the scan tool Brake Pedal Position Sensor parameter in the ECM displays greater than 0.25 V.
  - **If 0.25 V or less**  
Refer to Circuit/System Testing.
  - **If greater than 0.25 V**
5. Verify the scan tool Brake Pedal Position Sensor parameter voltage changes as the brake pedal is applied and displays less than 4.75 V when the brake pedal is fully applied.
  - **If the voltage does not change, or is greater than 4.74 V**  
Refer to Circuit/System Testing.
  - **If the voltage changes and less than 4.75 V**
6. Verify the scan tool Brake Pedal Position Sensor Learned Release Position parameter is within 0.1 V of the Brake Pedal Position Sensor parameter when the brake pedal is fully released.
  - **If difference is greater than 0.1 V**  
Perform the [Brake Pedal Position Sensor Learn](#) .
  - **If difference is 0.1 V or less**
7. Verify the Brake Pedal Position Sensor parameter transitions smoothly without any spikes or dropouts when slowly applying and releasing the brake pedal.
  - **If parameter does not transition smoothly or has spikes or dropouts**

Refer to Circuit/System Testing.

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

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

9. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

10. All OK.

### Circuit/System Testing

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

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

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

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

- **If 10  $\Omega$  or greater**

1. Disconnect the harness connector at the K20 Engine Control Module.

2. Test for less than 2  $\Omega$  in the low reference circuit end to end.

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

- **If less than 10  $\Omega$**

3. Ignition ON.

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

- **If less than 4.8 V**

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

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

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

3. Test for less than 2  $\Omega$  in the 5 V reference circuit end to end.

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

- **If greater than 5.2 V**

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

2. Test for less than 1 V between the 5 V reference circuit and ground.

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

- **If between 4.8-5.2 V**

5. Verify the scan tool Brake Pedal Position Sensor parameter is less than 0.25 V.

- **If 0.25 V or greater**

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

2. Test for less than 0.25 V between the signal circuit terminal 4 and ground.

- If 0.25 V or greater, repair the short to voltage on the circuit.

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

### Repair Instructions

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

- Refer to [Brake Pedal Position Sensor Replacement](#)
- Perform the [Brake Pedal Position Sensor Learn](#) following the replacement of the ECM or BPP sensor, or any repair that effects the BPP sensor alignment.
- Refer to [Control Module References](#) for Engine Control Module replacement, programming and setup.

### **DTC P0601-P0604, P0606, P062B, P062F, P0630, P16F3, OR P262B: CONTROL MODULE/VIN NOT PROGRAMMED OR MISMATCHED - ENGINE CONTROL MODULE (ECM)**

#### Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each of the diagnostic category.

#### DTC Descriptors

##### **DTC P0601**

Control Module Read Only Memory Performance

##### **DTC P0602**

Control Module Not Programmed

##### **DTC P0603**

Control Module Long Term Memory Reset

##### **DTC P0604**

Control Module Random Access Memory Performance

##### **DTC P0606**

Control Module Processor Performance

##### **DTC P062B**

## **DTC P062F**

Control Module Long Term Memory Performance

## **DTC P0630**

VIN Not Programmed or Mismatched - Engine Control Module (ECM)

## **DTC P16F3**

Control Module Redundant Memory Performance

## **DTC P262B**

Control Module Power Off Timer Performance

### **Circuit/System Description**

This diagnostic applies to internal microprocessor integrity conditions within the ECM. This diagnostic also addresses if the ECM is not programmed.

### **Conditions for Running the DTCs**

#### **P0601, P0602, P0630**

These DTCs run continuously when the ignition is in ON.

#### **P0603, P062F**

These DTCs run once per ignition cycle.

#### **P0604**

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

#### **P0606, P062B**

These DTCs run continuously when Ignition 1 Signal voltage is greater than 11 V.

#### **P16F3**

- The engine speed is greater than 680 RPM.
- DTCs P0101, P0102, P0103, P0106, P0107, P0108, P2227, P2228, P2229, or P2230 are not set.
- DTC P16F3 runs continuously when the above conditions are met.

#### **P262B**

DTC P262B runs during ECM power down.

### **Conditions for Setting the DTCs**

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

### **Actions Taken When the DTC Sets**

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

### **Conditions for Clearing the MIL/DTC**

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

- DTC P262B is a Type B DTC.
- DTC P062F is a Type C DTC.

### Diagnostic Aids

- A disconnected Camshaft Position Sensor could set DTC P0606 and may cause a no crank condition.
- Low voltage or a momentary loss of power or ground to the ECM may cause a DTC to set. Verify the following:
  - The battery cables are clean and tight, and the battery is fully charged. Refer to [Battery Inspection/Test](#).
  - The ECM ground circuits do not have an open or high resistance.
  - The ECM power circuits do not have an open, short to ground, or high resistance.

### Reference Information

Schematic Reference

### [Engine Controls Schematics \(Buick with LE2\)](#)

Connector End View Reference

### [COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#)

Component View Reference

### [Powertrain Component Views \(Buick\)](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

### [Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

### [Control Module References](#) for scan tool information

### Circuit/System Verification

1. Ignition ON, clear the DTC information with a scan tool.
2. Verify no other DTCs are set.
  - **If any other DTCs are set**  
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.
  - **If no other DTCs are set**
3. Verify DTC P0602 or P0630 is not set.
  - **If any of the DTCs are set**
    1. Program the K20 Engine Control Module. Refer to [Control Module References](#).
    2. Verify DTC P0602 or P0630 is not set.
      - If any of the DTCs are set, replace the K20 Engine Control Module.
      - If none of the DTCs are set
  - 3. All OK.

- If none of the DTCs are set

4. Verify DTC P0601, P0603, P0604, P0606, P062B, P062F, P16F3, or P262B is not set.

- If any of the DTCs are set

Replace the K20 Engine Control Module.

- If none of the DTCs are set

5. All OK.

### Repair Instructions

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

Refer to [Control Module References](#) for engine control module replacement, programming and setup.

## DTC P0627-P0629: FUEL PUMP ENABLE CIRCUIT

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptor

#### DTC P0627

Fuel Pump Enable Circuit

#### DTC P0628

Fuel Pump Enable Circuit Low Voltage

#### DTC P0629

Fuel Pump Enable Circuit High Voltage

### Diagnostic Fault Information

| Circuit | Short to Ground            | Open/High Resistance       | Short to Voltage | Signal Performance |
|---------|----------------------------|----------------------------|------------------|--------------------|
| Control | P0171, P0506, P0628, P12A6 | P0171, P0506, P0627, P12A6 | P0629, P12A6     | P12A6              |

### Circuit/System Description

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

### Conditions for Running the DTC

- The engine speed is greater than 0 RPM.
- The ignition voltage is greater than or equal to 11 V.
- The fuel pump enable circuit is commanded ON.
- The DTCs run continuously when the conditions above are met.

### Conditions for Setting the DTC

The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match for 2.5 s.

## Action Taken When the DTC Sets

DTCs P0627, P0628, and P0629 are Type C DTCs.

## Conditions for Clearing the DTC

DTCs P0627, P0628, and P0629 are Type C DTCs.

## Reference Information

Schematic Reference

## Engine Controls Schematics (Buick with LE2)

Connector End View Reference

## COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)

Powertrain Component View

## Powertrain Component Views (Buick)

Description and Operation

## Fuel System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

## Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

## Circuit/System Verification

1. Ignition ON.
2. Verify that DTC P0627, P0628, or P0629 is not set.
  - **If a DTC is set**  
  
Refer to Circuit/System Testing.
  - **If a DTC is not set**
3. Verify the parameters listed below do not display Malfunction when commanding the Fuel Pump Enable On and Off with a scan tool.
  - Fuel Pump Enable Circuit Low Voltage Test Status
  - Fuel Pump Enable Circuit Open Test Status
  - Fuel Pump Enable Circuit High Voltage Test Status
  - **If Malfunction is displayed**  
  
Refer to Circuit/System Testing.
  - **If Malfunction is not displayed**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

5. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

6. All OK.

### Circuit/System Testing

1. Ignition OFF, disconnect the K38 Chassis Control Module harness connector.

2. Ignition ON for 10 s.

3. Verify that a test lamp does not illuminate between the control circuit terminal 2 and ground.

- **If the test lamp illuminates**

1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

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

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

- **If the test lamp does not illuminate**

4. Remove the test lamp.

5. Verify the scan tool Fuel Pump Enable Circuit Low Voltage Test Status parameter is OK when commanding the Fuel Pump Enable On with a scan tool.

- **If OK is not displayed**

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

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

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

- **If OK is displayed**

6. Install a 3 A fused jumper wire between the control circuit terminal 2 and ground.

7. Verify the scan tool Fuel Pump Enable Circuit Low Voltage Test Status parameter is Malfunction when commanding the Fuel Pump Enable On with a scan tool.

- **If Malfunction is not displayed**

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

2. Test for less than 2  $\Omega$  in the control circuit end to end.

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

- **If Malfunction is displayed**

8. Test or replace the K38 Chassis Control Module.

### Repair Instructions

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

- Refer to [Chassis Control Module Replacement](#)
- Refer to [Control Module References](#) for Engine Control Module replacement, programming and setup.

### DTC P0641, P0651, P0697, P06A3, OR P06D2: 5V REFERENCE 1-5 CIRCUIT

#### 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.

- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

## **DTC Descriptors**

### **DTC P0641**

5V Reference 1 Circuit

### **DTC P0651**

5V Reference 2 Circuit

### **DTC P0697**

5V Reference 3 Circuit

### **DTC P06A3**

5V Reference 4 Circuit

### **DTC P06D2**

5V Reference 5 Circuit

## **Circuit/System Description**

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

## **Conditions for Running the DTC**

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

## **Conditions for Setting the DTC**

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

## **Action Taken When the DTC Sets**

DTCs P0641, P0651, P0697, P06A3, and P06D2 are Type A DTCs.

## **Conditions for Clearing the DTC**

DTCs P0641, P0651, P0697, P06A3, and P06D2 are Type A DTCs.

## **Diagnostic Aids**

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

- Intake manifold pressure and air temperature sensor
- Exhaust and intake camshaft position sensors
- Fuel pressure sensor
- Air conditioning (A/C) refrigerant pressure sensor

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

- Brake booster vacuum sensor
- Turbocharger boost sensor
- Crankshaft position sensor
- Brake pedal position sensor
- Clutch pedal position sensor

- Engine oil pressure sensor

The 5V reference 3 circuit provides 5 V to the accelerator pedal position sensor 2.

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

- Accelerator pedal position sensor 1
- Throttle position sensor

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

- Fuel rail pressure sensor
- Multifunction intake air sensor

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

### Reference Information

Schematic Reference

### Engine Controls Schematics (Buick with LE2)

Connector End View Reference

### COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)

Component View Reference

### Powertrain Component Views (Buick)

Electrical Information Reference

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

DTC Type Reference

### Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

### Control Module References for scan tool information

### Circuit/System Verification

1. Ignition ON.
2. Verify scan tool 5V Reference 1-5 Circuit Status parameters do not display Malfunction.
  - **If Malfunction is displayed**  
Refer to Circuit/System Testing.
  - **If Malfunction is not displayed**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
  - **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

5. All OK.

### Circuit/System Testing

**NOTE:** Additional DTCs will set when disconnecting the components.

1. Ignition OFF, disconnect the harness connector at all appropriate sensors for the applicable DTC. Refer to Diagnostic Aids.

2. Ignition ON.

3. Test for 4.8-5.2 V between one of the 5V reference circuits and ground.

- **If less than 4.8 V**

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

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

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

- **If greater than 5.2 V**

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

2. Test for less than 1 V between the 5V reference circuit for each applicable component and ground.

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

- **If between 4.8-5.2 V**

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

4. Verify the appropriate scan tool 5V Reference 1, 2, 3, 4, or 5 Circuit Status parameter displays OK while connecting each component associated with the 5V reference circuit one at a time.

- **If OK is not displayed when a component is connected**

Test the signal circuit of the component for a short to ground or voltage. If the circuit tests normal, replace the component.

- **If OK is displayed after all components have been connected**

5. All OK.

### Repair Instructions

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

- Refer to [Intake Air Pressure and Temperature Sensor Replacement](#)
- Refer to [Camshaft Position Sensor Replacement - Intake](#)
- Refer to [Camshaft Position Sensor Replacement - Exhaust](#)
- Refer to [Fuel Pressure Sensor Replacement - Fuel Feed Pipe](#)
- Refer to [Air Conditioning \(A/C\) Refrigerant Pressure Sensor Replacement \(LE2\)](#)
- Refer to [Power Brake Booster Vacuum Sensor Replacement](#)
- Refer to [Turbocharger Air Pressure Sensor Replacement](#)
- Refer to [Crankshaft Position Sensor Replacement \(AWD\). Crankshaft Position Sensor Replacement \(FWD\)](#)
- Refer to [Brake Pedal Position Sensor Replacement](#)
- Refer to [Clutch Pedal Position Sensor Replacement](#)

- Refer to [Engine Oil Pressure Sensor Replacement](#)
- Refer to [Accelerator Pedal with Position Sensor Assembly Replacement](#)
- Refer to [Throttle Body Assembly Replacement](#)
- Refer to [Fuel Injection Fuel Rail Fuel Pressure Sensor Replacement](#)
- Refer to [Mass Airflow Sensor Replacement](#) for multifunction intake air sensor replacement.
- Refer to [Control Module References](#) for engine control module replacement, programming, and setup.

## **DTC P0641 OR P06A6: 5 V REFERENCE CIRCUIT/5 V REFERENCE 1 PERFORMANCE (CHASSIS CONTROL MODULE)**

### **Diagnostic Instructions**

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### **DTC Descriptors**

#### **DTC P0641**

5 V Reference Circuit

#### **DTC P06A6**

5 V Reference 1 Performance

### **Diagnostic Fault Information**

| Circuit       | Short to Ground     | Open/High Resistance | Short to Voltage    | Signal Performance |
|---------------|---------------------|----------------------|---------------------|--------------------|
| 5 V Reference | P018C, P0641, P06A6 | P018C                | P018D, P0641, P06A6 | P06A6              |
| Signal        | P018C               | P018B, P018C         | P018D               | P018B              |
| Low Reference | -                   | P0641, P06A6         | -                   | P06A6              |

### **Circuit/System Description**

The fuel pressure sensor is located on the fuel line. The fuel pressure sensor monitors the fuel pressure in the fuel line. The chassis control module monitors the voltage signal from the fuel pressure sensor.

### **Conditions for Running the DTC**

The ignition is ON.

### **Conditions for Setting the DTC**

The chassis control module detects that the fuel pressure 5 V reference is above or below a predetermined voltage threshold.

### **Action Taken When the DTC Sets**

DTCs P0641 and P06A6 are Type A DTCs.

### **Conditions for Clearing the DTC**

DTCs P0641 and P06A6 are Type A DTCs.

### **Reference Information**

Schematic Reference

[Engine Controls Schematics \(Buick with LE2\)](#)

## COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)

Description and Operation

### Fuel System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

### Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

### Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B47 Fuel Pressure Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10  $\Omega$  between the low reference circuit terminal 2 and ground.
  - **If 10  $\Omega$  or greater**
    1. Ignition OFF, disconnect the harness connector at the K38 Chassis Control Module.
    2. Test for less than 2  $\Omega$  in the low reference circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K38 Chassis Control Module.
  - **If less than 10  $\Omega$**
3. Ignition ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 3 and ground.
  - **If less than 4.8 V**
    1. Ignition OFF, disconnect the harness connector at the K38 Chassis Control Module.
    2. Test for infinite resistance between the 5 V reference circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    3. Test for less than 2  $\Omega$  in the 5 V reference circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K38 Chassis Control Module.
  - **If greater than 5.2 V**
    1. Ignition OFF, disconnect the harness connector at the K38 Chassis Control Module, ignition ON.
    2. Test for less than 1 V between the 5 V reference circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K38 Chassis Control Module.
  - **If between 4.8-5.2 V**
5. Verify the scan tool Fuel Pressure Sensor Voltage parameter is less than 1 V.
  - **If 1 V or greater**
    1. Ignition OFF, disconnect the harness connector at the K38 Chassis Control Module, ignition ON.

2. Test for less than 1 V between the signal circuit terminal 1 and ground.
  - If 1 V or greater, repair the short to voltage on the circuit.
  - If less than 1 V, replace the K38 Chassis Control Module.
- **If less than 1 V**
6. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the 5 V reference circuit terminal 3, wait 15 seconds.
7. Verify the scan tool Fuel Pressure Sensor Voltage parameter is greater than 4.8 V.
  - **If 4.8 V or less**
    1. Ignition OFF, disconnect the harness connector at the K38 Chassis Control Module.
    2. Test for infinite resistance between the signal circuit terminal 1 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    3. Test for less than 2  $\Omega$  in the signal circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K38 Chassis Control Module.
  - **If greater than 4.8 V**
8. Test or replace the B47 Fuel Pressure Sensor.

### Repair Instructions

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

Refer to [Control Module References](#) for control module replacement, programming and setup.

## DTC P0650, P263A, OR P263B: MALFUNCTION INDICATOR LAMP (MIL) CONTROL CIRCUIT

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptor

#### DTC P0650

Malfunction Indicator Lamp (MIL) Control Circuit

#### DTC P263A

Malfunction Indicator Lamp (MIL) Control Circuit Low Voltage

#### DTC P263B

Malfunction Indicator Lamp (MIL) Control Circuit High Voltage

### Diagnostic Fault Information

| Circuit              | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|----------------------|-----------------|----------------------|------------------|--------------------|
| Ignition Voltage     | P0650           | P0650                | -                | -                  |
| Control              | P263A*          | P0650                | P263B            | -                  |
| * The MIL remains ON |                 |                      |                  |                    |

### Circuit/System Description

The malfunction indicator lamp (MIL) illuminates to inform the driver that an emission system fault has occurred and the powertrain control system requires service. Ignition voltage is supplied directly to the

MIL. The engine control module (ECM) turns the MIL ON by grounding the MIL control circuit when the emission system fault occurs. Under normal operating conditions, the MIL should be ON only when the vehicle is ON and the engine is OFF. MIL also flashes during engine misfire event.

### Conditions for Running the DTC

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

### Conditions for Setting the DTC

#### DTC P0650 or DTC P263A

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

#### DTC P263B

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

### Action Taken When the DTC Sets

DTC P0650, P263A, and P263B are type B DTCs

### Conditions for Clearing the DTC

DTC P0650, P263A, and P263B are type B DTCs

### Diagnostic Aids

If the ECM detects low voltage on the MIL control circuit during the control circuit driver OFF state, DTCs P0650 and DTC P263A may set simultaneously.

### Reference Information

Schematic Reference

- [Engine Controls Schematics \(Buick with LE2\)](#)

Connector End View Reference

### [COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

### [Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

### Circuit/System Verification

1. Engine Running.

2. Verify that the malfunction indicator lamp turns ON and OFF when commanding the Malfunction Indicator Lamp (MIL) On and Off with a scan tool.

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

Refer to Circuit/System Testing.

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

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

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

4. All OK.

### Circuit/System Testing

1. Ignition OFF, disconnect the X1 harness connector at the P16 Instrument Cluster, ignition ON.
2. Verify a test lamp illuminates between the control circuit terminal 16 and B+ when commanding the Malfunction Indicator Lamp (MIL) On and Off with a scan tool.

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

1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between the control circuit and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance, replace the K20 Engine Control Module.

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

1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
2. Test for less than 1 V between the control circuit and ground.
  - If 1 V or greater, repair the short to voltage on the circuit.
  - If less than 1 V.
3. Ignition OFF.
4. Test for less than 2  $\Omega$  between the control circuit end to end.
  - If 2  $\Omega$  or greater, repair the open high resistance in the circuit.
  - If less than 2  $\Omega$ , replace the K20 Engine Control Module.

- **If the test lamp turns ON and OFF**

3. Refer to [Malfunction Indicator Lamp \(MIL\) Diagnosis](#).

### Repair Instructions

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

Refer to [Control Module References](#) for engine control module replacement, programming, and setup.

## DTC P0685-P0687, P0689, P0690, OR P1682: ENGINE CONTROLS IGNITION RELAY/IGNITION 1 SWITCH CIRCUIT 2

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptors

#### DTC P0685

**DTC P0686**

Engine Controls Ignition Relay Control Circuit Low Voltage

**DTC P0687**

Engine Controls Ignition Relay Control Circuit High Voltage

**DTC P0689**

Engine Controls Ignition Relay Feedback Circuit Low Voltage

**DTC P0690**

Engine Controls Ignition Relay Feedback Circuit High Voltage

**DTC P1682**

Ignition 1 Switch Circuit 2

**Diagnostic Fault Information****Engine Controls Ignition Relay**

| Circuit                   | Short to Ground            | Open/High Resistance              | Short to Voltage                         |
|---------------------------|----------------------------|-----------------------------------|------------------------------------------|
| Relay Coil Supply Voltage | P0689, P1682, P16A7, P16AF | P0685, P0689, P1682, P16A7, P16AF | -                                        |
| Relay Control Circuit     | P0686, P0690, P16B3        | P0685, P0689, P1682, P16A7, P16AF | P0685, P0687, P0689, P1682, P16A7, P16AF |
| Relay Feedback Circuit    | P0689, P1682, P16A7, P16AF | P0689, P1682, P16A7, P16AF        | P0690, P16B3                             |

**Typical Scan Tool Data****Engine Controls Ignition Relay Control Circuit Low Voltage, Open, and High Voltage Test Status - Component Commanded OFF**

| Circuit                                                                                                                                                                                                                                                                                                                                                                                                                     | Short to Ground | Open        | Short to Voltage |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------|------------------|
| <b>Operating Conditions:</b> Component commanded OFF<br><b>Parameter Normal Range:</b> The following illustrates the normal parameter state with no circuit conditions: <ul style="list-style-type: none"> <li>Component OFF - OK for Open/Low Voltage Test Status and Not Run for High Voltage Test Status</li> <li>Component ON - Not Run for Open/Low Voltage Test Status and OK for High Voltage Test Status</li> </ul> |                 |             |                  |
| B+                                                                                                                                                                                                                                                                                                                                                                                                                          | Malfunction     | Malfunction | -                |
| Control                                                                                                                                                                                                                                                                                                                                                                                                                     | Malfunction     | Malfunction | Not Run          |

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

| Circuit | Short to Ground | Open | Short to Voltage |
|---------|-----------------|------|------------------|
|         |                 |      |                  |

| Circuit                                                                                                                                                                                                                                                                                                                                                                                                                        | Short to Ground | Open    | Short to Voltage |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------|------------------|
| <b>Operating Conditions:</b> Component commanded ON<br><b>Parameter Normal Range:</b> The following illustrates the normal parameter state with no circuit conditions: <ul style="list-style-type: none"> <li>• Component OFF - OK for Open/Low Voltage Test Status and Not Run for High Voltage Test Status</li> <li>• Component ON - Not Run for Open/Low Voltage Test Status and OK for High Voltage Test Status</li> </ul> |                 |         |                  |
| B+                                                                                                                                                                                                                                                                                                                                                                                                                             | Not Run         | Not Run | -                |
| Control                                                                                                                                                                                                                                                                                                                                                                                                                        | Not Run         | Not Run | Malfunction      |

### Circuit/System Description

There are 3 ignition voltage circuits supplied to the ECM. Two are supplied by the engine controls ignition relay, and the other is supplied by the ignition main relay. The ECM monitors and compares the ignition voltage supplied by the 2 relays.

### Conditions for Running the DTC

#### P0685, P0686, P0687

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

#### P0689

- DTC P0685 is not set.
- The engine controls ignition relay is commanded ON.
- Ignition 1 signal voltage is greater than 11 V.
- The DTC runs continuously when the above conditions are met.

#### P0690

- DTC P0685 is not set.
- The engine controls ignition relay is commanded OFF.
- The DTC runs continuously when the above conditions are met.

#### P1682

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

### Conditions for Setting the DTC

#### P0685

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

#### P0686

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

#### P0687

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

#### P0689

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

## **P0690**

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

## **P1682**

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

### **Action Taken When the DTC Sets**

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

### **Conditions for Clearing the DTC**

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

### **Diagnostic Aids**

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

### **Reference Information**

#### Schematic Reference

- [Engine Controls Schematics \(Buick with LE2\)](#)
- [Power Distribution Schematics \(Buick\)](#)

#### Connector End View Reference

### **COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)**

#### Component View Reference

### **Powertrain Component Views (Buick)**

#### Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Electrical Center Identification Views \(Buick\)](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

#### DTC Type Reference

### **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

#### Scan Tool Reference

### **Control Module References** for scan tool information

### **Circuit/System Verification**

#### **NOTE:**

- A short to voltage on other components may cause DTC P0690 to set. If any other DTC is set, diagnose that DTC first.

- **If you were sent here from Engine Cranks But Does Not Run, proceed to Circuit/System Testing.**

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

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

Refer to Circuit/System Testing.

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

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

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

3. All OK.

### Circuit/System Testing

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

1. Ignition OFF, disconnect the KR75 Engine Controls Ignition Relay.

2. Verify a test lamp illuminates between ground and the B+ terminals listed below:

- Terminal 85
- Terminal 30
- **If the test lamp does not illuminate**

Replace the front compartment fuse block.

- **If the test lamp illuminates**

#### NOTE:

- **High resistance in the circuit/underhood fuse block for either the KR75 Engine Controls Ignition Relay or the KR73 Ignition Main Relay can cause DTC P1682 to set.**
- **A short to voltage on any of the circuits supplied by the engine controls ignition relay can cause DTC P0690 to set.**

3. Ignition ON.

4. Verify that a test lamp does not illuminate between the ignition voltage circuit terminal 87 and ground.

- **If the test lamp illuminates**

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

2. Ignition ON.

3. Test for less than 1 V between ground and connector terminal 16.

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

- **If the test lamp does not illuminate**

5. Ignition OFF, connect a 25 A fused jumper wire between the B+ circuit terminal 30 and the ignition voltage circuit terminal 87.

6. Ignition ON.

7. Verify the scan tool Engine Controls Ignition Relay Feedback Signal parameter displays B+.

- **If B+ is not displayed**

1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module
2. Test for less than 2  $\Omega$  in the relay switch ignition voltage circuit end to end.
  - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than 2  $\Omega$
3. Test for infinite resistance between the relay switch ignition voltage circuit and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance, replace the K20 Engine Control Module.

