

2017 ENGINE PERFORMANCE

Engine Controls and Fuel - 1.4L (LUV) - Diagnostic Information and Procedures - Encore, Trax

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P0010, P0013, OR P2088-P2091: INTAKE/EXHAUST CAMSHAFT POSITION ACTUATOR SOLENOID VALVE

Diagnostic Instructions

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

DTC Descriptor

DTC P0010

Intake Camshaft Position Actuator Solenoid Valve Control Circuit

DTC P0013

Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit

DTC P2088

Intake Camshaft Position Actuator Solenoid Valve Control Circuit High Voltage

DTC P2089

Intake Camshaft Position Actuator Solenoid Valve Control Circuit High Voltage

DTC P2090

Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage

DTC P2091

Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Camshaft Position Actuator Solenoid Valve High Control	P0010, P0013, P2088, P2090	P0010, P0013	P0010, P0013	P0010, P0013, P2089, P2091	P0011, P0014
Camshaft Position Actuator Solenoid Valve Low Reference	-	P0010, P0013	P0010, P0013	-	-

Circuit/System Description

The camshaft position actuator system enables the Engine Control Module (ECM) to change the timing of the camshafts while the engine is operating. The Camshaft Position Actuator Solenoid Valve signal from the ECM is pulse width modulated (PWM). The ECM controls the Camshaft Position Actuator Solenoid Valve duty cycle by controlling the amount of solenoid valve On time. The Camshaft Position

Actuator Solenoid Valve controls the advance or the retard of each camshaft. The Camshaft Position Actuator Solenoid Valve controls the oil flow that applies the pressure to advance or retard the camshafts.

The ECM controls the Camshaft Position Actuator Solenoid Valve by supplying a 12 V pulse width modulated (PWM) signal. The ECM supplies a ground to the low reference circuit.

Conditions for Running the DTC

- The ignition voltage is greater than 11 V
- The ignition switch is in the crank or run position.
- The ECM has commanded the Camshaft Position Actuator Solenoid Valve On.
- The DTCs run continuously once 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 for greater than 5 s.

Actions Taken When the DTC Sets

{WithTurbocharger}DTCs listed in the DTC Descriptor Category=Type A DTC

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

Conditions for Clearing the DTC

{WithTurbocharger}DTCs listed in the DTC Descriptor Category=Type A DTC

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

Diagnostic Aids

If the condition is intermittent, move the related harnesses and connectors, with the engine operating, while monitoring the scan tool Circuit Test Status parameters for the component. The Circuit Test Status parameters 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 \(Buick with LUV\)](#), [Engine Controls Schematics \(Chevrolet with LUV\)](#)

Connector End View Reference

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

Component View Reference

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

Description and Operation

[Camshaft Actuator 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: If a crankshaft or camshaft position sensor DTC is set, the Camshaft Position Actuator output control will not function.

1. Ignition On.
2. Verify DTC P0335, P0336, P0340, or P0341 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. Engine idling, command the Camshaft Position Actuator to 10° while observing the following control circuit status parameters with a scan tool:

- Exhaust or Intake Camshaft Position Actuator Solenoid Valve Control Circuit Open Test Status
- Exhaust or Intake Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Test Status
- Intake or Exhaust Camshaft Position Actuator Solenoid Valve Control 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 and all vehicle systems Off, disconnect the appropriate harness connector at the camshaft position actuator solenoid valve. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 Ω between the low reference circuit terminal 1 and ground.
 - **If 5 Ω or greater**
 1. Ignition Off, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω, replace the K20 Engine Control Module.
 - **If less than 5 Ω**
3. Test for less than 5 Ω between the control circuit terminal 2 and ground.

- **If 5 Ω or greater**

1. Ignition Off, disconnect the harness connector at the K20 Engine Control Module.
2. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.

- **If less than 5 Ω**

4. Ignition On.

NOTE: A test lamp must be used for this test. The control circuit is pulled-up to a low current voltage, 1.5-3.5 V on the control circuit is normal.

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

- **If the test lamp illuminates**

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 the test lamp does not illuminate**

6. Remove the test lamp.

7. Connect the DMM black lead to the control circuit terminal 2. Connect the DMM red lead to B+. Set the DMM on the diode setting. Command the CMP actuator solenoid On and Off with a scan tool. The DMM should transition from OL when commanded Off to less than 1 V when commanded On.

- **If the circuit voltage does not correspond to the specified values**

1. Ignition Off, disconnect the harness connector at the K20 Engine Control Module.
2. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance or short to ground in the circuit
 - If less than 2 Ω , replace the K20 Engine Control Module

- **If the circuit voltage corresponds to the specified values**

8. Test or replace the appropriate camshaft position actuator solenoid valve.

Component Testing

1. Ignition Off, disconnect the harness connector at the appropriate Q6 Camshaft Position Actuator Solenoid Valve.

2. Test for 7-12 Ω between the control terminal 2 and the low reference circuit terminal 1.

- **If not between 7-12 Ω**

Replace the Q6 Camshaft Position Actuator Solenoid Valve.