- **If B+ is displayed**

8. Ignition OFF, connect a DMM, set to the diode setting, between control circuit terminal 86 and ground.

9. Verify the DMM displays OL.

- **If OL is not displayed**

1. Disconnect the X1 harness connector at the K20 Engine Control Module.
2. Test for infinite resistance between ground and the relay control circuit.
  - If less than infinite resistance, repair the short to ground in the circuit.
  - If infinite resistance, replace the K20 Engine Control Module.

- **If OL is displayed**

10. Ignition ON.

11. Verify the DMM displays less than 1 V.

- **If 1 V or greater**

1. Ignition OFF, disconnect the X1 connector at the K20 Engine Control Module.
2. Ignition ON.
3. Test for less than 1 V on the relay control circuit.
  - If 1 V or greater, repair the short to voltage on the circuit.
  - If less than 1 V
4. Test for less than 2  $\Omega$  in the control circuit end to end.
  - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - if less than 2  $\Omega$ , replace the K20 Engine Control Module.

- **If less than 1 V**

12. Test or replace the KR75 Engine Controls Ignition Relay.

## Component Testing

### Relay Test

1. Ignition OFF, disconnect the KR75 Engine Controls Ignition Relay.
2. Test for 70-110  $\Omega$  between terminals 85 and 86:

- **If less than 70  $\Omega$  or greater than 110  $\Omega$**

Replace the KR75 Engine Controls Ignition Relay.

- **If between 70-110  $\Omega$**

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

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

- **If less than infinite resistance**

Replace the KR75 Engine Controls Ignition Relay.

- **If infinite resistance**

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

5. Test for less than 2  $\Omega$  between terminals 30 and 87.

- **If 2  $\Omega$  or greater**

Replace the KR75 Engine Controls Ignition Relay.

- **If less than 2  $\Omega$**

6. All OK.

### Repair Instructions

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

- Refer to [Front Compartment Fuse Block Replacement](#).
- Refer to [Relay Replacement \(Attached to Wire Harness\)](#), [Relay Replacement \(Within an Electrical Center\)](#).
- Refer to [Control Module References](#) for engine control module replacement, programming, and setup.

## DTC P069E: FUEL PUMP CONTROL MODULE REQUESTED MIL ILLUMINATION

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide 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 constantly monitors the fuel pump control system for any condition which may adversely affect vehicle emissions. If a condition is detected, the fuel pump control module sets a DTC and sends a serial data message to the engine control module (ECM). The ECM sets DTC P069E to inform the technician that the fuel pump control module has set the emission related DTC. The serial data message sent by the fuel pump control module also contains a request for the ECM to illuminate the malfunction indicator lamp (MIL).

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

### Conditions for Running the DTC

The ignition is ON, or the engine is running for greater than 3 s.

### Conditions for Setting the DTC

The ECM receives a serial data message from the fuel pump control module indicating that an emission related DTC has set in the fuel pump control module.

### 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](#) for scan tool information

## Circuit/System Verification

### NOTE:

- Do not replace the engine control module for this DTC. DTC P069E is an informational DTC.
- Correct any engine control and communication DTCs before diagnosing fuel pump control module DTCs.

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

- If a DTC is set

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

- If a DTC is not set

2. Verify there are no fuel pump control module DTCs set.

- If a DTC is set

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

- If a DTC is not set

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

4. Verify the DTC does not set.

- If the DTC sets

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

- If the DTC does not set

5. All OK.

## Repair Instructions

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

## **DTC P0700: TRANSMISSION CONTROL MODULE REQUESTED MIL ILLUMINATION**

## 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each of the diagnostic category.

## DTC Descriptor

## DTC P0700

### Transmission Control Module Requested MIL Illumination

#### Circuit/System Description

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

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

#### Conditions for Running the DTC

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

#### Conditions for Setting the DTC

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

#### Action Taken When the DTC Sets

DTC P0700 is a Type A DTC.

#### Conditions for Clearing the MIL/DTC

DTC P0700 is a Type A DTC.

#### Diagnostic Aids

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

#### Reference Information

DTC Type Reference

#### Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

**Control Module References** for scan tool information

#### Circuit/System Verification

##### **NOTE:**

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

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

- **If a DTC is set**

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

- **If a DTC is not set**

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

- If a DTC is set

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

- If a DTC is not set

3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.

- If the DTC sets

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

- If the DTC does not set

5. All OK.

## Repair Instructions

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

## DTC P111E: ENGINE COOLANT TEMPERATURE (ECT) SENSOR NOT PLAUSIBLE

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptors

#### DTC P111E

Engine Coolant Temperature (ECT) Sensor Not Plausible

### Diagnostic Fault Information

| Circuit           | Short to Ground | High Resistance | Open  | Short to Voltage | Signal Performance |
|-------------------|-----------------|-----------------|-------|------------------|--------------------|
| ECT Sensor Signal | P0117           | P0118           | P0118 | P0118            | P0128, P111E       |
| Low Reference     | -               | P0118           | P0118 | P0118            | P0128              |

### Typical Scan Tool Data

#### ECT Sensor

| Circuit                                                                                                     | Short to Ground | Open            | Short to Voltage |
|-------------------------------------------------------------------------------------------------------------|-----------------|-----------------|------------------|
| <b>Operating Conditions:</b> Engine Running<br><b>Parameter Normal Range:</b> -39 to 149Å°C (-38 to 300Å°F) |                 |                 |                  |
| ECT Sensor                                                                                                  | 150Å°C (302Å°F) | -40Å°C (-40Å°F) | -40Å°C (-40Å°F)  |
| Low Reference                                                                                               | -               | -40Å°C (-40Å°F) | -40Å°C (-40Å°F)  |

### Circuit/System Description

The engine coolant temperature (ECT) sensor is a variable resistor that measures the temperature of the engine coolant. The engine control module (ECM) supplies 5V to the ECT sensor signal circuit and a ground for the low reference circuit.

The purpose of this diagnostic is to determine if the input from the ECT sensor is skewed warmer or colder than the Intake Air Temperature (IAT) sensor and Radiator Coolant Temperature (RCT) sensor. The internal clock of the ECM will record the amount of time the engine is OFF. If the required engine OFF time is met at start-up, the ECM will compare temperatures between the ECT, IAT, and RCT sensors.

If the ECM detects that the temperature difference between the ECT, IAT, and RCT sensors is not within an acceptable operating range, the ECM will continue to run this diagnostic to determine if a block heater was active during the engine OFF time.

### Conditions for Running the DTC

- DTCs P00B3, P00B4, P0111, P0112, P0113, P0114, P0117, P0118, P0128, P0601, P112F, P1621, or P2610 are not set.
- The vehicle has had a minimum ignition OFF time of 8 hours.
- The engine is running.
- The Ambient air temperature is warmer than  $-7^{\circ}\text{C}$  ( $19^{\circ}\text{F}$ )
- The block heater is not active.
- The fuel level is greater than 2.5%.
- This DTC runs once per ignition cycle when the above conditions are met.

### Conditions for Setting the DTC

- The ECM detects that there is a  $60^{\circ}\text{C}$  ( $140^{\circ}\text{F}$ ) or greater temperature difference between the start-up Engine Coolant Temperature (ECT) sensor, Intake Air Temperature (IAT) sensor and the Radiator Coolant Temperature (RCT) sensor.

OR

- The ECM detects the start-up Engine Coolant Temperature (ECT) sensor is between  $16^{\circ}\text{C}$  ( $61^{\circ}\text{F}$ ) and  $60^{\circ}\text{C}$  ( $140^{\circ}\text{F}$ ) warmer than the Intake Air Temperature (IAT) sensor and Radiator Coolant Temperature (RCT) sensor when the engine is cranking for less than 10 s.

OR

- The ECM detects the start-up Engine Coolant Temperature (ECT) sensor is at least  $16^{\circ}\text{C}$  ( $61^{\circ}\text{F}$ ) colder than the Intake Air Temperature (IAT) sensor and Radiator Coolant Temperature (RCT) sensor.

OR

- The ECM detects the start-up Engine Coolant Temperature (ECT) sensor is  $16^{\circ}\text{C}$  ( $61^{\circ}\text{F}$ ) warmer than the Intake Air Temperature (IAT) sensor and Radiator Coolant Temperature (RCT) sensor when the engine is cranking without starting for greater than 10 s.

### Action Taken When the DTC Sets

DTC P111E is a Type B DTC.

### Conditions for Clearing the DTC

DTC P111E is a Type B DTC.

### Diagnostic Aids

- Engine coolant that is leaking through the sensor will create a high resistance short to ground. This condition results in less voltage on the ECT sensor signal circuit, which is interpreted by the ECM as a warmer ECT.
- The ECM memory which includes the ignition OFF timer is maintained by battery power. If the ECM or the battery are disconnected for less than 15 seconds the proper operation of the ECM memory and the timer can be disrupted. Always disconnect these components for greater than 30 seconds.

### Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LE2\)](#)

## **COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)**

Description and Operation

### **Cooling System Description and Operation (LUV, LE2)**

Electrical Information Reference

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

DTC Type Reference

### **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

**Control Module References** for scan tool information

#### **Circuit/System Verification**

1. Verify that DTC P00B3, P00B4, P0111, P0112, P0113, P0114, P0117, P0118, P0128, P0601, P112F, P1621, or P2610 are not set.
  - **If DTC P00B3, P00B4, P0111, P0112, P0113, P0114, P0117, P0118, P0128, P0601, P112F, P1621, or P2610 are set**  
  
Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
  - **If DTC P00B3, P00B4, P0111, P0112, P0113, P0114, P0117, P0118, P0128, P0601, P112F, P1621, or P2610 are not set**
2. Ignition OFF for a minimum of 8 hours.
3. Ignition ON, observe scan tool parameters IAT Sensor 1, Radiator Coolant Temperature Sensor and the ECT Sensor and verify they are within 15Â°C (59Â°F) of each other and ambient temperature.
  - **If the Radiator Coolant Temperature Sensor parameter is not within 15Â°C (59Â°F) of the ECT Sensor and IAT Sensor 1 or ambient temperature.**  
  
Perform the diagnostic for DTC P00B3 or P00B4, Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
  - **If the IAT Sensor 1 parameter is not within 15Â°C (59Â°F) of the ECT Sensor and Radiator Coolant Temperature Sensor or ambient temperature.**  
  
Perform the diagnostic for DTC P0112, P0113, or P0114, Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
  - **If the ECT Sensor parameter is not within 15Â°C (59Â°F) of the IAT Sensor 1 and Radiator Coolant Temperature Sensor or ambient temperature.**  
  
Refer to Circuit/System Testing.
  - **If all the parameters are within 15Â°C (59Â°F) of each other and ambient temperature.**
4. Ignition OFF.
5. Verify the cooling system is filled to the correct coolant level. Refer to **Cooling System Leak Testing** , and **Cooling System Draining and Filling** .
  - **If the coolant level is not filled to the correct level**

Repair as necessary.

- **If the coolant level is correct**

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

7. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

8. All OK.

### Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the B34 Engine Coolant Temperature Sensor harness connector at the sensor. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 5  $\Omega$  between the low reference circuit terminal A or 2 and ground.

- **If 5  $\Omega$  or greater**

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

2. Test for less than 2  $\Omega$  in the low reference circuit end to end.

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

- **If less than 5  $\Omega$**

3. Ignition ON.

4. Verify the scan tool ECT Sensor parameter is colder than  $-39^{\circ}\text{C}$  ( $-38^{\circ}\text{F}$ ).

- **If warmer than  $-39^{\circ}\text{C}$  ( $-38^{\circ}\text{F}$ )**

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

2. Test for infinite resistance between the signal circuit terminal B or 1 and ground.

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

3. Test for less than 2  $\Omega$  in the signal circuit end to end.

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

- **If colder than  $-39^{\circ}\text{C}$  ( $-38^{\circ}\text{F}$ )**

5. Install a 3 A fused jumper wire between the signal circuit terminal B or 1 and the low reference circuit terminal A or 2.

6. Verify the scan tool ECT sensor parameter is warmer than  $149^{\circ}\text{C}$  ( $300^{\circ}\text{F}$ ).

- **If  $149^{\circ}\text{C}$  ( $300^{\circ}\text{F}$ ) or colder**

1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module, ignition ON.

2. Test for less than 1 V between the signal circuit and ground.

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

3. Ignition OFF.

4. Test for less than 2  $\Omega$  in the signal circuit end to end.

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

- **If warmer than  $149^{\circ}\text{C}$  ( $300^{\circ}\text{F}$ )**

7. Test or replace the B34A Engine Coolant Temperature Sensor.

### Component Testing

1. Ignition OFF, disconnect the harness connector at the B34 Engine Coolant Temperature Sensor.
2. Test the ECT sensor by varying the sensor temperature while monitoring the sensor resistance. Compare the readings with the [Temperature Versus Resistance \(Engine Coolant Temperature Sensor\)](#) table. The resistance values should be in range of the table values.
  - **If not within the specified range**
  - Replace the B34 Engine Coolant Temperature Sensor.
  - **If within the specified range**
3. Test for infinite resistance between each terminal and the sensor housing.
  - **If less than infinite resistance**  
  
Replace the B34 Engine Coolant Temperature Sensor.
  - **If infinite resistance**
4. All OK.

### Repair Instructions

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

- Refer to [Engine Coolant Temperature Sensor Replacement - Water Outlet](#)
- Refer to [Control Module References](#) for ECM replacement, programming and setup

## DTC P121A: MASS AIR FLOW (MAF) SENSOR SUPPLY VOLTAGE CONTROL CIRCUIT

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptors

#### DTC P121A

Mass Air Flow (MAF) Sensor Supply Voltage Control Circuit

### Diagnostic Fault Information

#### MAF Sensor Supply Voltage Control Circuit

| Circuit                                                                   | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|---------------------------------------------------------------------------|-----------------|----------------------|------------------|--------------------|
| Ignition Voltage                                                          | P0102, P121B    | P0102, P121A         | P0690            | -                  |
| MAF Control                                                               | P121B           | P0102, P121A         | P0102, 121C*     | -                  |
| *Internal ECM or sensor damage may occur if the circuit is shorted to B+. |                 |                      |                  |                    |

### Circuit/System Description

- Intake Air Temperature (IAT) sensor 1
- IAT sensor 2
- Humidity sensor
- Mass Air Flow (MAF) sensor
- Barometric pressure (BARO) sensor

The mass air flow (MAF) sensor is integrated with the intake air temperature (IAT) sensor. The MAF sensor is an air flow meter that measures the amount of air entering the engine. The engine control module (ECM) uses the MAF sensor signal to provide the correct fuel delivery for all engine speeds and loads. A large quantity of air entering the engine indicates a high load condition.

The ECM applies 5 volts to the MAF sensor on the MAF sensor signal circuit. The sensor uses the voltage to produce a frequency based on the inlet air flow through the sensor bore.

The MAF sensor is supplied power through the powertrain relay and a fuse. The ECM enables the MAF sensor only during engine run mode by grounding the MAF control circuit via a solid state device called a driver. The driver is equipped with a feedback circuit that is pulled-up to a voltage. The ECM monitors the status of the driver. If the ECM detects an incorrect voltage for the commanded state of the driver, a MAF sensor supply voltage low side driver control circuit DTC is set.

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

- Intake Air Temperature (IAT) sensor 1
- IAT sensor 2
- Humidity sensor
- Mass Air Flow (MAF) sensor
- BARO sensor

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

- IAT sensor 2
- Humidity sensor
- BARO sensor

The sensors listed below share an ECM supplied low reference circuit:

- IAT sensor 1
- IAT sensor 2
- Humidity sensor
- BARO sensor

#### **Conditions for Running the DTC**

##### **P121A**

- The ECM commands the MAF ON.
- The ECM commands the powertrain relay ON.
- The ignition voltage is at least 11 V.

The DTC runs continuously when the above conditions are met.

#### **Conditions for Setting the DTC**

##### **P121A**

The ECM detects the commanded and actual states of the MAF control circuit do not match for greater than 5 s.

#### **Action Taken When the DTC Sets**

DTC P121A is a Type B DTC.

#### **Conditions for Clearing the MIL/DTC**

DTC P121A is a Type B DTC.

#### **Reference Information**

Schematic Reference

**[Engine Controls Schematics \(Buick with LE2\)](#)**

Connector End View Reference

**[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#)**

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

## Powertrain Component Views

### [Powertrain Component Views \(Buick\)](#)

## 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:

- MAF Sensor Supply Voltage commanded OFF with a scan tool, the following parameters should display:
  - MAF Sensor Supply Voltage Control Circuit Low Voltage Test Status - OK
  - MAF Sensor Supply Voltage Control Circuit Open Test Status - OK
  - MAF Sensor Supply Voltage Control Circuit High Voltage Test Status - Not Run
- MAF Sensor Supply Voltage commanded ON with a scan tool, the following parameters should be displayed:
  - MAF Sensor Supply Voltage Control Circuit Low Voltage Test Status - Not Run
  - MAF Sensor Supply Voltage Control Circuit Open Test Status - Not Run
  - MAF Sensor Supply Voltage Control Circuit High Voltage Test Status - OK
- **If malfunction**

Refer to circuit system testing

- **If OK or Not Run**

### 2. Engine running, the following parameters should display:

- MAF Sensor Supply Voltage Command-ON
- MAF Sensor Supply Voltage Control Circuit Low Voltage Test Status - Not Run
- MAF Sensor Supply Voltage Control Circuit Open Test Status - Not Run
- MAF Sensor Supply Voltage Control Circuit High Voltage Test Status - OK
- **If malfunction**

Refer to circuit system testing

- **If OK or Not Run**

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

### 4. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

### 5. All OK

## Circuit/System Testing

1. Ignition OFF, disconnect the B75C Multifunction Intake Air sensor harness.
2. Ignition ON, verify that a test lamp illuminates between the ignition circuit terminal 5 and ground.
  - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF, remove the test lamp and remove the fuse for the ignition voltage circuit.
    2. Test for less than 2  $\Omega$  in the ignition voltage circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , verify the fuse is not open and there is voltage at the fuse.
  - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition OFF, remove the test lamp and remove the fuse for the ignition voltage circuit.
    2. Test for infinite resistance between the ignition voltage circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, test all components connected to the ignition circuit, replace as necessary.
  - **If a test lamp illuminates**
3. Ignition OFF, connect the test lamp between the control circuit terminal 4 and the ignition voltage circuit terminal 5.
4. Ignition ON. Command the MAF Sensor Supply Voltage Low Side Driver 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**
    1. Ignition OFF, remove the test lamp.
    2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K20 Engine Control Module.
  - **If the test lamp is always OFF**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for 2  $\Omega$  resistance between the control circuit and ground.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K20 Engine Control Module.
  - **If the test lamp turns ON and OFF**
5. Test or replace the B75C Multifunction Intake Air sensor.

### Repair Instructions

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

- Refer to [Mass Airflow Sensor Replacement](#) for multifunction intake air sensor replacement
- Refer to [Control Module References](#) for engine control module replacement, programming, and setup

## DTC P121B OR P121C: MASS AIR FLOW (MAF) SENSOR SUPPLY VOLTAGE CONTROL CIRCUIT LOW/HIGH VOLTAGE

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptors

#### DTC P121B

Mass Air Flow (MAF) Sensor Supply Voltage Control Circuit Low Voltage

#### DTC P121C

**Diagnostic Fault Information****MAF Sensor Supply Voltage Control Circuit**

| <b>Circuit</b>                                                            | <b>Short to Ground</b> | <b>Open/High Resistance</b> | <b>Short to Voltage</b> | <b>Signal Performance</b> |
|---------------------------------------------------------------------------|------------------------|-----------------------------|-------------------------|---------------------------|
| Ignition Voltage                                                          | P0102, P121B           | P0102, P121A                | P0690                   | -                         |
| MAF Control                                                               | P121B                  | P0102, P121A                | P0102, 121C*            | -                         |
| *Internal ECM or sensor damage may occur if the circuit is shorted to B+. |                        |                             |                         |                           |

**Circuit/System Description**

- Intake Air Temperature (IAT) sensor 1
- IAT sensor 2
- Humidity sensor
- Mass Air Flow (MAF) sensor
- Barometric pressure (BARO) sensor

The mass air flow (MAF) sensor is integrated with the intake air temperature (IAT) sensor. The MAF sensor is an air flow meter that measures the amount of air entering the engine. The engine control module (ECM) uses the MAF sensor signal to provide the correct fuel delivery for all engine speeds and loads. A large quantity of air entering the engine indicates a high load condition.

The ECM applies 5 volts to the MAF sensor on the MAF sensor signal circuit. The sensor uses the voltage to produce a frequency based on the inlet air flow through the sensor bore.

The MAF sensor is supplied power through the powertrain relay and a fuse. The ECM enables the MAF sensor only during engine run mode by grounding the MAF control circuit via a solid state device called a driver. The driver is equipped with a feedback circuit that is pulled-up to a voltage. The ECM monitors the status of the driver. If the ECM detects an incorrect voltage for the commanded state of the driver, a MAF sensor supply voltage low side driver control circuit DTC is set.

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

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

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

- IAT sensor 2
- Humidity sensor
- BARO sensor

The sensors listed below share an ECM supplied low reference circuit:

- IAT sensor 1
- IAT sensor 2
- Humidity sensor
- BARO sensor

**Conditions for Running the DTC****P121B**

- The ECM commands the MAF ON.

- The ECM commands the powertrain relay ON.
- The ignition voltage is at least 11 V.
- The DTC runs continuously when the above conditions are met.

## **P121C**

- The ECM commands the MAF OFF.
- The ECM commands the powertrain relay ON.
- The ignition voltage is at least 11 V.
- The DTC runs continuously when the above conditions are met.

### **Conditions for Setting the DTC**

## **P121B**

The ECM detects the commanded and actual states of the MAF control circuit do not match for greater than 5 s.

## **P121C**

The ECM detects the commanded and actual states of the MAF control circuit do not match for greater than 5 s.

### **Action Taken When the DTC Sets**

DTCs P121B and P121C are Type B DTCs.

### **Conditions for Clearing the MIL/DTC**

DTCs P121B and P121C are Type B DTCs.

### **Reference Information**

Schematic Reference

### **Engine Controls Schematics (Buick with LE2)**

Connector End View Reference

### **COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)**

Electrical Information Reference

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

Powertrain Component Views

### **Powertrain Component Views (Buick)**

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:

- MAF Sensor Supply Voltage commanded OFF with a scan tool, the following parameters should display:
  - MAF Sensor Supply Voltage Control Circuit Low Voltage Test Status - OK
  - MAF Sensor Supply Voltage Control Circuit Open Test Status - OK
  - MAF Sensor Supply Voltage Control Circuit High Voltage Test Status - Not Run
- MAF Sensor Supply Voltage commanded ON with a scan tool, the following parameters should be displayed:
  - MAF Sensor Supply Voltage Control Circuit Low Voltage Test Status - Not Run
  - MAF Sensor Supply Voltage Control Circuit Open Test Status - Not Run
  - MAF Sensor Supply Voltage Control Circuit High Voltage Test Status - OK
- **If malfunction**

Refer to circuit system testing

- **If OK or Not Run**

2. Engine running, the following parameters should display:

- MAF Sensor Supply Voltage Command - ON
- MAF Sensor Supply Voltage Control Circuit Low Voltage Test Status - Not Run
- MAF Sensor Supply Voltage Control Circuit Open Test Status - Not Run
- MAF Sensor Supply Voltage Control Circuit High Voltage Test Status - OK
- **If malfunction**

Refer to circuit system testing

- **If OK or Not Run**

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

4. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

5. All OK

### Circuit/System Testing

1. Ignition OFF, disconnect the B75C Multifunction Intake Air sensor harness.
2. Ignition ON, verify that a test lamp illuminates between the ignition circuit terminal 5 and ground.
  - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF, remove the test lamp and remove the fuse for the ignition voltage circuit.
    2. Test for less than 2  $\Omega$  in the ignition voltage circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , verify the fuse is not open and there is voltage at the fuse.
  - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition OFF, remove the test lamp and remove the fuse for the ignition voltage circuit.
    2. Test for infinite resistance between the ignition voltage circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, test all components connected to the ignition circuit, replace as necessary.
  - **If a test lamp illuminates**
3. Ignition OFF, connect the test lamp between the control circuit terminal 4 and the ignition voltage circuit terminal 5.

4. Ignition ON. Command the MAF Sensor Supply Voltage Low Side Driver 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**

1. Ignition OFF, remove the test lamp.
2. Test for infinite resistance between the control circuit and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance, replace the K20 Engine Control Module.

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

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
2. Test for 2  $\Omega$  resistance between the control circuit and ground.
  - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than 2  $\Omega$ , replace the K20 Engine Control Module.

- **If the test lamp turns ON and OFF**

5. Test or replace the B75C Multifunction Intake Air sensor.

### Repair Instructions

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

- Refer to [Mass Airflow Sensor Replacement](#) for multifunction intake air sensor replacement
- Refer to [Control Module References](#) for engine control module replacement, programming, and setup

## DTC P1255 OR P064A: FUEL PUMP CONTROL MODULE (CHASSIS CONTROL MODULE)

### Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptors

#### DTC P064A

Fuel Pump Control Module Performance

#### DTC P1255

Fuel Pump Control Module Driver High Temperature

### Circuit/System Description

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

### Conditions for Running the DTC

The engine is running.

### Conditions for Setting the DTC

The chassis 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.

## Reference Information

Schematic Reference

## Engine Controls Schematics (Buick with LE2)

Connector End View Reference

## COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)

Description and Operation

## Fuel System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

## Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

## Control Module References for scan tool information

## Circuit/System Verification

1. Ignition ON.
2. Verify DTC P0231, P0232 or P023F is not set.
  - **If any of the DTCs are set**  
  
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
  - **If none of the DTCs are set**
3. Verify that the area where the K38 Chassis Control Module is located is free of debris, clutter, or any insulating material that would cause the K38 Chassis Control Module to overheat.
  - **If any debris, clutter, or other material is found**
    1. Clear the area where the K38 Chassis Control Module is located.
    2. Clear the DTC and test drive the vehicle.
    3. Verify DTC P1255 or P064A is not set.
      - If DTC P1255 or P064A is set, replace the K38 Chassis Control Module.
      - If DTC P1255 or P064A is not set
  - 4. All OK.
    - **If no debris, clutter, or other material is found**
4. Clear the DTC and test drive the vehicle.
5. Verify DTC P1255 or P064A is not set.
  - **If DTC P1255 or P064A is set**  
  
Replace the K38 Chassis Control Module.
  - **If DTC P1255 or P064A is not set.**

### Repair Instructions

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

Refer to [Control Module References](#) for control module replacement, programming and setup.

## DTC P127C, P128A-P128D, P128F, P16E4, OR P16E5: FUEL RAIL PRESSURE TEMPERATURE SENSORS/SENSOR COMMUNICATION CIRCUIT 3 VOLTAGE

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptors

#### DTC P127C

Fuel Rail Pressure Sensor 2 Circuit Low Voltage

#### DTC P128A

Fuel Rail Pressure Sensor 1 Internal Performance

#### DTC P128B

Fuel Rail Pressure Sensor 2 Internal Performance

#### DTC P128C

Fuel Rail Pressure - Temperature Sensor Temperature 1 Message Incorrect

#### DTC P128D

Fuel Rail Pressure - Temperature Sensor Temperature 2 Message Incorrect

#### DTC P128F

Fuel Rail Pressure - Temperature Sensor Pressure Message Incorrect

#### DTC P16E4

Sensor Communication Circuit 3 Low Voltage

#### DTC P16E5

Sensor Communication Circuit 3 High Voltage

### Diagnostic Fault Information

| Circuit       | Short to Ground     | Open/High Resistance | Short to Voltage    | Signal Performance |
|---------------|---------------------|----------------------|---------------------|--------------------|
| 5 V Reference | P0452, P06D2, P16E5 | P16E4                | P06D2, P128A, P128B | P0191              |
| Signal        | P16E4               | P128C, P128D, P16E5  | P16E5               | P0191              |
| Low Reference | -                   | P128C, P128D, P16E5  | -                   | P0191              |

### Typical Scan Tool Data

## Fuel Rail Pressure Sensor

| Circuit                                                                                                                                           | Short to Ground | Open      | Short to Voltage |
|---------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------|------------------|
| <b>Operating Conditions:</b> The engine is operating with the throttle closed. All accessories OFF.<br><b>Parameter Normal Range:</b> 2.9-3.2 MPa |                 |           |                  |
| 5 V Reference                                                                                                                                     | 655.4 MPa       | 655.4 MPa | 655.4 MPa        |
| Signal                                                                                                                                            | 655.4 MPa       | 655.4 MPa | 655.4 MPa        |
| Low Reference                                                                                                                                     | -               | 655.4 MPa | -                |

### Circuit/System Description

The fuel pressure/temperature sensor transmits fuel pressure and temperature information by serial data using the Society of Automotive Engineers (SAE) J2716 Single Edge Nibble Transmission (SENT) protocol. The fuel pressure/temperature sensor internal microprocessor allows 4 separate sensor outputs from one 3 wire sensor. The engine control module (ECM) supplies the fuel pressure/temperature sensor with a 5 V reference circuit, a low reference circuit, and an asynchronous signal/serial data circuit. The asynchronous signal means communication is only going from the fuel pressure/temperature sensor to the ECM. The ECM decodes the serial data signal into separate voltages.

### Conditions for Running the DTC

#### P127C, P16E4 or P16E5

- Ignition is ON.
- No DTC clear code.
- The DTCs run continuously when the above conditions are met.

#### P128A or P128B

- DTC P128F, P16E4 or P16E5 is not set.
- Ignition is ON.
- The DTCs run continuously when the above conditions are met.

#### P128C, P128D, or P128F

- DTC P16E4 or P16E5 is not set.
- Ignition is ON.
- The DTCs run continuously when the above conditions are met.

### Conditions for Setting the DTC

#### P127C

The engine control module detects the fuel pressure sensor 2 SENT digital read value is less than or equal to 76 for greater than 30 s with the engine running or greater than 10 s with the engine cranking.

#### P128A

The engine control module detects the fuel pressure sensor 1 SENT digital read value is greater than or equal to 4,089 for greater than 3 s.

#### P128B

The engine control module detects the fuel pressure sensor 2 SENT digital read value is greater than or equal to 4,089 for greater than 3 s.

#### P128C

The engine control module detects communication errors on the fuel pressure sensor temperature 1 SENT signal circuit for greater than 1 s.

#### P128D

The engine control module detects communication errors on the fuel pressure sensor temperature 2 SENT signal circuit for greater than 1 s.

### **P128F**

The engine control module detects fuel pressure sensor SENT signal discrepancies for greater than 3 s.

### **P16E4**

The engine control module detects the fuel pressure sensor SENT signal shorted low for greater than 3 s.

### **P16E5**

The engine control module detects the fuel pressure sensor SENT signal shorted high for greater than 3 s.

#### **Action Taken When the DTC Sets**

- DTCs P127C, P128A, P128B, P128F, P16E4, and P16E5 are Type A DTCs.
- DTCs P128C and P128D are Type B DTCs.
- A message center or an indicator displays Propulsion Power is Reduced and Service Stabilitrak.

#### **Conditions for Clearing the DTC**

- DTCs P127C, P128A, P128B, P128F, P16E4, and P16E5 are Type A DTCs.
- DTCs P128C and P128D are Type B DTCs.

#### **Diagnostic Aids**

- A high resistance condition on the fuel pressure/temperature sensor circuits could cause a DTC to set.
- Inspect for a contaminated fuel system.

#### **Reference Information**

Schematic Reference

#### **Engine Controls Schematics (Buick with LE2)**

Connector End View Reference

#### **COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)**

Powertrain Component View

#### **Powertrain Component Views (Buick)**

Description and Operation

#### **Fuel System Description**

Electrical Information Reference

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

DTC Type Reference

#### **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

## Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify that DTC P0641, P0651, P0697, or P06A3 is not set.
  - **If any of the DTCs are set**  
  
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.
  - **If none of the DTCs are set**
3. Verify that DTC P0182, P0183, P0187, P0188, P111F, P126E, P126F, P127C, P128A, P128B, P128C, P128D, P128F, P16E4, or P16E5 are not set.
  - **If DTC P128A, P128B, P128C, P128D, or P128F are the only DTCs set**  
  
Replace the B310 Fuel Pressure/Temperature Sensor.
  - **If DTC P0183, P0184, P0187, P0188, P111F, P126E, P126F, P127C, P16E4, or P16E5 is set with any of the DTCs**  
  
Refer to Circuit/System Testing.
  - **If none of the DTCs are set**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
5. Verify the DTC does not set.
  - **If the DTC sets**  
  
Refer to Circuit/System Testing.
  - **If the DTC does not set**
6. All OK.

## Circuit/System Testing

**NOTE:**        **Disconnecting the fuel pressure/temperature sensor harness connector causes additional DTCs to set.**

1. Ignition/Vehicle OFF, and all vehicle systems OFF, disconnect the harness connector at B310 Fuel Pressure/Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5  $\Omega$  between the low reference circuit terminal 1 and ground.
  - **If 5  $\Omega$  or greater**
    1. Ignition/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for less than 2  $\Omega$  in the low reference circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K20 Engine Control Module.
  - **If less than 5  $\Omega$**
3. Ignition/Vehicle ON.
4. Test for 4.8-5.2 V between the 5 V reference circuit terminal 2 and ground.
  - **If less than 4.8 V**
    1. Ignition/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the 5 V reference circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    3. Test for less than 2  $\Omega$  in the 5 V reference circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.

- If less than 2  $\Omega$ , replace the K20 Engine Control Module.
- **If greater than 5.2 V**
  1. Ignition/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, ignition/vehicle ON.
  2. Test for less than 1 V between the 5 V reference circuit and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V, replace the K20 Engine Control Module.
- **If between 4.8-5.2 V**
- 5. Test for 4.8-5.2 V between the signal circuit terminal 3 and ground.
  - **If less than 4.8 V**
    1. Ignition/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    3. Test for less than 2  $\Omega$  in the signal circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K20 Engine Control Module.
  - **If greater than 5.2 V**
    1. Ignition/Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, ignition/vehicle ON.
    2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K20 Engine Control Module.
  - **If between 4.8-5.2 V**- 6. Replace the B310 Fuel Pressure/Temperature Sensor.

### Repair Instructions

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

- Refer to [Fuel Injection Fuel Rail Fuel Pressure Sensor Replacement](#) for B310 Fuel Pressure/Temperature Sensor
- Refer to [Control Module References](#) for K20 Engine Control Module replacement, programming, and setup

## DTC P135A: IGNITION COIL SUPPLY VOLTAGE CIRCUIT BANK 1

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptor

### DTC P135A

Ignition Coil Supply Voltage Circuit Bank 1

### Diagnostic Fault Information

| Circuit | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|---------|-----------------|----------------------|------------------|--------------------|
|         |                 |                      |                  |                    |

| Circuit          | Short to Ground                                                      | Open/High Resistance                                                 | Short to Voltage | Signal Performance |
|------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|------------------|--------------------|
| Ignition Voltage | P0201, P0202, P0203, P0204, P0300, P0351, P0352, P0353, P0354, P135A | P0201, P0202, P0203, P0204, P0300, P0351, P0352, P0353, P0354, P135A | -                | -                  |

### Circuit/System Description

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

### Conditions for Running the DTC

- Delay starting at ignition On for 5 engine revolutions.
- Ignition Run/Crank relay voltage is greater than 5 V
- PT relay voltage is greater than 11 V

The DTC runs continuously when the above conditions are met.

### Conditions for Setting the DTC

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

### Action Taken When the DTC Sets

DTC P135A is a Type B DTC.

### Conditions for Clearing the DTC

DTC P135A is a Type B DTC.

### Reference Information

Schematic Reference

### Engine Controls Schematics (Buick with LE2)

Connector End View Reference

### COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)

Description and Operation

### Electronic Ignition System Description

Electrical Information Reference

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

Scan Tool Reference

### Control Module References

### Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Ignition 1 Signal parameter displays On.
  - If On is not displayed

Refer to Circuit/System Testing.

- **If On is displayed**

3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

5. All OK.

### Circuit/System Testing

1. Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
2. Connect a 3 A fused jumper wire between the control circuit terminal 67 and ground, ignition ON.
3. Verify a test lamp illuminates between the ignition circuit terminal 51 and ground.

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

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

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

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

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

- **If the test lamp illuminates**

4. Replace the K20 Engine Control Module.

### Repair Instructions

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

- Refer to [Ignition Coil Replacement](#)
- Refer to [Control Module References](#) for engine control module replacement, programming, and setup

## DTC P1400: COLD START EMISSION REDUCTION CONTROL SYSTEM

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptor

## DTC P1400

### Cold Start Emission Reduction Control System

#### Circuit/System Description

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

- Spark advance
- Engine airflow
- Engine coolant temperature
- Engine run time

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

#### Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0114, P0116, P0117, P0118, P0121, P0122, P0123, P0201, P0202, P0203, P0204, P0222, P0223, P0300, P0301, P0302, P0303, P0304, P0335, P0336, P0351, P0352, P0353, P0354, P0641, P0651, P0697, P06A3, P2122, P2123, P2127, P2128, P2135, and P2138 are not set.
- The engine coolant temperature (ECT) is between  $-12$  to  $+56^{\circ}\text{C}$  ( $10$ - $132^{\circ}\text{F}$ ).
- The calculated 3-way catalyst temperature is colder than  $500^{\circ}\text{C}$  ( $932^{\circ}\text{F}$ ).
- The barometric (BARO) pressure is greater than 75 kPa.
- The engine control module (ECM) will exit the diagnostic if the calculated 3-way catalyst temperature is greater than  $1,000^{\circ}\text{C}$  ( $1832^{\circ}\text{F}$ ) when the engine run time is greater than 17 s.
- Vehicle speed is less than 1.6 km/h (1 mph).
- The accelerator pedal is not depressed.
- The ECM will exit the diagnostic if the engine run time is greater than a calibrated value.
- This DTC runs within the first 15 s of start-up. This diagnostic runs once per trip when a cold start has been determined.

#### Conditions for Setting the DTC

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

#### Action Taken When the DTC Sets

DTC P1400 is a Type A DTC.

#### Conditions for Clearing the DTC

DTC P1400 is a Type A DTC.

#### Reference Information

Schematic Reference

#### Engine Controls Schematics (Buick with LE2)

Connector End View Reference

#### COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)

Electrical Information Reference

- Circuit Testing
- Connector Repairs

- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

## [Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

### [Circuit/System Verification](#)

1. Verify that none of the conditions listed below exists with the air intake system:

- Damage, restriction, or modification
- Dirty or deteriorating air filter element
- Crankcase ventilation system for correct operation
- Water intrusion
- Vacuum leak and other unmetered air downstream of the mass air flow (MAF) sensor
- Intake manifold leak
- **If any of the above conditions exist**

Repair as necessary.

- **If none of the conditions exist**

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

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

Repair as necessary.

- **If none of the conditions exist**

3. If all of the above conditions test normal, inspect for an engine mechanical condition that could alter the air flow into the combustion chamber. Refer to [Symptoms - Engine Mechanical](#) .

- **If a condition exists, repair or replace as necessary**
- **If none of the conditions exists**

4. Vehicle OFF, allow the engine to cool to be within the temperatures listed in the Conditions for Running the DTC.

5. Engine running.

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

7. Verify the DTC does not set.

- **If the DTC sets**

Refer to step 1

- **If the DTC is not set**

8. All OK.

### [Repair Instructions](#)

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

**DTC P150C: TRANSMISSION CONTROL MODULE ENGINE SPEED REQUEST SIGNAL MESSAGE COUNTER INCORRECT**

### [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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

## DTC Descriptor

### DTC P150C

Transmission Control Module Engine Speed Request Signal Message Counter Incorrect

## Circuit/System Description

To improve vehicle shift feel, the transmission control module (TCM) is constantly sending the ECM serial data messages with requests to modify engine speed or torque. These 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 P150C when it detects a discrepancy in the structure of this message causing its integrity to be questioned.

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

## Conditions for Running the DTC

- DTCs P0506, P0507, or U0101 are not set.
- The engine is running for greater than 0.5 s.
- The DTC runs continuously when the above conditions are met.

## Conditions for Setting the DTC

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

## Action Taken When the DTC Sets

DTC P150C is a Type B DTC.

## Conditions for Clearing the DTC

DTC P150C is a Type B DTC.

## Reference Information

Description and Operation

## Data Link Communications Description and Operation

DTC Type Reference

## Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

## Circuit/System Verification

### NOTE:

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

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

- **If any other DTCs are set**

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

- **If only DTC P150C is set**

2. Replace the K71 Transmission Control Module.
3. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the freeze frame/failure records data.
4. Verify the DTC does not set.

- **If the DTC sets**

Replace the K20 Engine Control Module.

- **If the DTC does not set**

5. All OK.

### Repair Instructions

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

Refer to [Control Module References](#) for ECM or TCM replacement, programming, and setup

## DTC P1516, P2101, P2119, OR P2176: THROTTLE ACTUATOR CONTROL (TAC) MODULE

### Diagnostic Instructions

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

### DTC Descriptor

#### DTC P1516

Throttle Actuator Control (TAC) Module Throttle Actuator Position Performance

#### DTC P2101

Throttle Actuator Position Performance

#### DTC P2119

Throttle Closed Position Performance

#### DTC P2176

Minimum Throttle Position Not Learned

### Diagnostic Fault Information

| Circuit         | Short to Ground     | Open/High Resistance | Short to Voltage | Signal Performance  |
|-----------------|---------------------|----------------------|------------------|---------------------|
| Control - Close | P1516, P2101        | P1516, P2101         | P1516, P2101     | P1516, P2101, P2176 |
| Control - Open  | P1516, P2101, P2119 | P1516, P2101         | P1516, P2101     | P1516, P2101, P2176 |

### Circuit/System Description

| Circuit         | Description                                                                   |
|-----------------|-------------------------------------------------------------------------------|
| Control - Close | The output circuit is switched from ground to 12 V to activate the component. |
| Control - Open  | The output circuit is switched from ground to 12 V to activate the component. |

| Component                 | Description                                                                                                                                                                                                                                                                                                                  |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| K20 Engine Control Module | The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.                                                                                          |
| Q38 Throttle Body         | The throttle valve is actuated by a bidirectional DC motor. A spring pulls the valve to a rest or default position, in which the valve is almost closed. The throttle actuator motor can push against the force of the spring to open or close the valve. The more current flow through the motor, the more the valve moves. |

The ECM determines the driver's intent based on input from the accelerator pedal position sensors, then calculates the appropriate throttle response based on the throttle position sensors.

### Conditions for Running the DTC

#### P1516

- DTC P0606, P1682 = Not set
- Ignition Voltage = Greater than 6.4 V
- Reduced Engine Power = Not Activated
- Desired Throttle Position = Steady State - For greater than 4 s

DTC runs continuously when the above conditions are met.

#### P2101 Condition 1

- DTC P0606, P1682 = Not set
- Ignition Voltage = Greater than 6.4 V
- Reduced Engine Power = Not Activated
- Engine = Running

#### Condition 2

- Engine = Not Running
- Ignition Voltage = Greater than 8.4 V
- Throttle Position = Learned
- Throttle Actuator Control System = Active
- Battery Saver Mode = Not Activated

DTC runs continuously when the above conditions are met.

#### P2119

- DTC P0122, P0123, P0222, P0223, P06A3 = Not set
- Battery Saver Mode = Not Activated
- Reduced Engine Power = Not Activated
- Ignition Voltage = Greater than 5.5 V
- Throttle Actuator Control System = Not Activated

DTC runs continuously when the above conditions are met.

#### P2176

- Ignition Voltage = Greater than 6.4 V
- Reduced Engine Power = Not Activated
- Throttle Position Learn = Active

DTC runs continuously when the above conditions are met for greater than 2 s.

### Conditions for Setting the DTC

#### P1516

- The following parameters are not within 2% of each other:
  - Desired Throttle Position
  - Throttle Position

#### DTC P2101 Condition 1

- The following parameters are not within 10% of each other:
  - Desired Throttle Position
  - Throttle Position

#### Condition 2

- Throttle Position Learn = Active
- Throttle Position = Greater than 36%

#### Condition 3

- Reduced Engine Power = Active
- Throttle Position = Greater than 35%

#### P2119

The throttle blade has not reached the closed position after the engine has been turned off.

#### P2176

Minimum Throttle Position Not Learned = Exceeded Number of Attempts

### Actions Taken When the DTC Sets

- DTC P1516 is a Type B DTC.
- DTCs P2101, P2176 are Type A DTCs.
- DTC P2119 is a Type C DTC.
- Reduced Engine Power = Active
- P16 Instrument Cluster = Reduced Engine Power
- Under certain conditions, the control module commands the engine Off.

### Conditions for Clearing the DTC

- DTC P1516 is a Type B DTC.
- DTCs P2101, P2176 are Type A DTCs.
- DTC P2119 is a Type C DTC.

### Diagnostic Aids

- A high resistance condition on the throttle position and throttle actuator control circuits could cause a DTC to set.
- A weak battery may cause this DTC to set.
- If the throttle blade becomes stuck, a DTC will set. Depending on the position of the throttle blade, the ECM may enter Engine Shutdown Mode. The ECM will disable fuel and de-energize the throttle actuator. If the condition remains present during the next ignition cycle, the ECM may disable engine cranking. Inspect the throttle body assembly for a stuck throttle blade if a throttle actuator DTC is current and the engine won't crank.

- Inspect for a condition in which the throttle blade may have been held open. For example, ice may have formed in the throttle bore causing the throttle blade not to close.
- Under cold start conditions, it might happen briefly that the desired and the actual throttle blade position do not match.

## Reference Information

Schematic Reference

### Engine Controls Schematics (Buick with LE2)

Connector End View Reference

### COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)

Description and Operation

### Throttle Actuator Control (TAC) System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

### Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

### Control Module References

### Circuit/System Verification

1. Ignition On/Vehicle In Service Mode
2. Verify DTC P0121, P0122, P0123, P0222, P0223, P0562, P0621, P0622, P16A0-P16A2, P2135 is not set.
  - **If any of the DTCs are set**  
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)
  - **If none of the DTCs are set**
3. Verify the scan tool parameter: Throttle Body Idle Air Flow Compensation = Less than 90%
  - **If 90% or greater**  
Refer to [Throttle Body Inspection and Cleaning](#) .
  - **If less than 90%**
4. Clear the DTCs.
5. Ignition/Vehicle Off
6. Ignition On/Vehicle In Service Mode
7. Perform the scan tool control function: Throttle Sweep

Verify the scan tool parameter: TAC Motor = Enabled

- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

8. Verify the scan tool parameter: TAC Motor = Enabled

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: Q38 Throttle Body
- Wiggle the harness and connector: K20 Engine Control Module
- **If not the specified state**

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

- **If the specified state**

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

10. Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **If the DTC does not set**

11. All OK.

### Circuit/System Testing

1. Ignition/Vehicle Off

2. Verify the following conditions do not exist:

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

- The throttle blade has not reached the closed position after the engine has been turned off.
- The throttle blade is not closed by the spring.
- The throttle blade is binding in open or closed position.
- **If a condition exists**

Replace the component: Q38 Throttle Body

- **If no condition exists**

**NOTE:** Disconnecting the component electrical connector causes additional DTCs to set.

3. Disconnect the electrical connector: Q38 Throttle Body

4. Ignition On/Vehicle In Service Mode

5. Test for 6 to 9 V between the test points:

- Control circuit terminal 1 & Ground
- Control circuit terminal 2 & Ground
- **If less than 6 V**

1. Ignition/Vehicle Off

2. Disconnect the electrical connector: X2 @ K20 Engine Control Module

3. Test for infinite resistance between the test points:

- Control circuit terminal 1 @ Component harness & Ground
- Control circuit terminal 2 @ Component harness & Ground
- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

4. Test for less than 2  $\Omega$  between the test points:

- Control circuit terminal 1 @ Component harness & The other end of the circuit @ Control module harness
- Control circuit terminal 2 @ Component harness & The other end of the circuit @ Control module harness
- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the component: K20 Engine Control Module

• **If greater than 9 V**

1. Ignition/Vehicle Off

2. Disconnect the electrical connector: X2 @ K20 Engine Control Module

3. Ignition On/Vehicle In Service Mode

4. Test for less than 1 V between the test points:

- Control circuit terminal 1 @ Component harness & Ground
- Control circuit terminal 2 @ Component harness & Ground
- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, replace the component: K20 Engine Control Module

• **If between 6 and 9 V**

6. Ignition/Vehicle Off

7. Disconnect the electrical connector: X2 @ K20 Engine Control Module

8. Test for less than 2  $\Omega$  between the test points:

- Control circuit terminal 1 @ Component harness & The other end of the circuit @ Control module harness
- Control circuit terminal 2 @ Component harness & The other end of the circuit @ Control module harness
- **If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.**
- **If less than 2  $\Omega$**

9. Test or replace the component: Q38 Throttle Body

### Repair Instructions

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

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

## DTC P163A: CONTROL MODULE FUEL PRESSURE REGULATOR 1 CONTROL SYSTEM CIRCUITRY PERFORMANCE

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide 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). The ECM monitors the current required to control fuel pressure regulator and compares the current value to calibrated low and high thresholds.

### Conditions for Running the DTC

- DTC P0016, P0017, P0090, P0091, P0092, P00C8, P00C9, P00CA, P0111, P0112, P0113, P0114, P0117, P0118, P0119, P0128, P0192, P0193, P0335, P0336, P0340, P0341, P0365, P0366, P0627, P0628, P0629, or P1682 are not present.
- The engine is running.
- Battery voltage is greater than or equal to 11 V.
- Low side fuel pressure is greater than 300 kPa (43.5 PSI).
- Intake air temperature (IAT) is warmer than or equal to -10Â°C (14Â°F).
- Barometric pressure is greater than 70 kPa.
- Fuel temperature is between -10Â°C and +132Â°C (14Â°F and 270Â°F).
- 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 B DTC.

### Conditions for Clearing the DTC

DTC P163A is a Type B DTC.

### Reference Information

Schematic Reference

### Engine Controls Schematics (Buick with LE2)

Connector End View Reference

### COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)

Powertrain Component View

### Powertrain Component Views (Buick)

Description and Operation

### Fuel System Description

Electrical Information Reference

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

DTC Type Reference

### Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

### Control Module References for scan tool information

### Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify that no other DTCs are set.

- **If any other DTCs are set**

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

- **If no other DTCs are set**

3. Verify that DTC P163A is not set.

- **If the DTC is set**

Refer to Circuit/System Testing.

- **If the DTC is not set**

4. Operate the vehicle within the Conditions for Running the DTC. It may be helpful to operate the vehicle within the conditions identified from the Freeze Frame/Failure Records data.

5. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

6. All OK.

### Circuit/System Testing

1. Ignition/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the G18 High Pressure Fuel Pump. It may take up to 2 min for all vehicle systems to power down.

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

2. Test for 1.09-1.21  $\Omega$  at 20 $^{\circ}\text{C}$  (68 $^{\circ}\text{F}$ ) between the high control circuit terminal 2 and the low control circuit terminal 1 on the G18 High Pressure Fuel Pump.

- **If not between 1.09-1.21  $\Omega$**

Replace the G18 High Pressure Fuel Pump.

- **If between 1.09-1.21  $\Omega$**

3. Ignition ON, verify that a test lamp does not illuminate between ground and the terminals listed below:

- High control circuit terminal 2
- Low control circuit terminal 1

- **If the test lamp illuminates**

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

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

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

- **If the test lamp does not illuminate**

4. Test for B+ between the high control circuit terminal 2 and ground.

- **If less than B+**

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

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

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

3. Test for less than 2  $\Omega$  in the high control circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.

- If less than 2  $\Omega$ , replace the K20 Engine Control Module.
  - **If B+**
5. Ignition OFF, connect a test lamp between the high control circuit terminal 2 and the low control circuit terminal 1.
  6. Ignition ON, command the Fuel Pressure Regulator On and Off with a scan tool.
  7. Verify the test lamp turns ON and OFF.
    - **If the test lamp does not turn ON and OFF**
      1. Ignition OFF, disconnect the appropriate harness connector at the K20 Engine Control Module.
      2. Test for infinite resistance between the low control circuit terminal 1 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
      3. Test for less than 2  $\Omega$  in the low control circuit end to end.
        - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
        - If less than 2  $\Omega$ , replace the K20 Engine Control Module.
    - **If the test lamp turns ON and OFF**
  8. Test or replace the G18 High Pressure Fuel Pump.