- **If between 7-12 Ω**

3. Test for infinite resistance between each terminal and the Q6 Camshaft Position Actuator Solenoid Valve housing.

- **If less than infinite resistance**

Replace the Q6 Camshaft Position Actuator Solenoid Valve.

- **If infinite resistance**

4. All OK.

Repair Instructions

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

- **Camshaft Position Actuator Solenoid Valve Replacement**

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

DTC P0011 OR P0014: INTAKE/EXHAUST CAMSHAFT POSITION 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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0011

Intake Camshaft Position System Performance

DTC P0014

Exhaust Camshaft Position System Performance

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Camshaft Position Actuator Solenoid Valve High Control	P0010, P0013, P2088, P2090	P0010, P0013	P0010, P0013	P0010, P0013, P2089, P2091	P0011, P0014
Camshaft Position Actuator Solenoid Valve Low Reference	-	P0010, P0013	P0010, P0013	-	-

Circuit/System Description

The camshaft position actuator system enables the engine control module (ECM) to change the timing of the camshafts while the engine is operating. The camshaft position actuator solenoid valves are operated hydraulically in order to change the angle of the camshaft relative to crankshaft position. The camshaft position actuator solenoid valves are controlled by the engine control module (ECM). The ECM sends a pulse width modulated signal to the camshaft position actuator solenoid valves. The camshaft position actuator solenoid valves control the amount of engine oil flow that applies the pressure to advance or retard the camshafts.

Conditions for Running the DTC

- DTC P0010, P0013, P0016, P0017, P0335, P0340, P0341, P0365, or P0366 is not set.
- The engine is running.
- The ignition voltage is between 11-32 V.
- The camshaft position actuator is enabled.
- The rate of change in the camshaft position is less than $3\hat{\text{A}}^{\circ}$ for 4 s.
- DTCs P0011 and P0014 runs continuously once the above conditions are met for greater than 0.1 s.

Conditions for Setting the DTC

The ECM detects a difference between the camshaft position angle and the desired camshaft position angle is greater than 6 to $10\hat{\text{A}}^{\circ}$ based on engine coolant temperature and engine speed.

Actions Taken When the DTC Sets

{WithTurbocharger}DTCs listed in the DTC Descriptor Category=Type A DTC

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

Conditions for Clearing the DTC

{WithTurbocharger} DTCs listed in the DTC Descriptor Category=Type A DTC

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

Diagnostic Aids

- The engine oil condition has a major impact on the camshaft actuator system.
- A low oil level condition may set this DTC. The engine may require an oil change. Inquire with the customer when the last oil change was performed. You may also monitor the scan tool Engine Oil Life Remaining parameter. Advise the customer an oil change may be required.
- Inspect the engine for any recent engine mechanical repairs. An incorrectly installed camshaft, camshaft actuator, or timing belt can cause this DTC to set.
- A resistance greater than 8 Ω on the camshaft position actuator solenoid valve control circuit may set this DTC. If you suspect high resistance, ground the control circuit while the engine is idling. The scan tool Intake or Exhaust Camshaft Position Actuator Solenoid Valve Control Circuit Low Voltage Test Status should display Malfunction. If the parameter displays OK, test the control circuit for high resistance.

Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LUV\)](#), [Engine Controls Schematics \(Chevrolet with LUV\)](#)

Connector End View Reference

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

Component View Reference

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

Description and Operation

[Camshaft Actuator 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 engine oil level and the oil pressure are critical to the correct operation of the camshaft position actuator system.

Verify that the engine has the correct oil level and the correct oil pressure before continuing with this diagnostic.

- The engine oil condition has a major impact on the camshaft actuator system. Debris in the oil can interfere with the camshaft position actuator solenoid and the mechanical camshaft actuator operation. Inspect for dirty or degraded crankcase oil. The engine may require an oil change. Inquire with the customer when the last oil change was performed. You may also monitor the scan tool Engine Oil Life Remaining parameter. Advise the customer an oil change may be required.

1. Ignition On.

2. Verify the correct engine oil level and pressure. Refer to [Oil Pressure Diagnosis and Testing](#)

- If the oil level and the oil pressure are not correct

Repair as necessary

- If the oil level and the oil pressure are correct

NOTE: If a crankshaft or camshaft position sensor DTC is set, the scan tool Camshaft Position Actuator output control will not function.

3. Verify DTC P0010, P0013, P0016, P0017, P0335, P0336, P0340, P0341, P0365, P0366, P2088, P2089, P2090 or P2091 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

4. Engine idling.

5. Verify the scan tool parameters are less than 2° in each of the commanded states when commanding the Camshaft Position Actuator from $0-20^{\circ}$ and back to 0° with the scan tool.