## Component Testing

### Static Test

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  $\Omega$  in order to prevent misdiagnosis.
2. Test for 1.09-1.21  $\Omega$  at 20 $^{\circ}$ C (68 $^{\circ}$ F) between the high control circuit terminal 2 and the low control circuit terminal 1.
  - **If not between 1.09-1.21  $\Omega$**   
Replace the G18 High Pressure Fuel Pump.
  - **If between 1.09-1.21  $\Omega$**
3. Test for infinite resistance between each terminal and the G18 High Pressure Fuel Pump housing.
  - **If less than infinite resistance**  
Replace the G18 High Pressure Fuel Pump.
  - **If infinite resistance**
4. All OK

## Repair Instructions

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

- Refer to [Fuel Injection Pump Replacement](#) for G18 High Pressure Fuel Pump replacement
- Refer to [Control Module References](#) for control module replacement, programming and setup
- Perform the Fuel Rail Pressure Relief Valve Reset procedure, if supported on the scan tool.

## DTC P16A7, P16AF, OR P16B3: ENGINE CONTROLS IGNITION RELAY FEEDBACK CIRCUIT 2

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

## DTC Descriptors

### DTC P16A7

Engine Controls Ignition Relay Feedback Circuit 2

### DTC P16AF

Engine Controls Ignition Relay Feedback Circuit 2 Low Voltage

### DTC P16B3

Engine Controls Ignition Relay Feedback Circuit 2 High Voltage

## Diagnostic Fault Information

### Engine Controls Ignition Relay

| Circuit                   | Short to Ground            | Open/High Resistance              | Short to Voltage                         |
|---------------------------|----------------------------|-----------------------------------|------------------------------------------|
| Relay Coil Supply Voltage | P0689, P1682, P16A7, P16AF | P0685, P0689, P1682, P16A7, P16AF | -                                        |
| Relay Control Circuit     | P0686, P0690, P16B3        | P0685, P0689, P1682, P16A7, P16AF | P0685, P0687, P0689, P1682, P16A7, P16AF |
| Relay Feedback Circuit    | P0689, P1682, P16A7, P16AF | P0689, P1682, P16A7, P16AF        | P0690, P16B3                             |

## Typical Scan Tool Data

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

| Circuit                                                                                                                                                                                                                                                                                                                                                                                                                      | Short to Ground | Open        | Short to Voltage |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------|------------------|
| <b>Operating Conditions:</b> Component commanded OFF<br><b>Parameter Normal Range:</b> The following illustrates the normal parameter state with no circuit conditions: <ul style="list-style-type: none"><li>• Component OFF - OK for Open/Low Voltage Test Status and Not Run for High Voltage Test Status</li><li>• Component ON - Not Run for Open/Low Voltage Test Status and OK for High Voltage Test Status</li></ul> |                 |             |                  |
| B+                                                                                                                                                                                                                                                                                                                                                                                                                           | Malfunction     | Malfunction | -                |
| Control                                                                                                                                                                                                                                                                                                                                                                                                                      | Malfunction     | Malfunction | Not Run          |

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

| Circuit                                                                                                                                                                                                                                                                                                                                                                                                                     | Short to Ground | Open    | Short to Voltage |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------|------------------|
| <b>Operating Conditions:</b> Component commanded ON<br><b>Parameter Normal Range:</b> The following illustrates the normal parameter state with no circuit conditions: <ul style="list-style-type: none"><li>• Component OFF - OK for Open/Low Voltage Test Status and Not Run for High Voltage Test Status</li><li>• Component ON - Not Run for Open/Low Voltage Test Status and OK for High Voltage Test Status</li></ul> |                 |         |                  |
| B+                                                                                                                                                                                                                                                                                                                                                                                                                          | Not Run         | Not Run | -                |
| Control                                                                                                                                                                                                                                                                                                                                                                                                                     | Not Run         | Not Run | Malfunction      |

## Circuit/System Description

There are 3 ignition voltage circuits supplied to the engine control module (ECM). Two are supplied by the engine controls ignition relay, and the other is supplied by the ignition main relay. The ECM monitors and compares the ignition voltage supplied by the 2 relays.

### Conditions for Running the DTC

#### P16A7

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

#### P16AF

- The engine controls ignition relay is commanded ON.
- Ignition 1 signal voltage is greater than 11 V.
- The DTC runs continuously when the above conditions are met.

#### P16B3

The DTC runs when the engine controls ignition relay is commanded OFF.

### Conditions for Setting the DTC

#### P16A7

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

#### P16AF

The ECM detects the engine controls ignition relay feedback circuit 2 is less than 5 V.

#### P16B3

The ECM detects the engine controls ignition relay feedback circuit 2 is greater than 4 V for greater than 5 s.

### Action Taken When the DTC Sets

- DTC P16A7 is a Type A DTC.
- DTCs P16AF and P16B3 are Type C DTCs.

### Conditions for Clearing the DTC

- DTC P16A7 is a Type A DTC.
- DTCs P16AF and P16B3 are Type C DTCs.

### Diagnostic Aids

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

### Reference Information

#### Schematic Reference

- [Engine Controls Schematics \(Buick with LE2\)](#)
- [Power Distribution Schematics \(Buick\)](#)

#### Connector End View Reference

Component View Reference

**Powertrain Component Views (Buick)**

Electrical Information Reference

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

DTC Type Reference

**Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

**Control Module References** for scan tool information

**Circuit/System Verification**

**NOTE:**

- **A short to voltage on other components may cause DTC P16B3 to set. If any other DTC is set, diagnose that DTC first.**
- **If you were sent here from Engine Cranks But Does Not Run, proceed to Circuit/System Testing.**

1. Ignition ON, observe the scan tool DTC information. Verify DTC P16A7, P16AF, or P16B3 is not set.

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

Refer to Circuit/System Testing.

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

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

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

3. All OK.

**Circuit/System Testing**

**NOTE:**

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

1. Ignition OFF, disconnect the KR75 Engine Controls Ignition Relay.

2. Verify a test lamp illuminates between ground and the B+ terminals listed below:

- Terminal 85
- Terminal 30
- **If the test lamp does not illuminate**

Replace the front compartment fuse block.

- If the test lamp illuminates

**NOTE:**

- High resistance in the circuit/underhood fuse block for either the KR75 Engine Controls Ignition Relay or the KR73 Ignition Main Relay can cause DTC P16A7 to set.
- A short to voltage on any of the circuits supplied by the engine controls ignition relay can cause DTC P16B3 to set.

3. Ignition ON.

4. Verify that a test lamp does not illuminate between the ignition voltage circuit terminal 87 and ground.

- **If the test lamp illuminates**

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

2. Ignition ON.

3. Test for less than 1 V between ground and connector terminal 73.

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

- **If the test lamp does not illuminate**

5. Ignition OFF, connect a 20 A fused jumper wire between the B+ circuit terminal 30 and the ignition voltage circuit terminal 87.

6. Ignition ON.

7. Verify the scan tool Engine Controls Ignition Relay Feedback Signal parameter displays B+.

- **If B+ is not displayed**

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

2. Test for less than 2  $\Omega$  in the relay switch ignition voltage circuit end to end.

- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$

3. Test for infinite resistance between the relay switch ignition voltage circuit and ground.

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

- **If B+ is displayed**

8. Ignition OFF, connect a DMM, set to the diode setting, between control circuit terminal 86 and ground.

9. Verify the DMM displays OL.

- **If OL is not displayed**

1. Disconnect the X1 harness connector at the K20 Engine Control Module.

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

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

- **If OL is displayed**

10. Ignition ON.

11. Verify the DMM displays less than 1 V.

- **If 1 V or greater**

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

2. Ignition ON.

3. Test for less than 1 V on the relay control circuit.

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

4. Test for less than 2  $\Omega$  in the control circuit end to end.

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

- **If less than 1 V**

12. Test or replace the KR75 Engine Controls Ignition Relay.

## Component Testing

### Relay Test

1. Ignition OFF, disconnect the KR75 Engine Controls Ignition Relay.
2. Test for 70-110  $\Omega$  between terminals 85 and 86:

- **If less than 70  $\Omega$  or greater than 110  $\Omega$**

Replace the KR75 Engine Controls Ignition Relay.

- **If between 70-110  $\Omega$**

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

- 30 and 86
- 30 and 87
- 30 and 85
- 85 and 87
- **If less than infinite resistance**

Replace the KR75 Engine Controls Ignition Relay.

- **If infinite resistance**

4. Install a 20 A fused jumper wire between relay terminal 85 and 12 V. Install a jumper wire between relay terminal 86 and ground.
5. Test for less than 2  $\Omega$  between terminals 30 and 87.

- **If 2  $\Omega$  or greater**

Replace the KR75 Engine Controls Ignition Relay.

- **If less than 2  $\Omega$**

6. All OK.

## Repair Instructions

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

- Refer to [Front Compartment Fuse Block Replacement](#).
- Refer to [Relay Replacement \(Attached to Wire Harness\)](#), [Relay Replacement \(Within an Electrical Center\)](#).
- Refer to [Control Module References](#) for engine control module replacement, programming, and setup.

## DTC P2096 OR P2097: POST CATALYST FUEL TRIM SYSTEM LOW/HIGH LIMIT

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptor

#### DTC P2096

Post Catalyst Fuel Trim System Low Limit

## Post Catalyst Fuel Trim System High Limit

### Circuit Description

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

### Conditions for Running the DTC

- DTC P0016, P0017, P0030, P0036, P0053, P0054, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0128, P0131, P0132, P0133, P0134, P0135, P0137, P0138, P013A, P013B, P013E, P013F, P0140, P0141, P015A, P015B, P0178, P0179, P0201, P0202, P0203, P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0300, P0301, P0302, P0303, P0304, P0340, P0341, P0365, P0366, P0411, P0442, P0443, P0446, P0449, P0452, P0453, P0455, P0458, P0459, P0496, P0498, P0499, P111E, P1133, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P219A, P2227, P2228, P2229, P2230, P2269, P2270, P2271, P2440, P2444, or P2A00 is not set.
- The barometric pressure (BARO) is greater than 70 kPa (10.2 PSI).
- The manifold absolute pressure (MAP) is between 0-200 kPa (0-29 PSI).
- The intake air temperature (IAT) is between -20Â°C and +200Â°C (-4 and +392Â°F).
- The start up engine coolant temperature is warmer than -20Â°C (-4Â°F).
- The fuel control intrusive diagnostics are not active.
- The engine is operating under light acceleration, heavy acceleration, or cruise conditions.
- DTCs P2096 and P2097 run continuously when the conditions above have been met.

### Conditions for Setting the DTC

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

### Action Taken when the DTC Sets

DTCs P2096 and P2097 are Type B DTCs.

### Conditions for Clearing the MIL/DTC

DTCs P2096 and P2097 are Type B DTCs.

### Diagnostic Aids

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

### Reference Information

Schematic Reference

### Engine Controls Schematics (Buick with LE2)

Connector End View Reference

### COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)

Component View Reference

Electrical Information Reference

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

DTC Type Reference

**Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

**Control Module References** for scan tool information

**Circuit/System Verification**

1. Ignition ON.
2. Verify no other HO2S or fuel trim DTC is set.
  - **If any other HO2S or fuel trim DTC is set**  
Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for further diagnosis.
  - **If no other HO2S or fuel trim DTC is set**
3. Verify DTC P2096 or P2097 is not set.
  - **If a DTC is set**  
Refer to Circuit/System Testing.
  - **If no DTC is set**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed in the Freeze Frame/Failure Records data.
5. Verify DTC P2096 or P2097 is not set.
  - **If a DTC is set**  
Refer to Circuit/System Testing.
  - **If no DTC is set**
6. All OK.

**Circuit/System Testing**

Inspect for the conditions listed below:

**P2096**

- Air intake duct collapsed or restricted.
- Air filter dirty or restricted.
- Objects blocking the throttle body.
- Excessive fuel in the crankcase. Change engine oil as necessary.
- Rich fuel injectors. Refer to **Fuel Injector Diagnosis**.
- Excessive fuel system pressure. Refer to **Fuel System Diagnosis**.
- Fuel contamination. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis**.
- Fuel saturation of the evaporative emissions (EVAP) canister
- Stuck open or leaking EVAP purge valve
- Restricted exhaust. Refer to **Symptoms - Engine Exhaust** .

- Improperly operating crankcase ventilation system. Refer to [Crankcase Ventilation System Inspection/Diagnosis](#) .

## P2097

- Exhaust system leaks. Refer to [Symptoms - Engine Exhaust](#) .
- Split, kinked, or improperly connected vacuum hoses
- Insufficient fuel in the tank
- Leaks in the air induction system and air intake ducts
- Missing air filter element
- Cracked evaporative canister
- Evaporative pipes plugged, obstructed, or leaking
- Crankcase ventilation system leaking. Refer to [Crankcase Ventilation System Inspection/Diagnosis](#) .
- Engine vacuum leaks
- Low fuel system pressure. Refer to [Fuel System Diagnosis](#).
- Contaminated fuel. Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#).
- Lean fuel injectors. Refer to [Fuel Injector Diagnosis](#).
- If a condition is found

Repair as necessary.

### Repair Instructions

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

Perform the scan tool Fuel Trim Reset after completing the repair.

## **DTC P2122, P2123, P2127, P2128, OR P2138: ACCELERATOR PEDAL POSITION (APP) SENSORS 1-2**

### Diagnostic Instructions

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

### DTC Descriptor

#### **DTC P2122**

Accelerator Pedal Position (APP) Sensor 1 Circuit Low Voltage

#### **DTC P2123**

Accelerator Pedal Position (APP) Sensor 1 Circuit High Voltage

#### **DTC P2127**

Accelerator Pedal Position (APP) Sensor 2 Circuit Low Voltage

#### **DTC P2128**

Accelerator Pedal Position (APP) Sensor 2 Circuit High Voltage

#### **DTC P2138**

Accelerator Pedal Position (APP) Sensors 1-2 Not Plausible

## Diagnostic Fault Information

| Circuit                      | Short to Ground | Open/High Resistance | Short to Voltage           | Signal Performance |
|------------------------------|-----------------|----------------------|----------------------------|--------------------|
| 5V Reference - APP Sensor 1  | P06A3           | P2122, P2138         | P06A3                      | P2138              |
| Signal - APP Sensor 1        | P2122           | P2122, P2138         | P2123                      | P2138              |
| Low Reference - APP Sensor 1 | -               | P2123, P2138         | -                          | P2138              |
| 5V Reference - APP Sensor 2  | P0108, P0697    | P2127, P2138         | P0107, P0522, P0532, P0697 | P2138              |
| Signal - APP Sensor 2        | P2127           | P2127, P2138         | P2128                      | P2138              |
| Low Reference - APP Sensor 2 | -               | P2128, P2138         | -                          | P2138              |

## Typical Scan Tool Data

### APP Sensor 1

| Circuit                                                                                      | Short to Ground | Open     | Short to Voltage |
|----------------------------------------------------------------------------------------------|-----------------|----------|------------------|
| <b>Operating Conditions:</b> Engine idling.<br><b>Parameter Normal Range:</b> 0.88 to 1.08 V |                 |          |                  |
| 5 V Reference                                                                                | 0 V             | 0 V      | 2 to 4 V         |
| Signal                                                                                       | 0 V             | 0 V      | 4 to 5 V         |
| Low Reference                                                                                | -               | 4 to 5 V | -                |

### APP Sensor 2

| Circuit                                                                                      | Short to Ground | Open     | Short to Voltage |
|----------------------------------------------------------------------------------------------|-----------------|----------|------------------|
| <b>Operating Conditions:</b> Engine idling.<br><b>Parameter Normal Range:</b> 0.39 to 0.59 V |                 |          |                  |
| 5 V Reference                                                                                | 0 V             | 0 V      | 1 to 3 V         |
| Signal                                                                                       | 0 V             | 0 V      | 4 to 5 V         |
| Low Reference                                                                                | -               | 4 to 5 V | -                |

## Circuit/System Description

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

| Component                              | Description                                                                                                                                                                                                                         |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| B107 Accelerator Pedal Position Sensor | The sensor is an input to the control module. The input voltage varies depending on the position of the sensor.                                                                                                                     |
| K20 Engine Control Module              | The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly. |

The pedal assembly contains 2 potentiometer-type accelerator pedal position sensors, which are not serviceable. When the accelerator pedal is pressed, the voltages of both sensors goes up. This redundant design enables the ECM to detect if the 2 signals indicate the same accelerator pedal position.

## Conditions for Running the DTC

### DTC P2122, P2123, P2127, P2128

- DTC P0697, P06A3 = Not set

- Ignition = On or Engine Running
- Ignition Voltage = Greater than 6.4 V

DTC runs continuously when the above conditions are met.

### **P2138**

- DTC P0697, P06A3, P2122, P2123, P2127, P2128 = Not set
- Ignition Voltage = Greater than 6.4 V
- Reduced Engine Power = Inactive

DTCs run continuously when the above conditions are met.

### **Conditions for Setting the DTC**

#### **P2122**

APP Sensor 1 = Less than 0.46 V - For greater than 175 ms

#### **P2123**

APP Sensor 1 = Greater than 4.75 V - For greater than 175 ms

#### **P2127**

APP Sensor 2 = Less than 0.33 V - For greater than 175 ms

#### **P2128**

APP Sensor 2 = Greater than 2.6 V - For greater than 175 ms

#### **P2138**

APP Sensor 1 and 2 = Not within a calibrated range - For greater than 188 ms

### **Action Taken When the DTC Sets**

- DTCs P2122, P2123, P2127, P2128, 2138 are Type A DTCs.
- ECM commands the throttle actuator control (TAC) system to operate in a Reduced Engine Power mode.
- A message and/or warning indicator may be displayed to the driver.
- Under certain conditions, the control module commands the engine Off.

### **Conditions for Clearing the DTC**

DTCs P2122, P2123, P2127, P2128, 2138 are Type A DTCs.

### **Diagnostic Aids**

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

### **Reference Information**

Schematic Reference

### **Engine Controls Schematics (Buick with LE2)**

Connector End View Reference

### **COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)**

## Throttle Actuator Control (TAC) System Description

### Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

### DTC Type Reference

## Powertrain Diagnostic Trouble Code (DTC) Type Definitions

### Scan Tool Reference

## Control Module References

### Circuit/System Verification

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

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

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

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

3. Verify the scan tool parameter:

- APP Sensor 1 Circuit Status = OK
- APP Sensor 2 Circuit Status = OK
- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

4. Verify the scan tool parameter:

- APP Sensor 1 = 0.8 to 4.0 V - The value should not spike or drop out while moving the sensor through the entire range.
- APP Sensor 2 = 0.4 to 2.0 V - The value should not spike or drop out while moving the sensor through the entire range.
- **If not in the specified range or does not change**

Refer to: Circuit/System Testing

- **If in the specified range and changes**

5. Verify the scan tool parameter: APP Sensor 1 and 2 = Agree

- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

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

7. Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- If the DTC does not set

8. All OK.

## Circuit/System Testing

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

1. Ignition/Vehicle & All vehicle systems Off

2. Disconnect the electrical connector: B107 Accelerator Pedal Position Sensor

3. Test for less than 5  $\Omega$  between the test points:

- {APP Sensor 1} Low Reference circuit terminal 4 & Ground
- {APP Sensor 2} Low Reference circuit terminal 3 & Ground
- **If 5  $\Omega$  or greater**

1. Disconnect the electrical connector: K20 Engine Control Module

2. Test for less than 2  $\Omega$  between the test points:

- {APP Sensor 1} Low Reference circuit terminal 4 @ Component harness & The other end of the circuit @ Control module harness
- {APP Sensor 2} Low Reference circuit terminal 3 @ Component harness & The other end of the circuit @ Control module harness
- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the component: K20 Engine Control Module

- **If less than 5  $\Omega$**

4. Ignition On/Vehicle In Service Mode

5. Test for 4.8 to 5.2 V between the test points:

- {APP Sensor 1} 5 V Reference circuit terminal 6 & Low Reference circuit terminal 4
- {APP Sensor 2} 5 V Reference circuit terminal 1 & Low Reference circuit terminal 3
- **If less than 4.8 V**

1. Ignition/Vehicle Off

2. Disconnect the electrical connector: K20 Engine Control Module

3. Test for infinite resistance between the test points:

- 5 V Reference circuit terminal 6 @ Component harness & Ground
- 5 V Reference circuit terminal 1 @ Component harness & Ground
- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

4. Test for less than 2  $\Omega$  between the test points:

- 5 V Reference circuit terminal 6 @ Component harness & The other end of the circuit @ Control module harness
- 5 V Reference circuit terminal 1 @ Component harness & The other end of the circuit @ Control module harness
- If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
- If less than 2  $\Omega$ , replace the component: K20 Engine Control Module

- **If greater than 5.2 V**

1. Ignition/Vehicle Off

2. Disconnect the electrical connector: K20 Engine Control Module

3. Ignition On/Vehicle In Service Mode

4. Test for less than 1 V between the test points:

- 5 V Reference circuit terminal 6 @ Component harness & Ground
- 5 V Reference circuit terminal 1 @ Component harness & Ground
- If 1 V or greater, repair the short to voltage on the circuit.

- If less than 1 V, replace the component: K20 Engine Control Module
  - **If between 4.8 and 5.2 V**
6. Verify the scan tool parameter:
    - APP Sensor 1 = Less than 0.2 V
    - APP Sensor 2 = Less than 0.2 V
    - **If 0.2 V or greater**
      1. Ignition/Vehicle Off
      2. Disconnect the electrical connector: K20 Engine Control Module
      3. Ignition On/Vehicle In Service Mode
      4. Test for less than 1 V between the test points:
        - {APP Sensor 1} Signal circuit terminal 5 @ Component harness & Ground
        - {APP Sensor 2} Signal circuit terminal 2 @ Component harness & Ground
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the component: K20 Engine Control Module
    - **If less than 0.2 V**
  7. Connect a 3 A fused jumper wire between the test points:
    - {APP Sensor 1} Signal circuit terminal 5 & 5 V Reference circuit terminal 6
    - {APP Sensor 2} Signal circuit terminal 2 & 5 V Reference circuit terminal 1
  8. Verify the scan tool parameter: = Greater than 4.8 V
    - **If 4.8 V or less**
      1. Ignition/Vehicle Off & Remove Jumper wire(s)
      2. Disconnect the electrical connector: K20 Engine Control Module
      3. Test for infinite resistance between the test points:
        - {APP Sensor 1} Signal circuit terminal 5 @ Component harness & Ground
        - {APP Sensor 2} Signal circuit terminal 2 @ Component harness & Ground
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
      4. Test for less than 2  $\Omega$  between the test points:
        - {APP Sensor 1} Signal circuit terminal 5 @ Component harness & The other end of the circuit @ Control module harness
        - {APP Sensor 2} Signal circuit terminal 2 @ Component harness & The other end of the circuit @ Control module harness
        - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
        - If less than 2  $\Omega$ , replace the component: K20 Engine Control Module
    - **If greater than 4.8 V**
  9. Test or replace the component: B107 Accelerator Pedal Position Sensor

### Repair Instructions

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

- Refer to [Accelerator Pedal with Position Sensor Assembly Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

## DTC P2199: INTAKE AIR TEMPERATURE (IAT) SENSOR 1-2 NOT PLAUSIBLE

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptor

## Intake Air Temperature (IAT) Sensor 1-2 Not Plausible

## Diagnostic Fault Information

## IAT Sensor 1

| Circuit                                                                                    | Short to Ground       | Open/High Resistance         | Short to Voltage       | Signal Performance |
|--------------------------------------------------------------------------------------------|-----------------------|------------------------------|------------------------|--------------------|
| Signal                                                                                     | P0112, P0114**, P2199 | P0111, P0113, P0114**, P2199 | P0113*, P0114**, P2199 | P0111, P2199       |
| Low Reference                                                                              | -                     | P0111, P0113, P0114**, P2199 | P0113*, P0114**        | -                  |
| *Internal ECM or sensor damage may occur if the circuit is shorted to B+.<br>**Where used. |                       |                              |                        |                    |

## IAT Sensor 2

| Circuit                                                                   | Short to Ground                   | Open/High Resistance              | Short to Voltage                   | Signal Performance |
|---------------------------------------------------------------------------|-----------------------------------|-----------------------------------|------------------------------------|--------------------|
| Ignition Voltage                                                          | P0096, P0097, P00F4, P0102, P2199 | P0096, P0097, P00F4, P0102, P2199 | -                                  | P0096              |
| Signal                                                                    | P0096, P0097, P00F5, P2199        | P0096, P0097, P00F4, P0102, P2199 | P0096*, P0097, P00F4, P0102, P2199 | P0096              |
| Ground                                                                    | -                                 | P0096, P0097, P00F4, P0102, P2199 | -                                  | P0096              |
| *Internal ECM or sensor damage may occur if the circuit is shorted to B+. |                                   |                                   |                                    |                    |

## Typical Scan Tool Data

## IAT Sensor 1

| Circuit                                                                                                       | Short to Ground | Open or High Resistance | Short to Voltage |
|---------------------------------------------------------------------------------------------------------------|-----------------|-------------------------|------------------|
| <b>Operating Conditions:</b> Engine Running<br><b>Parameter Normal Range:</b> Varies with ambient temperature |                 |                         |                  |
| Signal                                                                                                        | 150Â°C (302Â°F) | -40Â°C (-40Â°F)         | -40Â°C (-40Â°F)* |
| Low Reference                                                                                                 | -               | -40Â°C (-40Â°F)         | -40Â°C (-40Â°F)* |
| *Internal ECM or sensor damage may occur if the circuit is shorted to B+                                      |                 |                         |                  |

## IAT Sensor 2

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

### Circuit/System Description

The intake air temperature (IAT) sensor 1 is a variable resistor that measures the temperature of the air in the sensor bore. The engine control module (ECM) supplies 5 V to the IAT sensor 1 signal circuit and a ground for the IAT sensor 1 low reference circuit. The signal varies with inlet air temperature and is displayed by the scan tool as  $^{\circ}\text{C}$  ( $^{\circ}\text{F}$ ).

The IAT sensor 2 produces a frequency signal based on the inlet air temperature very close to the humidity sensor within the sensor bore. The signal varies with inlet air temperature and is displayed by the scan tool as  $^{\circ}\text{C}$  ( $^{\circ}\text{F}$ ) and Hertz (Hz). The ECM applies 5 V to the circuit. The signal circuit is shared by the IAT sensor 2 and the humidity sensor. Ignition voltage and ground circuits are also supplied to the multifunction intake air sensor's internal circuits for these sensors:

- IAT sensor 2
- Humidity sensor
- MAF sensor

The multifunction intake air sensor houses the following:

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

### IAT Sensor 1 - Temperature, Resistance, Voltage Table

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

### IAT Sensor 2 - Temperature, Frequency Table

| IAT Sensor 2 | IAT Sensor 2 Frequency | IAT Sensor 2 Temperature                        |
|--------------|------------------------|-------------------------------------------------|
| Cold         | 45 Hz                  | $-40^{\circ}\text{C}$ ( $-40^{\circ}\text{F}$ ) |
| Warm         | 302 Hz                 | $104^{\circ}\text{C}$ ( $219^{\circ}\text{F}$ ) |

### Conditions for Running the DTC

- The ignition is ON.
- Ignition 1 voltage is at least 11 V.
- This DTC runs continuously within the enabling conditions.

### Conditions for Setting the DTC

The ECM detects that the absolute difference between the IAT sensor 1 and the IAT sensor 2 temperatures is greater than  $55^{\circ}\text{C}$  ( $99^{\circ}\text{F}$ ) for longer than 5 s.

### Action Taken When the DTC Sets

DTC P2199 is a Type B DTC.

### Conditions for Clearing the MIL/DTC

DTC P2199 is a Type B DTC.

### Diagnostic Aids

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

Sensor DTCs, check for a circuit problem.

## Reference Information

Schematic Reference

### Engine Controls Schematics (Buick with LE2)

Connector End View Reference

### COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)

Electrical Information Reference

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

Powertrain Component Views

### Powertrain Component Views (Buick)

DTC Type Reference

### Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38522-A Variable Signal Generator

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

## Circuit/System Verification

1. Ignition ON.
2. Verify that DTC P0641, P0651, P0697, or P06A3 is not set.

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

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

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

**NOTE:** To minimize the effects of residual engine heat and sensor internal heating elements, perform Steps 3 and 4 of this verification procedure only if the ignition has been OFF for 8 hours or more.

3. Ignition ON.
4. Verify the following scan tool parameters are within 30Â°C (54Â°F) of each other.
  - Start-Up IAT Sensor 1
  - IAT Sensor 2
  - IAT Sensor 3; where equipped
  - **If not within 30Â°C (54Â°F)**

Refer to Circuit/System Testing.

- **If within 30Â°C (54Â°F)**

5. Engine idling, verify the following scan tool parameters are between:  $-38$  and  $+149^{\circ}\text{C}$  ( $-36$  and  $+300^{\circ}\text{F}$ ).

- IAT Sensor 1
- IAT Sensor 2
- IAT Sensor 3; where equipped
- **If not between:  $-38$  and  $+149^{\circ}\text{C}$  ( $-36$  and  $+300^{\circ}\text{F}$ )**

Refer to Circuit/System Testing.

- **If between:  $-38$  and  $+149^{\circ}\text{C}$  ( $-36$  and  $+300^{\circ}\text{F}$ )**

6. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the freeze frame/failure records data.

7. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

8. All OK

### Circuit/System Testing

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

1. Ignition OFF, and all vehicle systems OFF, it may take up to 2 min. for all vehicle systems to power down. Disconnect the harness connector at the B75C Multifunction Intake Air sensor.

2. Test for less than  $2\ \Omega$  between the low reference circuit terminal 3 and ground.

- **If  $2\ \Omega$  or greater**

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

2. Test for less than  $2\ \Omega$  in the low reference circuit end to end.

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

- **If less than  $2\ \Omega$**

3. Ignition OFF, all vehicle systems OFF, test for less than  $2\ \Omega$  between the ground circuit terminal 7 and ground.

- **If  $2\ \Omega$  or greater**

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

2. Test for less than  $2\ \Omega$  in the ground circuit end to end.

- If  $2\ \Omega$  or greater, repair the open or high resistance in the circuit.
- If less than  $2\ \Omega$ , repair the open/high resistance in the ground connection.

- **If less than  $2\ \Omega$**

4. Ignition ON, verify that a test lamp illuminates between the ignition circuit terminal 5 and ground.

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

1. Ignition OFF, remove the test lamp and remove the fuse for the ignition voltage circuit.

2. Test for less than  $2\ \Omega$  in the ignition voltage circuit end to end.

- If  $2\ \Omega$  or greater, repair the open/high resistance in the circuit.
- If less than  $2\ \Omega$ , verify the fuse is not open and there is voltage at the fuse.

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

1. Ignition OFF, remove the test lamp and remove the fuse for the ignition voltage circuit.

2. Test for infinite resistance between the ignition voltage circuit and ground.

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

- If infinite resistance, test all components connected to the ignition circuit, replace as necessary.
  - **If a test lamp illuminates**
5. Ignition ON, test for 4.8-5.2 V between the intake air temperature sensor 1 signal circuit terminal 1 and ground.
- **If less than 4.8 V**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    3. Test for less than 2  $\Omega$  in the signal circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K20 Engine Control Module.
  - **If greater than 5.2 V**

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

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
  2. Ignition ON, test for less than 1 V between the signal circuit and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V, replace the K20 Engine Control Module.
  - **If between 4.8-5.2 V**
6. Ignition ON, verify the scan tool IAT Sensor 1 parameter is colder than -39 $^{\circ}$ C (-38 $^{\circ}$ F).
- **If warmer than -39 $^{\circ}$ C (-38 $^{\circ}$ F).**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the signal circuit terminal 1 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    3. Test for less than 2  $\Omega$  in the signal circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K20 Engine Control Module.
  - **If colder than -39 $^{\circ}$ C (-38 $^{\circ}$ F).**
7. Ignition OFF, install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 3.
8. Verify the scan tool IAT Sensor 1 parameter is warmer than 148 $^{\circ}$ C (298 $^{\circ}$ F).
- **If colder than 148 $^{\circ}$ C (298 $^{\circ}$ F).**
    1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 Engine Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
    3. Ignition OFF.
    4. Test for less than 2  $\Omega$  in the signal circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K20 Engine Control Module.
  - **If warmer than 148 $^{\circ}$ C (298 $^{\circ}$ F).**
9. Ignition ON, test for 4.8-5.2 V between the intake air temperature sensor 2 signal circuit terminal 8 and ground.
- **If less than 4.8 V**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the signal circuit and ground.
  - If less than infinite resistance, repair the short to ground on the circuit.
  - If infinite resistance
3. Test for less than 2  $\Omega$  in the signal circuit end to end.
  - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than 2  $\Omega$ , replace the K20 Engine Control Module.
- **If greater than 5.2 V**

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

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
  2. Ignition ON, test for less than 1 V between the signal circuit and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V, replace the K20 Engine Control Module.
  - **If between 4.8-5.2 V**
10. Determine if **EL-38522-A** Variable Signal Generator or equivalent is available.
- **EL-38522-A, Variable Signal Generator; or equivalent is not available**
    1. Test or replace the B75C Multifunction Intake Air sensor.
    2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the freeze frame/failure records data.
    3. Verify the DTC does not set.
      - **If the DTC sets**

Replace the K20 Engine Control Module.
      - **If no DTCs set**
  - **EL-38522-A, Variable Signal Generator; or equivalent is available**
11. Ignition OFF, connect the leads of the **EL-38522-A** Variable Signal Generator as follows:
- Red lead to the signal circuit terminal 8 at the harness connector
  - Black leads to ground
  - Battery voltage supply lead to B+
12. Set the **EL-38522-A** Variable Signal Generator to the following specifications.
- Signal switch to 5 V
  - Duty Cycle switch to 50% (Normal)
  - Frequency switch to 30 Hz
13. Ignition ON, verify the scan tool IAT Sensor 2 parameter is between 28-32 Hz.
- **If not between 28-32 Hz**

Replace the K20 Engine Control Module.
  - **If between 28-32 Hz**
14. Ignition OFF, and all vehicle systems OFF, it may take up to 2 min. for all vehicle systems to power down. Disconnect the harness connector at the B111B Turbocharger Boost/Intake Air Temperature sensor.
15. Test for less than 2  $\Omega$  between the intake air temperature sensor 3 low reference circuit terminal 1 and ground.
- **If 2  $\Omega$  or greater**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for less than 2  $\Omega$  in the low reference circuit end to end.
      - If 2  $\Omega$  or greater, repair the open or high resistance in the circuit.

- If less than 2  $\Omega$  replace the K20 Engine Control Module.

- **If less than 2  $\Omega$**

16. Ignition ON, test for 4.8-5.2 V between the signal circuit terminal 2 and ground.

- **If less than 4.8 V**

1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
  2. Test for infinite resistance between the signal circuit and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance
  3. Test for less than 2  $\Omega$  in the signal circuit end to end.
    - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
    - If less than 2  $\Omega$ , replace the K20 Engine Control Module.
- **If greater than 5.2 V**

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

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

- **If between 4.8-5.2 V**

17. Test or replace the B75C Multifunction Intake Air Sensor.

## Component Testing

### Multifunction Intake Air Sensor

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

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

2. Test the IAT sensor 1 by varying the sensor temperature while monitoring the sensor resistance. Compare the readings with the [Temperature Versus Resistance - Intake Air Temperature Sensor \(Delco Sensor\)](#) [Temperature Versus Resistance - Intake Air Temperature Sensor \(Bosch Sensor\)](#) table for Hitachi Sensors. The resistance values should be in range of the table values.

- **If not within the specified range**

Replace the B75C Multifunction Intake Air Sensor.

- **If within the specified range**

3. All OK.

### Multifunction Intake Air Sensor

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

- **If not within the specified range**

Replace the B75C Multifunction Intake Air Sensor.

- **If within the specified range**

2. All OK.

## Repair Instructions

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

- Refer to [Mass Airflow Sensor Replacement](#) for multifunction intake air sensor replacement
- Refer to [Control Module References](#) for engine control module replacement, programming, and setup.

## **DTC P219A: FUEL TRIM CYLINDER BALANCE**

### **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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### **DTC Descriptor**

#### **DTC P219A**

Fuel Trim Cylinder Balance

### **Circuit/System Description**

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

### **Conditions for Running the DTC**

- DTCs P0016, P0017, P0030, P0036, P0053, P0054, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0116, P0117, P0118, P0019, P0122, P0123, P0128, P0131-P0135, P0137, P0138, P013A, P013B, P013E, P013F, P0140, P0141, P0171, P0172, P0201-P0204, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0300, P0301-P0304, P0340, P0341, P0365, P0366, P0411, P0442, P0455, P0458, P0496, P111E, P1133, P1248, P1249, P124A, P124B, P16A0, P16A1, P16A2, P16F3, P2101, P2135, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P2270, P2271, P2440, P2444 or P2A00 are not set.
- The evaporative emission system device control and intrusive diagnostics are not active.
- The engine overspeed protection is not active.
- The engine is in closed loop status.
- The system voltage is greater than 11 V.
- The engine coolant temperature (ECT) is warmer than -20Â°C (-4Â°F).
- The engine speed is between 1,200-4,000 RPM.
- The mass air flow is between 0-100 g/s.
- The secondary air injection pump (if equipped) is not ON.
- The Exhaust Camshaft Position and Intake Camshaft Position are between 0-35 degrees.
- Engine run time is greater than 30 s.
- Fuel level is greater than 10% and no fuel level sensor fault is present.
- The DTC runs continuously when the above conditions have been met.

### **Conditions for Setting the DTC**

Multiple samples of the pre-catalyst HO2S accumulated voltage are consistently greater than the desired value.

### **Action Taken When the DTC Sets**

DTC P219A is a Type A DTC.

### **Conditions for Clearing the MIL/DTC**

DTC P219A is a Type A DTC.

## Diagnostic Aids

- The fuel trim cylinder balance diagnostic is very sensitive to heated oxygen sensor (HO2S) design. A non-OE sensor or an incorrect part number may cause a DTC to set.
- Monitoring the misfire current counters, or misfire graph, may help to isolate the cylinder that is causing the condition.
- Certain aftermarket air filters may cause a DTC to set.
- Certain aftermarket air induction systems or modifications to the air induction system may cause a DTC to set.
- Certain aftermarket exhaust system components may cause a DTC to set.

## Reference Information

Schematic Reference

### Engine Controls Schematics (Buick with LE2)

Connector End View Reference

### COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)

Component View Reference

### Powertrain Component Views (Buick)

Electrical Information Reference

- [Circuit Testing](#)
- [Troubleshooting with a Test Lamp](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)
- [Connector Repairs](#)

DTC Type Reference

### Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

## Circuit/System Verification

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

- **If any other DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.

- **If no other DTCs are set**

3. Verify DTC P219A is not set.

- **If a DTC is set**

Refer to Circuit/System Testing.

- **If no DTC is set**

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

5. Verify DTC P219A is not set.

- **If a DTC is set**

Refer to Circuit/System Testing.

- **If no DTC is set**

6. All OK.

### Circuit/System Testing

1. Engine idling, transmission in Park or Neutral, verify the manifold absolute pressure (MAP) sensor parameter is between 20-48 kPa.

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

Refer to [DTC P0106](#) .

- **If within the specified range, inspect for the conditions listed below:**
- Modified, damaged, leaking, or restricted air induction system components.
- Improperly operating crankcase ventilation system. Refer to [Crankcase Ventilation System Inspection/Diagnosis](#) .
- Split, kinked, or improperly connected vacuum hoses.
- Restricted, damaged, leaking, or modified exhaust system from the catalytic converter forward. Refer to [Symptoms - Engine Exhaust](#) .
- Improperly operating fuel injectors. Refer to [Fuel System Diagnosis](#).
- Fuel contamination. Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#).
- Excessive fuel in the crankcase due to leaking injectors. Change engine oil as necessary.
- Improperly operating ignition system. Refer to [Electronic Ignition System Diagnosis](#).
- **If a condition is found**

Repair as necessary.

- **If no condition is found**

2. Test the engine for any mechanical conditions such as sticking valves, lifters, etc., which could alter the flow into the combustion chamber. Refer to [Symptoms - Engine Mechanical](#) .

### Repair Instructions

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

Perform the scan tool Fuel Trim Reset after completing the repair.

## DTC P2227-P2230: BAROMETRIC PRESSURE (BARO) SENSOR

### Diagnostic Instructions

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

### DTC Descriptor

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

### DTC P2227

Barometric Pressure (BARO) Sensor Performance

### DTC P2228

Barometric Pressure (BARO) Sensor Circuit Low Voltage

DTC P2229

Barometric Pressure (BARO) Sensor Circuit High Voltage

DTC P2230

Barometric Pressure (BARO) Sensor Circuit Erratic

Diagnostic Fault Information

| Circuit       | Short to Ground | Open/High Resistance       | Short to Voltage    | Signal Performance |
|---------------|-----------------|----------------------------|---------------------|--------------------|
| 5 V Reference | P06D2, P2228    | P2227, P2228               | P06D2, P2227, P2229 | P2227              |
| Signal        | P2227, P2228    | P2227, P2229               | P2227, P2229        | P2227              |
| Low Reference | -               | P0113, P2199, P2227, P2229 | -                   | P2227              |

Typical Scan Tool Data

BARO

| Circuit                                                                                                                                         | Short to Ground | Open               | Short to Voltage   |
|-------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------------|--------------------|
| <b>Operating Conditions:</b> Ignition On/Vehicle In Service Mode & Engine Off<br><b>Parameter Normal Range:</b> 56 to 105 kPa (8.1 to 15.2 PSI) |                 |                    |                    |
| 5 V Reference                                                                                                                                   | 0 kPa (0 PSI)   | 0 kPa (0 PSI)      | 127 kPa (18.4 PSI) |
| Signal                                                                                                                                          | 0 kPa (0 PSI)   | 127 kPa (18.4 PSI) | 127 kPa (18.4 PSI) |
| Low Reference                                                                                                                                   | -               | 127 kPa (18.4 PSI) | -                  |

Circuit/System Description

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

| Component | Description |
|-----------|-------------|
|           |             |

| Component                            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| B75C Multifunction Intake Air Sensor | <p>The assembly has several functions:</p> <ul style="list-style-type: none"> <li>• The mass air flow sensor is a hot film type sensor that measures the mass of air (not the volume) entering the engine. The signal varies with engine load and is displayed by the scan tool in Hertz (Hz) and grams per second (g/s).</li> <li>• The intake air humidity sensor uses the same signal circuit as the intake air temperature sensor 2. The intake air humidity sensor modulates the pulse width of the signal. The intake air temperature sensor 2 modulates the frequency of the signal. That means the signal is both, PWM and FM modulated.</li> <li>• The barometric pressure sensor generates an analog voltage that is proportional to the ambient air pressure.</li> <li>• The intake air temperature sensor 1 varies its resistance depending on the temperature. <ul style="list-style-type: none"> <li>• Low temperature produces a high resistance: 5.6k <math>\Omega</math> @ 0<math>^{\circ}</math>C (32<math>^{\circ}</math>F)</li> <li>• High temperature produces a low resistance: 187 <math>\Omega</math> @ 100<math>^{\circ}</math>C (212<math>^{\circ}</math>F)</li> </ul> </li> </ul> |
| K20 Engine Control Module            | The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

| Component                            | Description                                                                                                                                                                                                                         |
|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| B75C Multifunction Intake Air Sensor | The barometric pressure sensor generates an analog voltage that is proportional to the ambient air pressure.                                                                                                                        |
| K20 Engine Control Module            | The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly. |

The barometric pressure sensor is integrated into the multifunction intake air sensor.

### Conditions for Running the DTC

#### P2227 Condition 1

- DTC P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0117, P0118, P0119, P0121, P0122, P0123, P0222, P0223, P0236, P0237, P0238, P1516, P2101, P2135, P2228, P2229 = Not set
- Engine Running = For greater than 30 s

#### Condition 2

- DTC P0106, P0107, P0108, P0237, P0238, P2228, P2229, P2230, P2610 = Not set
- Ignition = On
- Engine Off = For greater than 6 min

DTC runs continuously when the above conditions are met.

#### P2228, P2229

Engine Running = For greater than 30 s

DTC runs continuously when the above condition is met.

### **P2230**

- DTC P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0117, P0118, P0119, P0121, P0122, P0123, P0222, P0223, P0236, P0237, P0238, P1516, P2101, P2135, P2228, P2229 = Not set
- Ignition = On

DTC runs continuously when the above conditions are met.

### **Conditions for Setting the DTC**

#### **P2227 Condition 1**

BARO & Calculated BARO = The actual value is not within a predetermined range of the calculated value.

#### **Condition 2**

BARO = Less than 50 kPa (7.3 PSI) or Greater than 115 kPa (16.7 PSI)

### **P2228**

BARO = Less than 2 V - For greater than 5 s

### **P2229**

BARO = Greater than 4.5 V - For greater than 5 s

### **P2230**

BARO = Signal noisy or erratic - For greater than 5 s

### **Actions Taken When the DTC Sets**

DTCs P2227, P2228, P2229, P2230 are Type B DTCs.

### **Conditions for Clearing the DTC**

DTCs P2227, P2228, P2229, P2230 are Type B DTCs.

### **Reference Information**

Schematic Reference

### **Engine Controls Schematics (Buick with LE2)**

Connector End View Reference

### **COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)**

Component View Reference

### **Disassembled 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](#)

### [Circuit/System Verification](#)

1. Ignition On/Vehicle In Service Mode
2. Verify DTC P0106, P0107, P0108, P0641, P0651, P0697, P06A3, P06D2 is not set.
  - If any of the DTCs are set  
  
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)
  - If none of the DTCs are set
3. Determine the current vehicle testing altitude.
4. Verify the scan tool parameter:
  - MAP Sensor = [Altitude Versus Barometric Pressure](#) - The value should be within the range listed in the table.
  - Boost Pressure = [Altitude Versus Barometric Pressure](#) - The value should be within the range listed in the table.
  - BARO = [Altitude Versus Barometric Pressure](#) - The value should be within the range listed in the table.
  - **If not in the specified range**
  - {MAP Sensor} Refer to: [DTC P0106](#) .
  - {Boost Pressure} Refer to: [DTC P0236](#) .
  - {BARO} Refer to: Circuit/System Testing.
  - **If in the specified range**
5. Verify the scan tool parameter: BARO = The value should not spike or drop out.

Perform the action while monitoring the parameter:

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

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

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

Refer to: Circuit/System Testing

- **If the DTC is not set**

8. All OK.

### [Circuit/System Testing](#)

#### **NOTE:**

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

1. Ignition/Vehicle & All vehicle systems Off
2. Disconnect the electrical connector: B75C Multifunction Intake Air Sensor
3. Test for less than 10  $\Omega$  between the test points: Low Reference circuit terminal 7 & Ground
  - **If 10  $\Omega$  or greater**
    1. Disconnect the electrical connector: K20 Engine Control Module
    2. Test for less than 2  $\Omega$  between the test points: Low Reference circuit terminal 7 @ Component harness & The other end of the circuit @ Control module harness
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the component: K20 Engine Control Module
  - **If less than 10  $\Omega$**
4. Ignition On/Vehicle In Service Mode
5. Test for 4.8 to 5.2 V between the test points: 5 V Reference circuit terminal 2 & Low Reference circuit terminal 7
  - **If less than 4.8 V**
    1. Ignition/Vehicle Off
    2. Disconnect the electrical connector: K20 Engine Control Module
    3. Test for infinite resistance between the test points: 5 V Reference circuit terminal 2 @ Component harness & Ground
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    4. Test for less than 2  $\Omega$  between the test points: 5 V Reference circuit terminal 2 @ Component harness & The other end of the circuit @ Control module harness
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the component: K20 Engine Control Module
  - **If greater than 5.2 V**
    1. Ignition/Vehicle Off
    2. Disconnect the electrical connector: K20 Engine Control Module
    3. Ignition On/Vehicle In Service Mode
    4. Test for less than 1 V between the test points: 5 V Reference circuit terminal 2 @ Component harness & Ground
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the component: K20 Engine Control Module
  - **If between 4.8 and 5.2 V**
6. Verify the scan tool parameter: BARO = Greater than 4.7 V
  - **If 4.7 V or less**
    1. Ignition/Vehicle Off
    2. Disconnect the electrical connector: K20 Engine Control Module
    3. Test for infinite resistance between the test points: Signal circuit terminal 6 @ Component harness & Ground
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the component: K20 Engine Control Module
  - **If greater than 4.7 V**
7. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 6 & Low Reference circuit terminal 7
8. Verify the scan tool parameter: BARO = Less than 0.2 V
  - **If 0.2 V or greater**
    1. Ignition/Vehicle Off & Remove Jumper wire(s)
    2. Disconnect the electrical connector: K20 Engine Control Module
    3. Ignition On/Vehicle In Service Mode

4. Test for less than 1 V between the test points: Signal circuit terminal 6 @ Component harness & Ground
  - If 1 V or greater, repair the short to voltage on the circuit.
  - If less than 1 V
5. Ignition/Vehicle Off
6. Test for less than 2  $\Omega$  between the test points: Signal circuit terminal 6 @ Component harness & The other end of the circuit @ Control module harness
  - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
  - If less than 2  $\Omega$ , replace the component: K20 Engine Control Module
- **If less than 0.2 V**
9. Test or replace the component: B75C Multifunction Intake Air Sensor

### Repair Instructions

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

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

## DTC P2261: TURBOCHARGER BYPASS VALVE STUCK

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptor

#### DTC P2261

Turbocharger Bypass Valve Stuck

### Circuit/System Description

The dual-scroll turbocharger incorporates a wastegate that is controlled by the engine control module (ECM) by means of a pulse width modulation (PWM) solenoid, to regulate the pressure ratio of the compressor. An ECM controlled compressor bypass valve is integrated into the unit to prevent compressor surging and damage from vibrations by opening during abrupt closed throttle conditions. The bypass valve is open during closed throttle deceleration conditions to allow air to recirculate in the turbocharger and maintain compressor speed.

As engine load and speed increase, the turbocharger bypass valve is commanded closed by the ECM. As soon as the throttle closes, the valve is commanded open to allow the turbocharger air to recirculate to prevent compressor surging.

### Conditions for Running the DTC

- DTC P0033, P0034, P0035, P0101, P0102, P0103, P0236, P0237, or P0238 is not set.
- Engine speed is at least 1,500 RPM
- Boost pressure versus the BARO pressure ratio is between 1.0-3.2.
- Turbocharger bypass valve has been commanded Open greater than 6% for greater than 1.5 s immediately after an abrupt closed throttle has occurred and the resulting pressure ratio across the compressor exceeds the calibrated pressure ratio limit.

The DTC runs continuously when the above conditions have been met.

### Conditions for Setting the DTC

The ECM has detected a series of pulsations in the induction system that exceed a calibrated threshold.

## Action Taken When the DTC Sets

- DTC P2261 is a Type C DTC.
- The Service Vehicle Soon Indicator may illuminate.

## Conditions for Clearing the MIL/DTC

DTC P2261 is a Type C DTC.

## Reference Information

Schematic Reference

## Engine Controls Schematics (Buick with LE2)

Connector End View Reference

## COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)

Description and Operation

## Turbocharger System Description

Electrical Information Reference

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

DTC Type Reference

## Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information.

## Circuit/System Verification

1. Ignition On.
2. Verify that DTC P0033, P0034, or P0035 is not set
  - **If any of the DTCs are set**  
Refer to DTC P0033-P0035.
  - **If none of the DTCs are set**
3. Verify the scan tool BARO Sensor parameter is within the range specified in the Altitude Versus Barometric Pressure table for the current testing altitude.
  - **If the parameter is not within the range specified in the table.**  
Refer to DTC P2227-P2230.
  - **If the parameter is within the range specified in the table.**
4. Verify the scan tool Boost Pressure Sensor and BARO Sensor parameters are within 3 kPa (0.4 psi).
  - **If the parameters are not within 3 kPa (0.4 psi).**  
Refer to DTC P0236.
  - **If the parameters are within 3 kPa (0.4 psi).**

5. Verify a click is heard or felt from the Q40 turbocharger bypass solenoid valve when commanding the Turbocharger Bypass Solenoid Valve between Active and Inactive with a scan tool.