- Intake Camshaft Position Variance
- Exhaust Camshaft Position Variance
- Intake Camshaft Position Variance
- Exhaust Camshaft Position Variance
- If 2° or greater

Refer to Circuit/System Testing.

- If less than 2°

6. Verify that DTC P0011 or P0014 is not set.

- If any of the DTCs are set

Refer to Circuit/System Testing.

- If none of the DTCs set

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.

1. Ignition Off and all vehicle systems Off, disconnect the appropriate harness connector at the Q6 Camshaft Position Actuator Solenoid Valve. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 5 Ω between the low reference circuit terminal 1 and ground.

- **If 5 Ω or greater**

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

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

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

- **If less than 5 Ω**

3. Ignition On.

NOTE: A test lamp must be used for this test. The control circuit is pulled-up to a low current voltage, 1.5-4.5 V on the control circuit is normal.

4. Ignition On, verify that a test lamp does not illuminate between the control circuit terminal 2 and ground.

- **If the test lamp illuminates**

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 the test lamp does not illuminate**

5. Verify the test lamp illuminates when commanding the appropriate Camshaft Position Actuator Solenoid Valve On with a scan tool.

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

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

2. Test for less than 2 Ω in the control circuit end to end.

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

- **If the test lamp illuminates**

6. Ignition Off, remove the Q6 Camshaft Position Actuator Solenoid Valve.

7. Verify the conditions listed below do not exist with the Q6 Camshaft Position Actuator Solenoid Valve:

1. Torn, restricted, mis-positioned, or missing screens.
2. Engine oil leak between the oil sealing lands of the solenoid. Inspect the lands of the solenoid for nicks.
3. Oil seepage at the solenoid connector.

- **If a condition is found**

Replace the Q6 Camshaft Position Actuator Solenoid Valve.

- **If a condition is not found**

NOTE: After swapping toe solenoids, install jumper wires to the appropriate terminals of the harness connectors and the solenoids.

8. Ignition Off, swap the Q6 Camshaft Position Actuator Solenoid Valve with the Q6 Camshaft Position Actuator Solenoid Valve that is operating correctly.

9. Engine idling.

10. Verify the scan tool Camshaft Position Variance parameter is less than 2 $^{\circ}$ in each of the commanded states when commanding the Camshaft Position Actuator from 0-20 $^{\circ}$ and back to 0 $^{\circ}$ with a scan tool.

- **If $2\hat{A}^{\circ}$ or greater**

Replace the mechanical camshaft position actuator.

- **If less than $2\hat{A}^{\circ}$**

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

Component Testing

1. Ignition Off, disconnect the harness connector at the appropriate Q6 Camshaft Position Actuator Solenoid Valve.

2. Test for 7-12 Ω between the control terminal 2 and the low reference circuit terminal 1.

- **If not between 7-12 Ω**

Replace the Q6 Camshaft Position Actuator Solenoid Valve.

- **If between 7-12 Ω**

3. Test for infinite resistance between each terminal and the Q6 Camshaft Position Actuator Solenoid Valve housing.

- **If less than infinite resistance**

Replace the Q6 Camshaft Position Actuator Solenoid Valve.

- **If infinite resistance**

4. All OK

Repair Instructions

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

- [Camshaft Position Actuator Solenoid Valve Replacement](#)
- [Control Module References](#) for ECM replacement, programming and setup

DTC P0016 OR P0017: CRANKSHAFT POSITION

Diagnostic Instructions

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

DTC Descriptors

DTC P0016

Crankshaft Position - Intake Camshaft Position Not Plausible

DTC P0017

Crankshaft Position - Exhaust Camshaft Position Not Plausible

Circuit/System Description

The engine control module (ECM) uses the crankshaft position sensor, intake camshaft position sensor, and the exhaust camshaft position sensor information to monitor the correlation between the crankshaft, intake camshaft, and exhaust camshaft position.

Conditions for Running the DTC

- DTCs P0335, P0336, P0340, P0341, P0365, P0366, P0641, or P0651 is not set
- The engine is running.
- The camshaft position actuator solenoid valves are in the parked position.

The DTCs run continuously once the above conditions are met.

Conditions for Setting the DTC

The ECM detects a camshaft to crankshaft misalignment. The DTC sets if the crankshaft position sensor signal is 10 degrees before or after the normal position in relation to the crankshaft angle while the engine is running.

Action Taken When the DTC Sets

DTCs P0016 and P0017 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0016 and P0017 are Type B DTCs.

Diagnostic Aids

The following conditions can also set the DTCs:

- A short to ground in a camshaft position actuator solenoid valve control circuit.
- Crankshaft end play out of specification.
- A crankshaft reluctor wheel that has moved in relationship to top dead center (TDC).