- **If a click is not heard or felt**

Refer to Circuit/System Testing

- **If a click is heard or felt**

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

7. Verify a DTC does not set.

- **If a DTC sets**

Refer to Circuit/System Testing

- **If a DTC does not set**

8. All OK

### Circuit/System Testing

**NOTE:** Leave harness connector connected or re-connect it after removing valve.

1. Ignition Off. Disconnect the Q40 turbocharger bypass solenoid valve, ignition On.
2. Verify the turbocharger bypass valve plunger retracts and extends when commanding the Turbocharger Bypass Solenoid Valve between Active and Inactive with a scan tool.

- **The valve plunger does not retract and extend**

Replace the Q40 turbocharger bypass solenoid valve

- **The valve plunger retracts and extends**

3. Verify the conditions listed below do not exist with the turbocharger assembly. Refer to **Turbocharger Cleaning and Inspection**

- Cracked, damaged or worn turbine blades
- Restricted wastegate, turbine, ports or passages
- Foreign material
- **If a condition exists**

Repair or replace the turbocharger as necessary

- **If none of the conditions exist**

4. Replace the Q40 turbocharger bypass solenoid valve

### Component Testing

#### Static Test

1. Ignition Off, disconnect the harness connector at the Q40 turbocharger bypass solenoid valve.
2. Test for 10-14  $\Omega$  between the control terminal 2 and the Ignition terminal 1 of the Q40 turbocharger bypass solenoid valve.

- **If not between 10-14  $\Omega$**

Replace the Q40 turbocharger bypass solenoid valve.

- **If between 10-14  $\Omega$**

3. All OK

#### Dynamic Test

1. Install a 15 A fused jumper wire between the ignition terminal 2 of the Q40 turbocharger bypass solenoid valve and 12 V. Install a jumper wire between the control terminal 1 and ground.
2. Verify the Q40 turbocharger bypass solenoid valve plunger retracts.

- **If the plunger does not retract.**

Replace the Q40 turbocharger bypass solenoid valve.

- **If the plunger retracts.**

3. All OK

### Repair Instructions

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

- Refer to [Turbocharger Bypass Valve Solenoid Replacement](#)
- Refer to [Turbocharger Replacement](#)

## DTC P2544: TRANSMISSION TORQUE REQUEST CIRCUIT MESSAGE COUNTER INCORRECT

### 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### DTC Descriptors

#### DTC P2544

Transmission Torque Request Circuit 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 requests to modify engine speed or torque. These serial data messages are sent through two circuits which are part of a communication network called the controller area network (CAN). The ECM sets DTC P2544 when it detects a discrepancy in the structure of the message causing the integrity of the message to be questioned.

### Conditions for Running the DTC

- The engine run time is greater than 0.5 s.
- No other CAN errors are present.

### Conditions for Setting the DTC

The ECM detects that the engine speed and torque modification messages from the TCM are either corrupted or intermittently missing for greater than 4 s.

### Action Taken When the DTC Sets

- DTC P2544 is a Type B DTC.
- The TCM commands maximum line pressure during shifts, which results in harsh shifts.
- The TCM freezes adaptive functions.

### Conditions for Clearing the DTC

DTC P2544 is a Type B DTC.

### Diagnostic Aids

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

## DTC Type Reference

### Powertrain Diagnostic Trouble Code (DTC) Type Definitions

#### Circuit/System Verification

#### NOTE:

- **DTC P2544 is an informational DTC.**
- **Diagnose all other engine control module DTCs prior to DTC P2544.**

1. Verify that no other DTCs are set except for DTC P2544.

- **If any other DTCs are set**

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

- **If only DTC P2544 is set**

2. Replace the K71 Transmission Control Module.

3. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the freeze frame/failure records data.

4. Verify the DTC does not set.

- **If DTC sets**

Replace the K20 Engine Control Module.

- **If DTC does not set**

5. All OK.

#### Repair Instructions

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

Refer to [Control Module References](#) for ECM or TCM replacement, programming, and setup

### **DTC P2618: CRANKSHAFT POSITION SIGNAL OUTPUT CIRCUIT LOW/HIGH VOLTAGE**

#### Diagnostic Instructions

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

#### DTC Descriptor

#### **DTC P2618**

Crankshaft Position Signal Output Circuit Low Voltage

#### **DTC P2619**

Crankshaft Position Signal Output Circuit High Voltage

#### Conditions for Running the DTC

- Ignition Voltage = Greater than 11 V
- Ignition = On
- Crankshaft Position Sensor Circuit = Active

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

### Conditions for Setting the DTC

#### P2618

Crankshaft Position Signal Output Circuit = Short to Ground or Open - For greater than 5 s

#### P2619

Crankshaft Position Signal Output Circuit = Short to Voltage - For greater than 5 s

### Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type C DTC

### Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type C DTC

### Reference Information

DTC Type Reference

### Powertrain Diagnostic Trouble Code (DTC) Type Definitions

#### Circuit/System Verification

1. Engine Running
2. Verify there are no DTCs/symptoms related to the following system/component, if equipped:
  - K71 Transmission Control Module
  - K103 Fuel Injector Control Module
  - T3 Audio Amplifier
  - T6 Power Inverter Module
  - **If a DTC or symptom exists**

Refer to:

  - [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)
  - [Symptoms - Vehicle](#)
  - **If no DTC or symptom exists**
3. All OK.

### **DTC P2635: FUEL PUMP FLOW PERFORMANCE (CHASSIS CONTROL MODULE)**

#### Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

#### DTC Descriptor

#### **DTC P2635**

Fuel Pump Flow Performance

#### Diagnostic Fault Information

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

## **Circuit/System Description**

The engine control module (ECM) supplies voltage to the chassis control module when the ECM detects that the ignition is on. The voltage from the ECM to the chassis control module remains active for 2 seconds, unless the engine is in crank or run. While this voltage is being received, the chassis 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 line 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.
- Low fuel level warning not present.

## **Conditions for Setting the DTC**

This DTC sets when the chassis control module detects a predetermined fuel pressure performance degradation between the desired fuel pressure and the current fuel 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**

On vehicles equipped with a high pressure mechanical pump on Direct Fuel Injection engines, the vehicle may continue to run even though the pump in the fuel tank is not operating.

## **Reference Information**

Schematic Reference

## **Engine Controls Schematics (Buick with LE2)**

Connector End View Reference

## **COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)**

Description and Operation

## **Fuel System Description**

Electrical Information Reference

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

DTC Type Reference

## **Powertrain Diagnostic Trouble Code (DTC) Type Definitions**

Scan Tool Reference

**Control Module References** for scan tool information

**NOTE:** Do not replace the chassis control module based on a history DTC P2635. The DTC P2635 may be stored but that does not indicate a failure of the chassis control module. Refer to [Strategy Based Diagnosis](#) for further history DTC diagnostics.

1. Ignition ON.
2. Verify DTCs P018B, P018C, P018D, P0231, P0232 or P023F are not set.
  - **If any of the DTCs are set**  
  
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
  - **If none of the DTCs are set**
3. Verify the proper fuel system pressure. Perform the fuel system pressure test, refer to [Fuel System Diagnosis](#).
  - **If the fuel system pressure test is not normal**  
  
Replace the A7 Fuel Pump and Level Sensor Assembly.
  - **If the fuel system pressure test is normal**
4. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the A7 Fuel Pump and Level Sensor Assembly. It may take up to 2 minutes for all vehicle systems to power down.
5. Test for less than 10  $\Omega$  between the low reference circuit terminal 2 and ground.
  - **If 10  $\Omega$  or greater**
    1. Ignition OFF, disconnect the harness connector at the K38 Chassis Control Module.
    2. Test for less than 2  $\Omega$  in the low reference circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K38 Chassis Control Module.
  - **If less than 10  $\Omega$**
6. Connect a test lamp between the control circuit terminal 1 and the low reference circuit terminal 2.
7. Ignition ON.
8. Verify the test lamp turns ON and OFF when commanding the fuel pump ON and OFF using the scan tool ECM fuel pump enable control function.
  - **If the test lamp is always OFF**
    1. Ignition OFF, disconnect the harness connector at the K38 Chassis Control Module.
    2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
    3. Test for less than 2  $\Omega$  in the control circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K38 Chassis Control Module.
  - **If the test lamp is always ON**
    1. Ignition OFF, disconnect the harness connector at the K38 Chassis Control Module, ignition ON.
    2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K38 Chassis Control Module.
  - **If the test lamp turns ON and OFF**
9. All OK.

### Repair Instructions

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

- Refer to [Fuel Tank Fuel Pump Module Replacement \(FWD\)](#), [Fuel Tank Fuel Pump Module Replacement \(AWD\)](#).
- Refer to [Control Module References](#) for control module replacement, programming and setup.

## **SYMPTOMS - ENGINE CONTROLS**

### **Diagnostic Instructions**

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### **Symptoms Description**

Symptoms cover conditions that are not covered by DTCs. Certain conditions can cause multiple symptoms. These conditions are listed together under Symptoms Testing. Conditions that may only cause specific symptoms are listed separately under additional symptoms testing. Perform the symptoms testing before using the additional symptoms testing.

### **Symptoms Definition**

#### **Backfire**

Fuel ignites in the intake manifold or in the exhaust system, making a loud popping noise.

#### **Cuts Out, Misses**

A steady pulsation or jerking that follows engine speed, which is usually more pronounced as the engine load increases. This condition is not normally felt above 1,500 RPM or 48 km/h (30 MPH). The exhaust has a steady spitting sound at idle or at low speed.

#### **Detonation/Spark Knock**

A mild to severe ping which usually gets worse while under acceleration. The engine makes sharp metallic knocks that change with throttle opening.

#### **Dieseling, Run-On**

Fuel ignites in the intake manifold or in the exhaust system, making a loud popping noise.

#### **Engine Control Module (ECM) Commanded Reduced Engine Power**

The ECM illuminates the Reduced Engine Power lamp and will limit engine power under potential engine damaging or emissions related conditions. A DTC may not set.

#### **Hard Start**

Engine cranks OK, but does not start for a long time. The vehicle does eventually run, or may start but immediately stalls.

#### **Hesitation, Sag, Stumble**

Momentary lack of response as the accelerator is pushed down. This condition can occur at any vehicle speed. This condition is usually more pronounced when first trying to make the vehicle move, as from a stop. This condition may cause the engine to stall in severe conditions.

#### **Lack of Power, Sluggishness, or Sponginess**

The engine delivers less than expected power. Little or no increase in speed when the accelerator pedal is pushed down part way.

#### **Poor Fuel Economy**

Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, the fuel economy is noticeably lower than it was on this vehicle at one time, as previously shown by an actual road test.

### **Poor Fuel Fill Quality**

Difficulty when refueling the vehicle.

### **Rough, Unstable, or Incorrect Idle and Stalling**

The engine runs unevenly at idle. If severe, the engine or the vehicle may shake. Engine idle may vary in speed. Either condition may be severe enough to stall the engine.

### **Surges/Chuggles**

Engine power variation under steady throttle or cruise. Feels like the vehicle speeds up and slows down with no change in the accelerator pedal position.

### **Symptoms Verification**

Before using the Symptom tables, perform the following inspections:

- Verify that the MIL is operating correctly. Use the scan tool to command the lamp ON and OFF.
- Verify that there are no DTCs that are stored.
- Verify that the scan tool data is within a normal operating range. Refer to [Control Module References](#) for scan tool information.
- Verify that the vehicle tires are correctly inflated and meet original equipment specifications.
- Verify that the Flex Fuel reservoir has a sufficient amount of fuel in it.
- Verify the customer concern.
- Perform the Visual/Physical Inspection in this section. The visual/physical inspection is extremely important, and can lead to correcting a condition without additional testing. It may also help reveal the cause of an intermittent condition.

### **Identifying Intermittent Conditions**

Many intermittent conditions occur with harness or connector movement due to engine torque, rough pavement, vibration or physical movements of a component. Refer to the following for a list of issues that may cause an intermittent condition:

- Moisture and water intrusion in connectors, terminals, and components
- Incomplete connector mating
- Poor terminal contact
- High circuit or component resistance - High resistance can include any resistance, regardless of the amount, which can interrupt the operation of the component.
- Harness that is too short or tight
- Wire insulation that is chaffed or cut
- High or low ambient temperature
- High or low engine coolant temperatures
- High underhood temperatures
- Heat build up in component or circuit due to circuit resistance, poor terminal contact, or high electrical load
- High or low system voltage
- High vehicle load conditions
- Rough road surfaces
- Electromagnetic Interference (EMI)/circuit interference from relays, solenoids or other electrical surge
- Incorrect installation of aftermarket, add on accessories

## Visual/Physical Check

- Verify that the control module grounds are clean, tight, and correctly located.
- Verify that the vacuum hoses are not split or kinked, and are properly connected, as shown on the Vehicle Emission Control Information label.
- Verify that the air filter is clean and free from restrictions.
- Verify that there is no water intrusion in connectors terminals and components.
- Inspect the air intake ducts for the conditions listed below:
  - Collapsed
  - Damaged areas
  - Looseness
  - Incorrect installation
  - Leaking

If any condition listed above has allowed non-metered air to enter the air induction system, the **Throttle or Idle Learn** procedure must be performed after the repair is complete.

- Inspect for air leaks at the throttle body mounting area, the Mass Air Flow (MAF) sensor and intake manifold sealing surfaces.
- Inspect the wiring harness for the following conditions:
  - Poor connections
  - Pinches
  - Cuts
- Inspect for loose, damaged, unseated, or missing sensors/components.
- Inspect the terminals for corrosion and correct contact.

## Symptoms Testing

**Backfire, Cuts Out/Misses, Detonation/Spark Knock, Dieseling/Run-On, Engine Control Module (ECM) Commanded Reduced Engine Power, Hard Start, Hesitation/Sag/Stumble, Lack of Power/Sluggishness/Sponginess, Poor Fuel Economy, Rough, Unstable, or Incorrect Idle and Stalling, or Surges/Chuggles**

### 1. Test for the following conditions:

- Incorrectly operating fuel system. Test/inspect for the following:
  - Incorrect system operation or fuel pressure. Refer to **Fuel System Diagnosis**.
  - Leaking or incorrectly operating fuel injectors. Refer to **Fuel Injector Diagnosis**.
  - Contaminated or poor quality fuel. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis**.
- Incorrectly operating ignition system. Test/Inspect for the following:
  - Spark plugs with incorrect heat range or an abnormal condition. Refer to **Spark Plug Inspection** , and **Ignition System Specifications** .
  - Coolant or oil fouled spark plugs. For diagnosis, refer to **Oil Consumption Diagnosis** , and **Coolant in Combustion Chamber** .
  - Secondary ignition system susceptible to moisture. Wet down the secondary ignition system with water from a spray bottle to help locate damaged or deteriorated components. Look/listen for arcing or misfiring as the water is applied.
  - Weak spark using the **EL 26792** HEI Spark Tester. For equivalent regional tools, refer to **Special Tools (Mechanical Tools)** . Refer to **Electronic Ignition System Diagnosis**.
- Non-metered air flow into the air induction system. If a leak is found, repair as necessary. The **Throttle or Idle Learn** procedure must be performed when the repair is complete.
- An incorrectly installed MAF/Intake Air Temperature (IAT) Sensor. Refer to **Mass Airflow Sensor Replacement** .

- An incorrectly operating transmission Torque Converter Clutch (TCC). The scan tool should indicate an engine speed drop when the TCC is commanded ON.
- An incorrectly operating A/C compressor
- Items that can cause an engine to run lean or rich. Refer to [DTC P0171 or P0172](#) .
- Split or kinked vacuum hoses. Verify that the routing and connections are as shown on the vehicle emission control information label.
- Excessive knock sensor system spark retard activity. Refer to [DTC P0324, P0326, or P06B6](#) , [DTC P0325, P0327, or P0328](#) , and [Knock Sensor Replacement](#) .
- An incorrectly operating turbocharger system, if equipped.
- Leaking turbocharger charge air cooler system, if equipped.
- Electromagnetic interference on the reference circuit, which can cause a misfire condition. You can usually detect electromagnetic interference with a scan tool by monitoring the engine speed parameter. A sudden increase in the engine speed parameter with little change in actual engine speed indicates that electromagnetic interference is present. Inspect the high voltage components near the ignition control circuit if a condition exists.
- An incorrectly operating positive crankcase ventilation system. Inspect all connections for leaks or restrictions. Refer to [Crankcase Ventilation System Inspection/Diagnosis](#)
- A stuck open Evaporative Emission (EVAP) Canister Purge Solenoid Valve.
- An incorrectly operating variable camshaft actuator system. Engine warm and idling, command the intake and exhaust camshaft actuators from 0 degrees to 20 degrees and back to zero while observing the scan tool Intake Camshaft Position Variance and Exhaust Camshaft Position Variance parameters. Each parameter should be less than 2 degrees in each of the commanded states.
  - If any of the parameters is greater than 2 degrees, inspect the suspect camshaft actuator and camshaft actuator solenoid valve and valve bore for contamination, obstruction, and damage. Refer to [Camshaft Actuator System Description](#) , [Camshaft Position Actuator Solenoid Valve Replacement - Exhaust](#) , and [Camshaft Position Actuator Solenoid Valve Replacement - Intake](#) .
- An incorrectly operating engine cooling system. Test/Inspect for the following:
  - A thermostat with incorrect heat range. Refer to [Thermostat Diagnosis](#) .
  - Incorrectly operating engine coolant thermostat heater, if equipped. Refer to DTC P0597-P0599.

Incorrect engine coolant level. Refer to [Cooling System Draining and Filling](#) .
- An incorrectly operating exhaust system. Test/Inspect the components for the following:
  - Physical damage or possible internal malfunction.
  - Restricted 3-way catalytic converters.

For more information, refer to [Symptoms - Engine Exhaust](#) .
- An engine mechanical condition. Test/Inspect for the following:
  - Too much oil in the combustion chamber or leaking valve seals
  - Incorrect cylinder compression
  - Sticking or leaking valves
  - Worn camshaft lobes
  - Incorrect valve timing
  - Broken valve springs
  - Too much carbon buildup in the combustion chambers. Clean the chambers with Top Engine Cleaner, if necessary. Follow the instructions on the can.
  - Incorrect engine parts

For additional information, refer to [Symptoms - Engine Mechanical](#) .

2. If the above conditions do not address the symptom, refer to the additional symptoms tests.

## **Detonation/Spark Knock:**

- Test the engine for an overheating condition. Refer to [Symptoms - Engine Cooling](#) .
- Inspect for excessive carbon buildup in the combustion chambers. Clean the chambers with Top Engine Cleaner, if necessary. Follow the instructions on the can.
- If there are no engine mechanical faults, fill the fuel tank with a known high quality fuel that meets the vehicle minimum octane requirements.

## **ECM Commanded Reduced Engine Power**

Under certain conditions the engine control module may limit engine power by reducing engine torque and, for some vehicles, fuel pressure as well. For most, but not all of the conditions, the engine control module will illuminate the reduced engine power lamp on the instrument cluster. If equipped with the driver information center feature, a reduced engine power message may be displayed as well. A DTC may not be set.

A repair may not be necessary. Observe the scan tool Reduced Engine Power History parameter or refer to [K20 Engine Control Module: Scan Tool Information](#) to determine the reason for the reduced engine power event.

Verify or inspect for the following:

- Vehicle being operated at sustained high engine speeds, or, towing heavy loads up an incline for an extended period of time, which may cause the engine oil or coolant to overheat. Inspect the airflow passageways in front of the engine for obstructions and clear away any debris or foreign material that is found. If no obstructions are found, review approved driving habits with the customer. The customer may need to operate the vehicle at a higher engine speed to improve cooling system performance, or, at a slower engine speed to reduce engine load.
- A cooling fan condition which may cause the ECM to reduce engine power. Refer to [Cooling System Description and Operation \(LUV, LE2\)](#) to verify correct operation of the cooling fan.
- Fuel temperature out of range too high.
- High pressure fuel system condition. Refer to [Fuel System Diagnosis](#), and [Fuel System Description](#) to verify high pressure fuel system operation.
- Reduced engine power due to OnStar® remote command. Verify the vehicle is not in the OnStar® initiated Stolen Vehicle Slowdown mode.
- Turbocharger boost pressure out of range, if equipped. Refer to [DTC P0234 or P0299](#) .
- Intake air temperature out of range too high. Engine running, observe the scan tool IAT sensor parameter. The readings should be between -40Â° C and +149Â° C (-40Â° F and +300Â° F. Refer to [DTC P0112, P0113, or P0114](#) for additional information.
- If equipped with manual transmission, excessively hot manual transmission fluid. Under severe operating conditions the fluid may become overheated, which may result in ECM commanded reduced engine power. Allow the transmission and fluid to cool down. Review the maintenance recommendation in the owners manual to determine if the transmission fluid is due to be serviced.
- If equipped with automatic transmission, an incorrect learned brake pedal position (BPP) sensor. Verify the following actions have not occurred:
  - An engine control module has been replaced
  - A BPP sensor that has been replaced
  - A BPP sensor is misaligned or incorrectly installed

If any of the above actions have occurred, the [Brake Pedal Position Sensor Learn](#) procedure must be performed.

## **Fuel Odor**

- Inspect for leaking, damaged, or deteriorated fuel lines and components.
- Inspect for a saturated EVAP canister. Refer to [Evaporative Emission Control System Description](#) .

- Inspect for a condition with the internal components of the fuel tank assembly. Refer to [Fuel System Description](#) .

## Hard Start

- Observe the scan tool Throttle Body Idle Airflow Compensation parameter. A value greater than 90% may indicate an excessive accumulation of deposits in the throttle bore. Inspect the throttle body and bore and clean, if necessary. Refer to [Throttle Body Inspection and Cleaning](#) .
- Test the engine coolant temperature (ECT) sensor. Compare the ECT sensor value to the intake air temperature (IAT) sensor value on a cold engine. The ECT and IAT sensor values should be within approximately 3Â°C (5Â°F). If the ECT sensor is out of range with the IAT sensor, test the resistance of the ECT sensor. Refer to [Temperature Versus Resistance - Intake Air Temperature Sensor \(Delco Sensor\)](#) [Temperature Versus Resistance - Intake Air Temperature Sensor \(Bosch Sensor\)](#) for resistance specifications. Replace the ECT sensor if the resistance is not within specification. If the sensor is within the specification, test the ECT circuits for a high resistance.
- Verify that the fuel system operates correctly and provides adequate pressure for engine start-up. The fuel pump should turn ON for 2 s when the ignition is turned ON. Refer to [Fuel System Diagnosis](#), and [Fuel System Description](#) for fuel pressure specifications and additional information.

## Hesitation, Sag, Stumble

- Test the fuel pressure. Refer to [Fuel System Diagnosis](#).
- Test the manifold absolute pressure (MAP) sensor. Refer to [DTC P0106](#) .
- Test the generator. Refer to [Symptoms - Engine Electrical](#) . Repair the charging system if the generator output voltage is less than 9 V or more than 16 V.

## Lack of Power, Sluggishness, or Sponginess (LE2)

- Inspect the engine electrical system for incorrect operation. Refer to [Symptoms - Engine Electrical](#) .
- Verify that each injector harness is connected to the correct injector.
- Inspect the MAF sensor for obstruction, contamination, and damage. Refer to [Mass Airflow Sensor Replacement](#) .
- If equipped with a Supplemental Transmission Auto Shift, verify that the brake sensor is not stuck in the applied position. The Enhanced Electronic Pedal Override functionality in the ECM reduces the driver torque request if the accelerator pedal and the brake pedal are applied simultaneously
- Verify the correct operation of the turbocharger system. Perform the following:
  - Inspect the turbocharger moving components for looseness, binding, wear and damage.
  - Verify that the turbocharger air inlet ducts and outlet ducts are tightly sealed and that the air passages are not obstructed. Engine running, use a smoke generating device or a solution of dish soap and water in a spray bottle to pinpoint any air leaks.
  - Inspect the turbocharger system for external fluid leaks. Inspect the gaskets and sealing surfaces and look for cracks in the turbocharger components.
  - Inspect for excessive turbocharger system noise. Operate the vehicle at various acceleration modes and compare the turbocharger noise to the noise made by a known good system.
  - For additional information, refer to [Turbocharger Cleaning and Inspection](#) .

## Lack of Power, Sluggishness, or Sponginess (Except LE2)

- Inspect the engine electrical system for incorrect operation. Refer to [Symptoms - Engine Electrical](#) .
- Verify that each injector harness is connected to the correct injector.
- Inspect the MAF sensor for obstruction, contamination, and damage. Refer to [Mass Airflow Sensor Replacement](#) .

## Poor Fuel Economy

- Observe the scan tool Throttle Body Idle Airflow Compensation parameter. A value greater than 90% may indicate an excessive accumulation of deposits in the throttle bore. Inspect the throttle body and bore and clean, if necessary. Refer to [Throttle Body Inspection and Cleaning](#).
- Inspect for heavy loads being carried or towed
- Inspect for acceleration rate too much or too often
- Inspect for incorrect operation of the speedometer.
- Inspect the brake system for brake drag.

### **Rough, Unstable, or Incorrect Idle and Stalling**

- An excessively high idle may be due to the floor mat interfering with the accelerator pedal. With this condition present, it may not be possible to shift the transmission into gear. Inspect the accelerator pedal for binding and verify that the floor mat is not interfering with the accelerator pedal movement.
- Engine idle speed be unstable or the engine may stall if the ECM has learned an incorrect idle/airflow compensation value. A DTC may also set. Observe the scan tool Throttle Body Idle Airflow Compensation parameter. A value greater than 90% may indicate an excessive accumulation of deposits in the throttle bore. If the throttle body needs cleaning, refer to [Throttle Body Inspection and Cleaning](#).

The actions listed below may also cause the ECM to learn an incorrect idle value:

- The ECM has been replaced
- The throttle body has been replaced
- The throttle body has been cleaned but the idle learn procedure was not performed after completing the cleaning
- The air induction system was leaking, allowing non-metered air to enter the combustion chamber. The leak was repaired, but the idle learn procedure was not performed after repairing the leak.

If any of the actions listed above have occurred, the [Throttle or Idle Learn](#) procedure must be performed.

- Inspect the engine mounts for looseness, damage, and wear.
- Inspect the intake and exhaust manifolds for casting flash.

### **Surges/Chuggles**

- Verify that each injector harness is connected to the correct injector.
- Inspect for slow responding Heated Oxygen Sensors (HO2S). The HO2S should respond quickly to a change in throttle position. If the HO2S do not respond to different throttle positions, inspect for contamination from fuel, silicon, or the incorrect use of room temperature vulcanizing sealant. The sensors may have a white powdery coating and result in a high, but false, signal voltage, which gives a rich exhaust indication. The ECM reduces the amount of fuel delivered to the engine, causing a driveability condition.

## **ENGINE CRANKS BUT DOES NOT RUN**

### **Diagnostic Instructions**

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### **Circuit/System Description**

The engine cranks but does not run is an organized approach to identify a condition which causes the engine to crank but not start. This diagnostic directs the technician to the appropriate system diagnosis.

### **Diagnostic Aids**

Inspect for any of the conditions listed below:

- If equipped with a key type ignition system, a partially retracted or folded over ignition key. When attempting to start the engine, the mechanical portion of the vehicle key must be locked in the fully extended position with the fob parallel to the key. Leaving the key partially retracted or folded over when starting may interrupt transponder authentication and result in an intermittent no-start condition. In such instances, DTC B3055 may also be set. If an intermittent no-start complaint is received, it may be necessary to discuss with the customer their starting habits and verify they are locking the key in the fully extended position, fob parallel to the key, before starting.
- A crankshaft position sensor condition. Check the crankshaft position sensor engine reference signal with a scan tool. Observe the Engine Speed parameter while cranking the engine. The scan tool should indicate a steady 200-300 RPM while cranking. If erratic values, such as sudden spikes in the engine speed, are displayed, the engine reference signal is not stable enough for the engine to start and run properly.
- Insufficient fuel. Thoroughly inspect the fuel delivery system for sufficient fuel volume to the fuel injectors. Inspect the fuel supply components for partial blockage or restrictions.
- Fuel injectors with partially blocked and restricted nozzles, or a malfunctioning solenoid. Refer to [Fuel Injector Diagnosis](#) for diagnosis.
- Fuel injector ON time inadequate. When this condition is present, there may be fuel spray at the fuel injectors and the indicated fuel pressure may be correct, yet there may not be enough fuel to start the engine. If the engine control module (ECM) receives incorrect inputs from the various information sensors, the fuel delivered by the fuel injectors may be inadequate to start the engine. Check all the engine data parameters with a scan tool and compare the values indicated with the expected values or the values from a known good vehicle.
- Loose unsecured engine electrical grounds. Inspect the engine for good secure electrical grounds.
- Water or foreign material in the fuel, which can cause either a no start or a engine will not stay running condition. During freezing weather water can freeze inside the fuel system. The engine may start after 30 min in a heated repair shop. The malfunction may not recur until parked overnight in freezing temperatures. Extreme weather conditions can cause contaminated fuel to prevent the vehicle from starting.
- An ignition system that is susceptible to moisture. If the engine starts and runs after being brought into a warm, dry repair shop, the ignition system may be susceptible to moisture. Spray water on the ignition system components and wiring while cranking the engine in order to check for an engine starting or will not stay running concern.
- If the engine almost starts and then stalls, check for an open in the ground circuits of the crankshaft position sensor and the camshaft position sensor - Intake or camshaft position sensor - Exhaust.

## Reference Information

Schematic Reference

### [Engine Controls Schematics \(Buick with LE2\)](#)

Connector End View Reference

### [COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

- **EL 26792** HEI Spark Tester

For equivalent regional tools, refer to [Special Tools \(Mechanical Tools\)](#) .

### Circuit/System Verification

**NOTE:** This diagnostic assumes the following:

- The battery is completely charged.
- The engine cranking speed is acceptable.
- There is adequate fuel in the fuel tank.

### Circuit/System Testing

1. Crank the engine for up to 15 s.
2. Verify that DTC P0117, P0118, P0122, P0123, P0222, P0223, P0335, P0336, P0513, P0562, P0563, P0601, P0602, P0603, P0604, P0606, P062F, P0633, P0685, P0689, P0690, P1516, P1631, P1682, P16F3, P2101, P2119, or P2610 is not set.

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

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

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

3. Ignition ON.

4. Verify the security indicator on the instrument cluster illuminates momentarily.

- **If the indicator stays ON or is flashing**

Review the [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) , for Immobilizer system DTCs. For additional information, refer to [Immobilizer Description and Operation](#) .

- **If the indicator does not stay ON and is not flashing**

5. Verify the scan tool Engine Speed parameter displays greater than 0 RPM while cranking the engine.

- **If 0 RPM**

Refer to [DTC P0335 or P0336](#).

- **If greater than 0 RPM**

6. Connect the **EL 26792** HEI Spark Tester between the boot of a spark plug wire and ground.

**NOTE:** An erratic or weak spark is considered a no spark condition.

7. Verify the spark tester sparks while cranking the engine.

- **If the spark tester does not spark**

Refer to [Electronic Ignition System Diagnosis](#).

- **If the spark tester sparks**

8. Ignition ON.

**NOTE:**

- If the engine is too hot, high fuel pressure readings may result due to hot soak fuel boiling. Allow the engine coolant temperature to cool to less than 60Â° C (150Â° F) before attempting to verify fuel pressure.
- The Fuel Pump Enable may need to be commanded On a few times in order to obtain the highest possible fuel pressure.

- **Additional DTCs may set when using the fuel pump output control.**

9. Command the Fuel Pump Enable On several times with a scan tool.
10. Verify the scan tool Fuel Pressure Sensor parameter is between 345-650 kPa (50-94 PSI) with the fuel pump running.
  - **If not within the specified range**  
Refer to [Fuel System Diagnosis](#).
  - **If within the specified range**
11. Verify the scan tool Fuel Pressure Sensor parameter, after the fuel pump has turned OFF, decreases to less than 600 kPa (87 PSI) and does not decrease greater than 34 kPa (5 PSI) in 1 minute.
  - **If not within the specified range**  
Refer to [Fuel System Diagnosis](#).
  - **If within the specified range**
12. Verify the conditions listed below do not exist:
  - Collapsed air intake duct to the throttle body
  - Air filter and air intake system for restrictions and obstructions
  - Spark plugs for being gas or coolant fouled
  - A skewed manifold absolute pressure (MAP) sensor
  - A skewed engine coolant temperature (ECT) sensor
  - Test the exhaust system for restrictions. Refer to [Restricted Exhaust](#).
  - Test the fuel for contamination. Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#).
  - Engine mechanical condition, for example, worn timing belt or low compression. Refer to [Symptoms - Engine Mechanical](#).
    - **If a condition exists**  
Repair as necessary.
    - **If no conditions exist**
13. All OK.

### Repair Verification

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

## MALFUNCTION INDICATOR LAMP (MIL) DIAGNOSIS

### Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### Circuit/System Description

The engine control module (ECM) and the transmission control module (TCM) monitor powertrain conditions for any condition which may adversely affect vehicle emissions. The ECM and the TCM communicate these conditions through the serial data network. When the ECM or TCM detects the adverse condition, a request is sent to the instrument panel cluster to illuminate the malfunction indicator lamp (MIL). Ignition 1 voltage is supplied internally through the instrument panel cluster to the MIL. The instrument panel cluster turns the MIL ON by internally grounding the MIL. The MIL should be on steady with the ignition ON and the engine OFF. The MIL should turn OFF when the engine is started.

### Reference Information

## [Engine Controls Schematics \(Buick with LE2\)](#)

Connector End View Reference

## [COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

## [Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

### **Circuit/System Verification**

1. Ignition ON.
2. Command the Malfunction Indicator Lamp On and Off with a scan tool.
  - **If the MIL does not turn ON and OFF**  
  
Refer to Circuit/System Testing.
  - **If the MIL turns ON and OFF**
3. All OK.

### **Circuit/System Testing**

1. Ignition OFF, disconnect the harness connector at the P16 Instrument Cluster.
2. Ignition ON.
3. Verify a test lamp illuminates between the Ignition voltage circuit terminal 8 and ground.
  - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF.
    2. Test for less than 2  $\Omega$  in the ignition voltage circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , verify the fuse is not open and there is voltage at the fuse.
  - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition OFF.
    2. Test for infinite resistance between the ignition voltage circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, test all components connected to the ignition voltage circuit and replace as necessary.
  - **If the test lamp illuminates**
4. Replace the P16 Instrument Cluster.

### **Repair Instructions**

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

- Refer to [Instrument Cluster Replacement \(Buick\)](#).

- Refer to [Control Module References](#) for control module replacement, programming and setup

## FUEL SYSTEM DIAGNOSIS

### Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### Circuit/System Description

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

The fuel system is an electronic returnless on-demand design. A returnless fuel system reduces the internal temperature of the fuel tank by not returning hot fuel from the engine to the fuel tank. Reducing the internal temperature of the fuel tank results in lower evaporative emissions.

The fuel tank stores the fuel supply. An electric turbine style fuel pump attaches to the fuel tank fuel pump module inside the fuel tank. The fuel pump supplies high pressure fuel through the fuel feed pipe and the fuel feed front pipe check valve to the high pressure fuel pump. The fuel pump also supplies fuel to a venturi pump located on the bottom of the fuel tank fuel pump module. The function of the venturi pump is to fill the fuel tank fuel pump module reservoir. The fuel tank fuel pump module contains a reverse flow check valve. Both check valves maintain fuel pressure in the fuel feed pipe and the fuel rail in order to prevent long cranking times.

### Diagnostic Aids

- A faulty fuel feed front pipe check valve may cause a rattle, tick, knock, or buzz noise. The noise may be more pronounced at idle, approximately 600-800 RPM.
- An erratic low side fuel pressure reading may be caused by a faulty fuel feed front pipe check valve.
- Observe the Misfire Counters or perform the Fuel Injector Diagnosis to help identify a leaking fuel injector.

### Reference Information

#### Description and Operation

#### [Fuel System Description](#)

#### Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

#### Scan Tool Reference

#### [Control Module References](#) for scan tool information

#### Special Tools

- **CH-41769** Fuel Line Quick Disconnect Separator
- **EN-37287** Fuel Line Shut-off Adapter

For equivalent regional tools, refer to [Special Tools \(Mechanical Tools\)](#).

**NOTE:**

- **Repair all fuel system related DTCs, except P2635, before performing this diagnostic.**
- **Inspect the fuel system for damage or external leaks before proceeding.**
- **Verify that adequate fuel is in the fuel tank before proceeding.**
- **The Fuel Pump Enable may need to be commanded On a few times in order to obtain the highest possible fuel pressure.**
- **DO NOT perform the Fuel System Diagnosis if the engine coolant temperature is above 60°C (150°F). High fuel pressure readings may result due to hot soak fuel boiling. With the engine OFF, the fuel pressure may increase beyond the pressure relief regulator valve's setting point of 690 kPa (100 PSI)  $\pm$  5%.**

1. Ignition ON, engine OFF, command the Fuel Pump Enable On several times with a scan tool.

2. Verify that the scan tool Fuel Pressure Sensor parameter is between 345-650 kPa (50-94 PSI).

- **If less than 345 kPa (50 PSI)**

Refer to Circuit/System Testing - Fuel Pressure Low.

- **If greater than 650 kPa (94 PSI)**

Replace the G12 Fuel Pump.

- **If between 345-650 kPa (50-94 PSI)**

3. Verify that the scan tool Fuel Pressure Sensor parameter, after the fuel pump is turned off, decreases to less than 600 kPa (87 PSI).

- **If greater than 600 kPa (87 PSI)**

Replace the G12 Fuel Pump

- **If less than 600 kPa (87 PSI)**

4. Verify that the scan tool Fuel Pressure Sensor parameter does not decrease greater than 34 kPa (5 PSI) in 1 min.

- **If greater than 34 kPa (5 PSI)**

Refer to Circuit/System Testing - Fuel Pressure Leaks Down.

- **If less than 34 kPa (5 PSI)**

5. Engine idling.

6. Verify that the scan tool Fuel Pressure Sensor parameter is between 300-400 kPa (43-58 PSI).

- **If less than 300 kPa (43 PSI)**

Refer to Circuit/System Testing - Fuel Pressure Low.

- **If greater than 400 kPa (58 PSI)**

Replace the G12 Fuel Pump.

- **If between 300-400 kPa (43-58 PSI)**

7. Verify that the scan tool Short Term Fuel Pump Trim and the Long Term Fuel Pump Trim when multiplied together are less than 1.5.

- **If greater than 1.5**

Refer to Circuit/System Testing - Fuel Pressure Low.

- **If less than 1.5**

8. Verify that the scan tool Fuel Pressure Sensor and the Desired Fuel Pressure are within 45 kPa (6.5 PSI) at 300 kPa (43.5 PSI) request or 60 kPa (8.7 PSI) at 400 kPa (58 PSI) request of each other while operating the vehicle through varying loads.

- **If greater than 45 kPa (6.5 PSI) / 60 kPa (8.7 PSI)**

Refer to Circuit/System Testing - Fuel Pressure Drops Off.

- **If less than 45 kPa (6.5 PSI) / 60 kPa (8.7 PSI)**

9. If the fuel system components test normal, refer to [Symptoms - Engine Controls](#), and [Fuel Injector Diagnosis](#).

### Circuit/System Testing

#### Fuel Pressure Low

1. Verify none of the conditions listed below exist:

- Restricted or dislocated fuel feed front pipe check valve
- Restricted fuel feed pipe
- Inspect the harness connectors and the ground circuits of the fuel pump for poor connections.
- **If a condition exists**

Repair as necessary.

- **If no conditions exist**

Replace the G12 Fuel Pump.

#### Fuel Pressure Leaks Down

1. Ignition OFF, relieve the fuel pressure. Refer to [Fuel Pressure Relief](#).

2. Install the **EN-37287** between the chassis fuel feed hose and the engine compartment fuel feed pipe.

3. Open the valve on the **EN-37287**.

4. Ignition ON, command the Fuel Pump Enable On and then Off with a scan tool.

5. Close the valve on the **EN-37287**.

6. Verify that the scan tool Fuel Pressure Sensor parameter does not decrease more than 34 kPa (5 PSI) in 1 min.

- **If greater than 34 kPa (5 PSI)**

Replace the G12 Fuel Pump.

- **If less than 34 kPa (5 PSI)**

7. Test for a faulty fuel feed front pipe check valve.

- **If a condition exists**

Replace the fuel feed front pipe.

- **If no condition exists**

8. Test for a leaking G18 High Pressure Fuel Pump.

- **If a condition exists**

Replace the G18 High Pressure Fuel Pump.

- **If no condition exists**

Locate and replace the leaking Q17 Fuel Injector.

## Fuel Pressure Drops Off

1. Verify none of the conditions listed below exist:

- Restricted or dislocated fuel feed front pipe check valve
- Restricted fuel feed pipe
- Inspect the harness connectors and the ground circuits of the fuel pump for poor connections.
- **If a condition exists**

Repair as necessary.

- **If no conditions exist**

Replace the G12 Fuel Pump.

### Repair Instructions

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

- Refer to [Fuel Feed Pipe Replacement \(Underbody\)](#), [Fuel Feed Pipe Replacement \(At Tank AWD\)](#), [Fuel Feed Pipe Replacement \(At Tank FWD\)](#).
- Refer to [Fuel Injector Replacement](#)
- Refer to [Fuel Injection Pump Replacement](#) for G18 High Pressure Fuel Pump replacement
- Refer to [Fuel Tank Fuel Pump Module Replacement \(FWD\)](#), [Fuel Tank Fuel Pump Module Replacement \(AWD\)](#).

## FUEL INJECTOR DIAGNOSIS

### Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### Circuit/System Description

Two methods of testing fuel injector balance are available, the Active Fuel Injector Tester (AFIT) or a scan tool. The Active Fuel Injector Tester and SIDI adaptor connects to the engine control module harness connectors to test the high pressure fuel pump performance, fuel injector wiring, and fuel injector operation. The AFIT displays step by step instructions to precisely determine pressure drop of each fuel injector. The scan tool fuel injector balance test is performed while the engine is running at idle. The scan tool pressurizes the fuel rail to a predetermined pressure before each fuel injector is pulsed for a precise amount of time allowing a measured amount of the fuel to be injected. This causes a drop in the system fuel pressure that is recorded and used to compare each fuel injector.

### Diagnostic Aids

- Monitoring the scan tool Cylinder 1-4 Current Misfire Counters may help to isolate the fuel injector that is causing the condition.
- Operating the vehicle over a wide temperature range may help isolate the fuel injector that is causing the condition.

### Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LE2\)](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)

- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

## Special Tools

- **CH-47976** Active Fuel Injector Tester
- **CH-47976-500** Active Fuel Injection Tester (AFIT) SIDI Adapter Kit

For equivalent regional tools, refer to [Special Tools \(Mechanical Tools\)](#).

## Fuel Injector Coil Test

### NOTE:

- **The resistance test must be performed at the fuel injector or mis-diagnosis will occur.**
- **The DMM and test leads must be calibrated to 0  $\Omega$  in order to prevent mis-diagnosis.**

1. Disconnect the appropriate Q17 Fuel Injector.
2. Test for 1.35-1.65  $\Omega$  at 20 $^{\circ}\text{C}$  (68 $^{\circ}\text{F}$ ) between the control + circuit terminal 2 and the control - circuit terminal 1 at the Q17 Fuel Injector.
  - **If not between 1.35-1.65  $\Omega$**   
Replace the Q17 Fuel Injector.
  - **If between 1.35-1.65  $\Omega$**
3. Test for infinite resistance between each terminal at the Q17 Fuel Injector and the Q17 Fuel Injector housing/case.
  - **If less than infinite resistance**  
Replace the Q17 Fuel Injector.
  - **If infinite resistance**
4. All OK. Perform the Fuel Injector Balance Test.

## Fuel Injector Balance Test

### NOTE:

- **DO NOT perform this test if the engine coolant temperature (ECT) is above 60 $^{\circ}\text{C}$  (140 $^{\circ}\text{F}$ ). Irregular fuel pressure readings may result due to hot soak fuel boiling.**
- **Verify that adequate fuel is in the fuel tank before proceeding with this diagnostic.**

## Fuel Injector Balance Test with Active Fuel Injector Tester - Preferred Method

1. Verify the battery is fully charged and all accessories are OFF.
2. Ignition OFF, all vehicle systems OFF. Install the **CH-47976** Active Fuel Injector Tester and the **CH-47976-500** Active Fuel Injection Tester (AFIT) SIDI Adapter Kit, refer to the Active Fuel Injector Tester User Guide. It may take up to 2 min for all vehicle systems to power down.
3. Turn ON the Active Fuel Injector Tester and select the vehicle.
4. Ignition ON, perform the Injector Test with the Active Fuel Injector Tester.
  - **If the Active Fuel Injector Tester aborts testing due to incorrect fuel pressure or fuel leak down**  
Refer to [Fuel System Diagnosis](#).
  - **If the Active Fuel Injector Tester does not abort testing**

5. Compare the test results with the appropriate recommended tolerance.

- **If any fuel injector exceeds the recommended tolerance**

Replace the appropriate Q17 Fuel Injector(s).

- **If all fuel injectors are within the recommended tolerance**

6. All OK.

### Fuel Injector Balance Test with Scan Tool

1. Verify the correct low side fuel pressure. Refer to [Fuel System Diagnosis](#).
2. Engine idling, verify the scan tool Fuel Rail Pressure Sensor parameter is approximately 3 MPa (435 psi).

**NOTE:** The engine speed must be between 600-1000 RPM to perform this test.

3. Select the Fuel Injector Balance function within the Control Functions menu of a scan tool.
4. Select and test an injector. Repeat for each injector.
5. Obtain and record a pressure drop value for each injector.
6. Add all of the individual pressure drop values except for the injector suspected of being faulty. This is the total pressure drop.
7. Divide the total pressure drop by the number of fuel injectors that were added together. This is the average pressure drop.
8. Multiply the average pressure drop by 0.20. This is the acceptable variance from the average pressure drop, 20 percent.
9. Verify the difference between any individual pressure drop and the average pressure drop is not greater than the acceptable variance.

- **If greater than the acceptable variance**

Replace the Q17 Fuel Injector.

- **If within the acceptable variance**

10. All OK.

### Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

Refer to [Fuel Injector Replacement](#)

## FUEL INJECTOR CIRCUIT DIAGNOSIS

### Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### Diagnostic Fault Information

| Circuit                   | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|---------------------------|-----------------|----------------------|------------------|--------------------|
| Fuel Injector 1 Control + | P2147           | P0201                | P2148            | P1248              |
| Fuel Injector 1 Control - | P0261           | P0201                | P0262, P2148     | P1248              |
| Fuel Injector 2 Control + | P2150           | P0202                | P2151            | P1249              |
| Fuel Injector 2 Control - | P0264           | P0202                | P0265, P2151     | P1249              |
| Fuel Injector 3 Control + | P2153           | P0203                | P2154            | P124A              |
| Fuel Injector 3 Control - | P0267           | P0203                | P0268, P2154     | P124A              |

| Circuit                   | Short to Ground | Open/High Resistance | Short to Voltage | Signal Performance |
|---------------------------|-----------------|----------------------|------------------|--------------------|
| Fuel Injector 4 Control + | P2156           | P0204                | P2157            | P124B              |
| Fuel Injector 4 Control - | P0270           | P0204                | P0271, P2157     | P124B              |

### 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 injector high voltage control circuits. When a fuel injector circuit condition is detected by the ECM, the affected fuel injector(s) is disabled.

### Diagnostic Aids

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

### Reference Information

Schematic Reference

### Engine Controls Schematics (Buick with LE2)

Connector End View Reference

### COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE)

Description and Operation

### Fuel System Description

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

### Circuit/System Verification

**NOTE:** Do Not perform this procedure unless directed here from the Fuel Injector Balance Test.

1. Engine idling.
2. Verify the scan tool Cylinder 1-4 Current Misfire Counter parameters do not increment.

- **If the Cylinder 1-4 Current Misfire Counters increment**

Refer to Circuit/System Testing.

- **If the Cylinder 1-4 Current Misfire Counters do not increment**

3. Verify the scan tool Cylinder 1-4 Injector Control Circuit Status parameters display OK.

- **If the Cylinder 1-4 Injector Control Circuit Status parameters do not display OK**

- If the **Cylinder 1-4 Injector Control Circuit Status** parameters display **OK**

4. All OK.

### Circuit/System Testing

1. Ignition OFF, all vehicle systems OFF, disconnect the X2 harness connector at the K20 Engine Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for infinite resistance between the appropriate Q17 Fuel Injector control + circuit and ground.
  - **If less than infinite resistance**
    1. Disconnect the harness connector of the Q17 Fuel Injector.
    2. Test for infinite resistance between the Q17 Fuel Injector control + circuit and ground.
      - If infinite resistance
    3. Test for infinite resistance between the Q17 Fuel Injector control - circuit and ground.
      - If less than infinite, repair the short to ground in the circuit.
      - If infinite, replace the Q17 Fuel Injector.
  - **If infinite resistance**
3. Ignition ON.
4. Test for less than 1 V between the Q17 Fuel Injector control + circuit and ground.
  - **If 1 V or greater**
    1. Disconnect the harness connector of the Q17 Fuel Injector, ignition ON.
    2. Test for less than 1 V between the Q17 Fuel Injector control + circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, repair the short to voltage on the control - circuit.
  - **If less than 1 V**
5. Ignition OFF.
6. Test for less than 3  $\Omega$  between the Q17 Fuel Injector control + circuit and control - circuit.
  - **If 3  $\Omega$  or greater**
    1. Disconnect the harness connector of the Q17 Fuel Injector.
    2. Test for less than 2  $\Omega$  on the control + circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$
    3. Test for less than 2  $\Omega$  on the control - circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the Q17 Fuel Injector.
  - **If less than 3  $\Omega$**
7. Replace the K20 Engine Control Module.

### Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- Refer to [Fuel Injector Replacement](#)
- Refer to [Control Module References](#) for K20 Engine Control Module replacement, setup, and programming

## ALCOHOL/CONTAMINANTS-IN-FUEL DIAGNOSIS

### Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

## Circuit/System Description

Water contamination in the fuel system may cause driveability conditions such as hesitation, stalling, no start, or misfires in one or more cylinders. Water may collect near a single fuel injector at the lowest point in the fuel injection system and cause a misfire in that cylinder. If the fuel system is contaminated with water, inspect the fuel system components for rust or deterioration.

Ethanol concentrations of greater than 10% in non-blended gasoline or greater than 85% with E85 blended gasoline for flexible fuel applications can cause driveability conditions such as hesitation, lack of power, stalling, or no start. Excessive concentrations of ethanol used in vehicles not designed for it may cause fuel system corrosion, deterioration of rubber components, and fuel filter restriction.

## Reference Information

### Special Tool

**CH 44175-A** Alcohol Tester Kit, if available

For equivalent regional tools, refer to [\*\*Special Tools \(Mechanical Tools\)\*\*](#).

## Circuit/System Verification

1. Remove a sample of fuel from the bottom of the fuel tank and place in a clean, clear container.
2. Place the sample on a level surface for 2 min.
3. Verify the sample is clear and bright in color.

- **If the sample appears cloudy, or contaminated with water, as indicated by a water layer at the bottom of the sample**

Refer to Circuit/System Testing - Particulate Contaminants in Fuel.

- **If alcohol contamination is suspected**

Refer to Circuit/System Testing - Alcohol in Fuel Testing.

- **If the sample remains clear and bright**

4. All OK.

## Circuit/System Testing

### Alcohol in Fuel Testing with Special Tool, if Available

1. Test the fuel composition using **CH 44175-A** Alcohol Tester Kit and Instruction Manual.
2. Verify no water appears in the fuel sample.

- **If water appears in the fuel sample**

Clean the fuel system.

- **If no water appears in the fuel sample**

3. Subtract 50 from the reading on the DMM in order to obtain the percentage of alcohol in the fuel sample.
4. Verify the non-blended gasoline fuel sample does not measure greater than 15% or an E85 blended gasoline fuel sample measures greater than 91% ethanol.

- **If greater than the specified value**

1. Add fresh regular gasoline to the vehicle's fuel tank.
2. Remove a new sample of fuel from the tank.
3. Test the fuel composition using **CH 44175-A** Alcohol Tester Kit and Instruction Manual.
4. Subtract 50 from the reading on the DMM in order to obtain the percentage of alcohol in the fuel sample.
5. Verify the non-blended gasoline fuel sample does not measure greater than 15% or an E85 blended gasoline fuel sample measures greater than 91% ethanol.

- If additional testing indicates that the ethanol percentage is still above 15% for a non-blended gasoline sample, drain and replace the vehicle's fuel. Refer to [Fuel Tank Draining](#).
- If additional testing indicates that the E85 blended gasoline sample still measures above 91%, continue adding fresh, regular gasoline until the ethanol content is 85% or less.
- **If the specified value or less**

5. All OK.

### Alcohol in Fuel Testing without Special Tool

**NOTE:** This procedure is for non-blended gasoline only. If excessive alcohol content is suspected with E85 fuel add 15% tank volume of fresh, regular gasoline to the fuel tank.

1. Using a 100 ml (3.38 oz) specified cylinder with 1 ml (0.034 oz) graduation marks, fill the cylinder with fuel to the 90 ml (3.04 oz) mark.
2. Add 10 ml (0.34 oz) of water in order to bring the total fluid volume to 100 ml (3.38 oz) and install a stopper.
3. Shake the cylinder vigorously for 10-15 s.
4. Carefully loosen the stopper in order to release the pressure.
5. Re-install the stopper and shake the cylinder vigorously again for 10-15 s.
6. Put the cylinder on a level surface for approximately 5 min in order to allow adequate liquid separation. If alcohol is present in the fuel, the volume of the lower layer, which would now contain both alcohol and water, will be more than 10 ml (0.34 oz). For example, if the volume of the lower layer is increased to 15 ml (0.51 oz), this indicates at least 5% alcohol in the fuel. The actual amount of alcohol may be somewhat more because this procedure does not extract all of the alcohol from the fuel.
7. Verify the non-blended gasoline fuel sample does not measure greater than 15%.
  - **If greater than the specified value**
    1. Add fresh regular gasoline to the vehicle's fuel tank.
    2. Remove a new sample of fuel from the tank.
    3. Test the fuel composition of the new sample.
    4. Verify the non-blended gasoline fuel sample does not measure greater than 15%.
      - If greater than the specified value, drain and replace the vehicle's fuel. Refer to [Fuel Tank Draining](#).
      - If the specified value or less, all OK.
  - **If the specified value or less**
8. All OK.

### Particulate Contaminants in Fuel

1. Using an approved fuel container, draw approximately 0.5 liter (0.53 qt) of fuel from the bottom of the fuel tank.
2. Place the container on a level surface for approximately 5 min in order to allow settling of the particulate contamination. Particulate contamination will show up in various shapes and colors. Sand will typically be identified by a white or light brown crystals. Rubber will appear as black and irregular particles.
3. Verify there are no physical contaminants or water present in the fuel sample.
  - **If any physical contaminants or water are present**  
Clean the fuel system.
  - **If no physical contaminants or water are present**
4. All OK.

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

- Refer to [Fuel System Cleaning](#)
- Refer to [Fuel Tank Draining](#)

## EVAPORATIVE EMISSION CONTROL SYSTEM DIAGNOSIS

### Special Tools

EN-41413-VLV EVAP Service Port Vent Fitting

### Operating Instructions for the Evaporative Emission System Tester

#### Vehicle Setup

**WARNING:** Refer to [Fuel and Evaporative Emission Pipe Warning](#) .

**CAUTION:** Refer to [Clean, Dry, Low Pressure Gas Source Caution](#) .

**NOTE:** When servicing the evaporative emission (EVAP) system, test pressure must not exceed 13 in H<sub>2</sub>O (0.5 PSI) as pressure in excess of this could cause system components to perform inaccurately.

**NOTE:** A large difference between the vehicle temperature and shop temperature will seriously affect the accuracy of the tests. Always allow at least 15 min for the vehicle temperature to adjust to the shop temperature. Refer to Temperature Variation Instructions for more information about vehicle versus shop temperatures.

1. Engine OFF, open the hood. Position a large fan to blow air under the vehicle onto the fuel tank area.
2. Connect the red battery clip from the tester to the positive battery terminal.

**NOTE:** The vehicle battery must be fully charged for optimum tester performance.

3. Connect the black battery clip from the tester to chassis ground.

#### Flow Meter Test - Leak Detection

**CAUTION:** Refer to [Fuel and Evaporative Emission Hose/Pipe Connection Cleaning Caution](#) .

1. Open the Nitrogen tank valve and turn the NITROGEN/SMOKE valve on the front control panel to NITROGEN.
2. Connect the hose to the correct test orifice on the bottom front of the tester. For orifice size, refer to the vehicle specific information found in service procedures for DTCs that relate to EVAP system leaks.
3. Press and release the remote switch to activate the tester.

**NOTE:** The tester will time out after about 15 min. You may press the remote switch to reactivate the tester as desired.

4. Position the sliding red flag on the flow meter to align with the floating indicator. When the red flag is set, press and release the remote switch to deactivate the tester.
5. Remove the hose from the test orifice and install the hose onto the vehicle. For proper connection location, and the special tool numbers for any adapters that may be required, refer to the service procedures for DTCs that relate to EVAP system leaks.

6. Ignition ON, seal the EVAP system per instructions in the service procedures for DTCs that relate to EVAP system leaks. Most systems can be sealed using a scan tool output control for the EVAP Vent Solenoid Valve, other systems require that the vent system be plugged.

**NOTE:**

- **Larger volume fuel tanks, and/or those with lower fuel levels, may require several minutes to fill with nitrogen.**
- **Static buildup may cause the float indicator to stick. It may be necessary to tap on the flow meter to free up the float.**
- **If fuel level is 90% or greater it will take longer to fill the system with smoke because the fuel fill tube check valve will be closed and force any smoke to pass through the on-board refueling vapor recovery pipe and orifice.**

7. Press and release the remote switch to activate the nitrogen flow and fill the system.
8. Verify the stable floating indicator position to the red flag.

- **Above the red flag, result is unacceptable - fail**

Go to the Smoke Procedure

- **Below the red flag - pass. Test complete**

9. Press and release the remote switch to deactivate the tester.

**Smoke Procedure - Locate the Leak**

**NOTE:**

**It is not recommended to use the tester in an outside repair bay area because wind and sunlight may affect temperature and your ability to see the smoke.**

1. Turn OFF any fans that may cause air movement around or near the vehicle.

**NOTE:**

**Completely unwind the nitrogen/smoke hose from the bracket to optimize the tester's performance.**

2. Connect the nitrogen/smoke hose to the vehicle as directed in the service procedures. Some vehicles require that the nitrogen/smoke hose be connected at the front of the EVAP system at the EVAP service port. An adapter may be necessary. Other vehicles require the connection be made at the rear of the system using an adapter at the fuel fill cap or capless fuel fill. Consult the service procedures for DTCs that relate to EVAP system leaks for vehicle specific instructions regarding connection location and adapters.
3. Open the Nitrogen tank valve and turn the nitrogen/smoke valve on the control panel to smoke.

**NOTE:**

**The remote switch operates on a push ON, push OFF fashion.**

4. Press and release the remote switch to activate the tester and inject smoke into the EVAP system.
5. Verify smoke has filled the EVAP system by opening the system opposite the end where smoke is injected.

**NOTE:**

- **When injecting smoke at the service port, remove the fuel fill cap until smoke is observed. Then close the system and continue testing.**
- **If using a special tool fuel fill cap adapter at the filler neck, vent the system at the service port, with special tool EN-41413-VLV until smoke is observed then remove the vent fitting tool and close the system to continue with the test.**
- **Inject smoke in less than 2 min cycles for optimum tester performance.**

6. Press and release the remote switch to deactivate the tester.

**NOTE:**

**For optimum visual smoke performance, deactivate the smoke flow and allow the system pressure to drop. Allowing the smoke to exit small holes at a low flow rate greatly enhances visibility.**

7. Introduce smoke into the system for an additional 60 s. Continue introducing smoke at 15 s intervals, as necessary until leak source is identified.
8. Using a high-intensity white light, inspect the entire EVAP system path, and look for the source of the leak indicated by the exiting smoke.
  - **Smoke seen leaking**  
  
Repair or replace the affected component.
  - **No smoke seen leaking**
9. All OK

### Temperature Variation Instructions

#### The Concern

Ideal circumstances for conducting the EVAP flow meter test require equal temperatures between the Nitrogen gas and the vehicle EVAP system. Significant differences in temperature between them can result in a flow or pressure change during testing, causing misleading results. Typically, the evaporative emission system tester is stored indoors, approximately 21Â°C (70Â°F). Vehicles brought in for diagnosis may have an EVAP system at significantly different temperatures.

#### For Example

**NOTE:**

**With no temperature difference between the Nitrogen gas and EVAP system, the resulting vehicle EVAP system pressure will remain stable at 13 in. H<sub>2</sub>O (0.5 PSI) once pressurized, providing no leaks are present.**

When the EVAP flow meter tests are performed with significant differences in temperature between the Nitrogen gas and the vehicle EVAP system, the following results can occur:

- An increase in flow during the flow meter test can be caused by a vehicle's warm EVAP system cooling down.
- A decrease in flow during the flow meter test can be caused by a vehicle's cool EVAP system warming up.

#### The Solution

When working on a vehicle with significant temperature differences between the vehicle EVAP system and the Nitrogen gas, allow the vehicle EVAP system temperature to stabilize as close as possible to the temperature of the Nitrogen gas before conducting the flow meter test.

### INSPECTION/MAINTENANCE SYSTEM CHECK

#### Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Diagnostic System Check - Vehicle](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

#### Circuit/System Description

Several states require for a vehicle to pass on-board diagnostic (OBD) system tests and inspection/maintenance (I/M) emission inspections in order to renew license plates. This is accomplished by viewing the Inspection/Maintenance System Status or Data display on a scan tool. Using a scan tool, the technician can observe the I/M status in order to verify that the vehicle meets the criteria that complies with the local area requirements.

#### Condition for Updating the Inspection/Maintenance Emission System Status

**NOTE:** New vehicles may not report an Inspection/Maintenance System Check pass or fail status for certain post catalyst oxygen sensor or heated oxygen sensor 2 diagnostics prior to 700 miles. After replacing a catalytic converter on a vehicle with greater than 700 miles, it may require up to an additional 700 miles to prevent a false failure status.

Each system monitor requires at least one, and sometimes several, diagnostic tests. The result of each test is reported by a diagnostic trouble code (DTC). A system monitor is complete when either all of the DTCs composing the monitor have Run and Passed, or when any one of the DTCs comprising the monitor has illuminated the malfunction indicator lamp (MIL). Once the system monitor is complete, the Inspection/Maintenance System Status or Data will indicate YES in the Completed or Value column.

For example, when the HO2S heater status indicates YES, either all of the oxygen sensor heater tests have passed or one of the tests has illuminated the MIL. If the vehicle has two heated oxygen sensors, either both heater circuit tests have passed or one of the heater circuit tests has illuminated the MIL. The Inspection/Maintenance System Status or Data will indicate NO under the Completed or Value column when any of the required tests for that system have not run. The following is a list of conditions that may set the Inspection/Maintenance System Status or Data indicator to NO:

- The vehicle is new from the factory and has not yet been driven through the necessary drive conditions to complete the tests.
- The battery has been disconnected or discharged below operating voltage.
- The engine control module (ECM) power or ground has been interrupted.
- The ECM has been reprogrammed.
- The ECM DTCs have been cleared.

### Monitored Emission Control Systems

The OBD II System monitors all emission control systems that are on-board. The OBD II regulations require monitoring of the following:

- The air conditioning system
- The catalyst efficiency
- Comprehensive component monitoring, emission related inputs and outputs
- The evaporative emission (EVAP) system
- The fuel delivery system
- Heated catalyst monitoring
- Misfire monitoring
- The oxygen sensor system (HO2S)
- The oxygen sensor heater system (HO2S heater)

For the specific DTCs required for each system, refer to **Inspection/Maintenance (I/M) System DTC Table**. Systems such as fuel delivery, misfire, and comprehensive components may not be listed in a system status list. These tests run continuously and do not require an inspection/maintenance system status indicator.

### Circuit/System Verification

1. Verify that all Inspection/Maintenance System Status or Data indicators report YES, and that no I/M Test DTCs are present.

- **If any I/M Test DTCs are set**

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

- **If no I/M Test DTCs are set**

2. All OK.

### Circuit/System Testing

**NOTE:**

Many DTC related repairs will instruct the technician to clear the DTC information. Clearing the DTC will reset the Inspection/Maintenance System Status or Data indicators to NO. Performing the I/M Complete System Set Procedure will set each of the I/M System Status indicators to YES.

1. Verify no I/M DTCs are present.

- If an I/M DTC is set that would prevent the I/M System Status tests from completing, diagnose that DTC before continuing.

Refer to [Inspection/Maintenance \(I/M\) System DTC Table](#).

- If no I/M DTCs are set

2. Review applicable service bulletins for software updates that would prevent the I/M System Status tests from completing.

- If a control module re-program or other repair is required,

Perform the [Inspection/Maintenance Complete System Set Procedure](#) after repair.

- If no repair is required

3. Observe the Inspection/Maintenance System Status or Data indicators.

- If any Inspection/Maintenance System Status or Data indicators report NO

Perform the [Inspection/Maintenance Complete System Set Procedure](#).

- If no Inspection/Maintenance System Status or Data indicators report NO

4. All OK.

## INSPECTION/MAINTENANCE COMPLETE SYSTEM SET PROCEDURE

### Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### Circuit/System Description

The purpose of the inspection/maintenance complete system set procedure is to satisfy the enable criteria necessary to execute all of the inspection/maintenance readiness diagnostics and complete the trips for those particular diagnostics. When all inspection/maintenance monitored diagnostic tests are completed, the inspection/maintenance system status indicators are set to yes. Perform the inspection/maintenance complete system set procedure if any inspection/maintenance system status indicators are set to NO.

### Condition for Meeting a Cold Start

- The ignition voltage between 10-18 V.
- The barometric pressure (BARO) is more than 75 kPa (10.15 PSI).
- The engine coolant temperature (ECT) at start-up is greater than  $-5^{\circ}\text{C}$  ( $23^{\circ}\text{F}$ ).
- The intake air temperature (IAT) at start-up is less than  $40^{\circ}\text{C}$  ( $104^{\circ}\text{F}$ ).
- The difference between the start-up IAT and ECT are within  $3^{\circ}\text{C}$  ( $5^{\circ}\text{F}$ ).
- The engine is OFF for greater than 6 h or the following conditions must be met:
  - The start-up IAT minus start-up ECT 1 are within  $12^{\circ}\text{C}$  ( $22^{\circ}\text{F}$ ).
  - The start-up ECT minus start-up IAT are within  $50^{\circ}\text{C}$  ( $90^{\circ}\text{F}$ ).
- Fuel level is between 25-75%.

### Circuit/System Verification

1. Verify that all I/M System Status indicators report YES, and that no I/M Test DTCs are present.

- If any I/M Test DTCs are set

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

- If no I/M Test DTCs are set

2. All OK.

### Inspection/Maintenance System Set Procedure

**NOTE:** Whenever the ignition is turned ON, ignition positive voltage is supplied to the heated oxygen sensor (HO2S) heaters. After verifying the enable criteria, turn OFF the ignition for approximately 5 minutes to allow the sensors to cool before continuing with the test. Once the engine is started, do NOT turn the engine OFF for the remaining portion of the set procedure.

1. Ensure that the vehicle meets the conditions for a cold start listed above.
  - If the Evaporative Emission (EVAP) inspection/maintenance system status indicator displays NO, perform the EVAP Service Bay test if applicable.
2. Turn OFF all accessories; HVAC system, other electrical loads, including aftermarket/add-on equipment, etc., and open the hood.
3. Set the vehicle parking brake and ensure the vehicle is in park for automatic transmission or neutral for manual transmission.
4. Turn the ignition ON for 1 min.
5. Start and idle the engine for 5 min.
6. Run the engine for 6 min within the following conditions:
  - Calculated air flow is between 9-30 g/s
  - Engine speed is steady between 1,300-3,000 RPM
7. Apply and hold brake pedal, and shift to Drive for automatic, or apply clutch pedal for manual and operate the vehicle within the following conditions for 2 min:
  - Manifold Absolute Pressure (MAP) signal is greater than 12 g/s
  - Engine speed is greater than 1,000 RPM

**NOTE:** Do NOT touch the accelerator pedal until told to do so. A change in throttle position sensor angle or an increase in engine speed may invalidate this portion of the test.

8. Release the accelerator pedal and shift the vehicle to Park for automatic, or Neutral and release clutch pedal for manual, and allow the engine to idle for 2 min.
9. Close the hood, release the parking brake and drive vehicle at 90 km/h (55 MPH) for 2 min.
10. Release the accelerator pedal for at least 10 s. This will allow the vehicle to enter the deceleration fuel cut off.
11. Safely stop the vehicle, with the engine in drive for automatic or neutral with the clutch pedal depressed and parking brake applied for manual. Allow the vehicle to idle for 2 min.

**NOTE:** Do NOT disturb the vehicle or turn ON the ignition until told to do so. Disturbing the vehicle may invalidate this portion of the test.

12. Shift the vehicle to park for automatic and neutral for manual. Turn OFF the ignition and exit the vehicle. Do NOT disturb the vehicle for 45 min.
13. Observe the Inspection/Maintenance System Status with a scan tool. All of the inspection/maintenance System Status indicators should display YES.
  - If the EVAP inspection/maintenance system status indicator displays NO, turn OFF the ignition, ensure that the vehicle meets the conditions for a cold start, and repeat steps 6 through 11 three more times, or until the EVAP inspection/maintenance system status indicator transitions to yes. If the indicator continues to display NO, refer to the [Inspection/Maintenance \(I/M\) System DTC Table](#) to identify the DTCs that did not run.

- If any of the inspection/maintenance system status indicators display NO, refer to the [Inspection/Maintenance \(I/M\) System DTC Table](#) for the indicator which did not display yes. The inspection/maintenance system DTC table identifies the DTCs associated with each inspection/maintenance system status Indicator.

## INSPECTION/MAINTENANCE (I/M) SYSTEM DTC TABLE

| System                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | DTCs Required to Set System Status to YES                                            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| If an inspection/maintenance system status indicator did NOT update to YES during the <a href="#">Inspection/Maintenance System Check</a> , review each indicator and reference this table to determine each DTC associated with the inspection/maintenance system status indicator. Each DTC listed below has specific conditions that must be met for the diagnostic to run. Included within the conditions are additional DTCs which, if set, may inhibit the DTCs listed below from running. Reviewing and operating the vehicle within the conditions for running for each DTC listed below will allow the inspection/maintenance system status indicators to transition to YES. |                                                                                      |
| Catalyst Monitor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <a href="#">DTC P0420</a>                                                            |
| Oxygen Sensor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <a href="#">DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, or P2271</a> |
| Oxygen Sensor Heater                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <a href="#">DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, or P0141</a>          |
| Camshaft System                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <a href="#">DTC P0011 or P0014</a>                                                   |

## SERVICE BAY TEST

### Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### Description

The purpose of the evaporative emission (EVAP) Service Bay Test is to aid in resetting the EVAP Inspection/Maintenance (I/M) System Status. For this vehicle, that is equipped with the engine off natural vacuum diagnostic, the Service Bay Test uses the scan tool to initiate the engine control module (ECM) regular sequence of EVAP system DTC tests, but with different enable criteria. By using the Service Bay Test the I/M indicator can be set without the need for multiple cold soaks.

The scan tool displays for the Service Bay Test are based on the events that occur within the following three categories:

### EVAP Service Bay Test Status - Running

The vehicle must remain at rest, in Park, or in Neutral, during this portion of the test. This test inspects for large leaks and vent system restrictions. The purge valve leak diagnostic may run, but is not required. The scan tool will display test progress or the reason for an abort or failure.

### EVAP Service Bay Test Status - Vehicle Ready for Drive Cycle

The scan tool will display time and distance needed to warm the fuel. The drive distance remaining rounds down to zero when there is anything less than 1 mile or kilometer remaining. The vehicle must be driven until the "return to service bay" message is displayed.

### EVAP Service Bay Test Status - Engine Off Conditions Met

During this portion of the test, the ECM will remain active for up to 45 min when the ignition is turned OFF to allow control of the EVAP vent solenoid valve and run the engine off natural vacuum test. The ECM inspects for small leaks during this period by monitoring fuel tank pressure or vacuum. If the system is sealed, there will be a pressure or vacuum change. Pressure or vacuum changes that are not within the calibrated values indicate a leak.

### NOTE:

- Do not reorder the scan tool screen display. The EVAP Service Bay Test Status parameter is the main status message to observe. It will indicate when each category is active with the Test Results status parameter right beneath it.
- There are many possible screen messages. It is very important that you watch these messages and record any failure or abort message as this will aid the diagnosis.
- If any of these issues occur during or after the engine running portion of the test, the vehicle will need to soak for at least 8 h before retrying.
- An incorrect "drive distance not met" message is an indication that the service bay test aborted earlier and the vehicle was keyed off followed by retrying without waiting for at least 10 min before retrying.

When the EVAP diagnostics are initiated by the Service Bay Test, the scan tool will indicate if the enable conditions listed below are not met, or will display a specific reason if the test aborts. When complete, the display will indicate that the tests completed or failed.

If

- The Service Bay Test aborts
- The scan tool resets
- The scan tool locks up
- The scan tool sets an error
- The diagnostic connector becomes disconnected

Before starting the engine, the vehicle should be left keyed off for at least 10 min before retrying.

After the ignition off portion of the test has completed, the Service Bay Test will delay ECM shut down for 10 min to allow for analysis of scan tool data. A complete Test Results status message along with EVAP Monitor Complete value of YES is the goal.

### Conditions for Running the Test

The following conditions must be met in order to enable the Service Bay Test:

- The battery voltage is between 11-32 V.
- The engine coolant temperature (ECT) is less than 35°C (95°F) at start-up.
- The intake air temperature (IAT) is less than 34°C (93°F) at start-up.
- The ambient air temperature is between 0-40°C (32-104°F) at start-up.
- The fuel level is within 10-90% capacity and cannot be refueled during the tests.
- The vehicle must have sat for 8 h since the last run time.
- The EVAP I/M System Status indicator is set to NO.

**NOTE:** The use of the scan tool Clear DTCs function will reset all I/M statuses.

- There are no DTCs displayed.
- The vehicle must be driven for the time and distance specified on the scan tool.
- The ignition must remain OFF during the engine OFF portion of the test, and the vehicle must remain at rest.

### Test Procedure

#### NOTE:

- If the Service Bay Test aborts or fails, a DTC will NOT be set.

- You must not rush the scan tool selections or erroneous results or error messages could occur.

1. Select the Service Bay Test with the scan tool.

**WARNING:** Refer to [Road Test Warning](#) .

2. Follow the instructions on the scan tool. The EVAP Service Bay Test should complete and should not abort or fail.

- **If the test aborts**

Correct the condition for running the test, then retest.

or

- **If the test fails**

Repair the vehicle for the condition indicated by the failure message, then retest.

- **If the test passes**

**NOTE:** There are several test parameters displayed and can vary by engine RPO.

3. Verify that the EVAP Monitor Complete parameter, is set to YES.

## **ELECTRONIC IGNITION SYSTEM DIAGNOSIS**

### **Diagnostic Instructions**

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

### **Circuit/System Description**

This ignition system uses an individual coil for each cylinder. The engine control module (ECM) controls the spark events by transmitting the timing pulses on the ignition control (IC) circuits to the individual ignition coils in firing order sequence.

### **Diagnostic Aids**

- An open/high resistance on the low reference circuit to the ignition coil may cause a misfire.
- An erratic or weak spark is considered a no spark condition.

### **Reference Information**

Schematic Reference

[Engine Controls Schematics \(Buick with LE2\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX \(ENCORE\)](#)

Description and Operation

[Electronic Ignition System Description](#)

Electrical Information Reference

- [Circuit Testing](#)

- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

## [Control Module References](#)

Special Tools

**EL 26792** HEI Spark Tester

For equivalent regional tools, refer to [Special Tools \(Mechanical Tools\)](#).

## [Circuit/System Testing](#)

**NOTE:** Do not perform this diagnostic procedure unless you were sent here from a misfire DTC or the Engine Cranks But Does Not Run diagnostic.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate T8 Ignition Coil. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5  $\Omega$  between the ground circuit terminal 1 or A and ground.
  - **If 5  $\Omega$  or greater**
    1. Ignition OFF.
    2. Test for less than 2  $\Omega$  in the ground circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , repair the open/high resistance in the ground connection.
  - **If less than 5  $\Omega$**
3. Test for less than 5  $\Omega$  between the low reference circuit terminal 2 or B and ground.
  - **If 5  $\Omega$  or greater**
    1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
    2. Test for less than 2  $\Omega$  in the low reference circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , replace the K20 Engine Control Module.
  - **If less than 5  $\Omega$**
4. Ignition ON.
5. Verify a test lamp illuminates between the ignition circuit terminal 4 or D and ground.
  - **If the test lamp does not illuminate**
    1. Ignition OFF, remove the test lamp.
    2. Test for less than 2  $\Omega$  in the ignition circuit end to end.
      - If 2  $\Omega$  or greater, repair the open/high resistance in the circuit.
      - If less than 2  $\Omega$ , verify the fuse is not open and there is voltage at the fuse.
  - **If the test lamp illuminates**
6. Ignition OFF, exchange the suspect T8 Ignition Coil with the T8 Ignition Coil of a known functioning cylinder.
7. Engine Running.
8. Verify the scan tool Cylinder 1-4 Current Misfire Counter does not increment for the same cylinder that the suspect T8 Ignition Coil was removed from.
  - **If increments**

Replace the K20 Engine Control Module.
  - **If does not increment**
9. Test or replace the T8 Ignition Coil.

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

1. Ignition OFF, connect the **EL 26792** HEI Spark Tester to the appropriate T8 Ignition Coil.
2. Engine Running.
3. Verify the spark output of the T8 Ignition Coil.

- **If no output or the output is weak**

Replace the T8 Ignition Coil

- **If the output is good**

4. All OK.

### Repair Instructions

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

- Refer to [Ignition Coil Replacement](#)
  - Refer to [Control Module References](#) for engine control module replacement, programming, and setup.
-