Reference Information

Description and Operation

Camshaft Actuator System Description

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 P0335, P0336, P0340, P0341, P0365, P0366, P0641 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. Engine Running at normal operating temperature.
4. Verify DTC P0016 or P0017 is not set.

- **If the DTC is set**

Inspect for the following and repair as necessary:

- A Q6 Camshaft Position Actuator Solenoid Valve that is stuck in the full advance or retard position.
- The correct installation of the Q6 Camshaft Position Actuator Solenoid Valves.
- The correct installation of the B23 Camshaft Position Sensors.
- The correct installation of the B26 Crankshaft Position Sensor.
- A timing chain tensioner condition.
- An incorrectly installed timing chain.
- Excessive play in the timing chain.

- A crankshaft reluctor wheel that has moved in relationship to top dead center (TDC) on the crankshaft.
 - **If the DTC is not set**
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 6. Verify the DTC does not set.
 - **If the DTC sets**

A mechanical condition listed above still exists.
 - **If the DTC does not set**
 7. All OK.

Repair Instructions

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

- [Camshaft Position Actuator Solenoid Valve Replacement](#)
- [Camshaft Position Sensor Replacement](#)
- [Crankshaft Position Sensor Replacement](#)
- [Timing Chain Tensioner Replacement](#)

DTC P0030-P0032, P0036-P0038, P0053, P0054, P0135, OR P0141: HO2S HEATER CONTROL

Diagnostic Instructions

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

DTC Descriptors

DTC P0030

HO2S Heater Control Circuit Sensor 1

DTC P0031

HO2S Heater Control Circuit Low Voltage Sensor 1

DTC P0032

HO2S Heater Control Circuit High Voltage Sensor 1

DTC P0036

HO2S Heater Control Circuit Sensor 2

DTC P0037

HO2S Heater Control Circuit Low Voltage Sensor 2

DTC P0038

HO2S Heater Control Circuit High Voltage Sensor 2

DTC P0053

HO2S Heater Resistance Sensor 1

DTC P0054

DTC P0135

HO2S Heater Performance Sensor 1

DTC P0141

HO2S Heater Performance Sensor 2

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
HO2S Heater Voltage Supply	P0030, P0036, P0102, P0132, P0134, P0135, P0138, P0141, P0443, *	P0030, P0036, P0132, P0134, P0135, P0138, P0140, P0141, P0154, P0155, P0158, P0160, P0161	P0030, P0036, P0132, P0134, P0135, P0138, P0140, P0141	P0690	P0135, P0141
HO2S Heater Control	P0030, P0031, P0036, P0037, P0053, P0054, P0135, P0141	P0030, P0036, P0053, P0132, P0135, P0138, P0140, P0141	P0030, P0036, P0132, P0134, P0135, P0138, P0140, P0141	P0030, P0032, P0036, P0038, P0132, P0134, P0135, P0138, P0140, P0141, P0690	P0135, P0141
*Opens Fuse					

Typical Scan Tool Data**HO2S Sensor 1 Current/HO2S Sensor 2 Current**

Circuit	Short to Ground	Open	Short to Voltage
Parameter Normal Range: 0.2-1.5 A			
HO2S Heater Low Control	0 A	0 A	0 A
HO2S Heater Voltage Supply	0 A	0 A	0.2-2 A

Circuit/System Description

Heated oxygen sensors (HO2S) are used for fuel control and post-catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. Each HO2S must reach operating temperature to provide an accurate voltage signal. A heating element inside each of the HO2S minimizes the time required for the sensor to reach operating temperature. Voltage is provided to the heater by an ignition voltage circuit through a fuse. With the engine running, ground is provided to the heater by the HO2S heater low control circuit, through a low side driver within the engine control module (ECM). The ECM uses pulse-width modulation (PWM) to control the HO2S heater operation to maintain a specific HO2S operating temperature range.

Conditions for Running the DTC**P0030, P0031, P0032, P0036, P0037 and P0038**

- The ignition voltage is greater than 11 V.
- The engine speed is greater than 400 RPM.
- The DTCs run continuously when the above conditions are met for greater than 10 s.

P0053 and P0054

- DTCs P0111, P0112, P0113, P0116, P0117, P0118, P0119, P0128, P262B are not set.
- The engine is running.
- The difference between the engine coolant temperature and intake air temperature is less than 8°C (14.4°F)
- The ignition is OFF for greater than 8 h.
- The Engine Coolant Temperature (ECT) is greater than -30°C (-22°F).
- DTCs P0053 and P0054 run once per drive cycle when the above conditions are met.

P0135 and P0141

- DTCs P0116, P0117, P0118, P0119 or P0128 are not set.
- The ignition voltage is greater than 10 V.
- The HO2S heater is active.
- The scan tool HO2S Heater device control is not active.
- The DTCs run twice per drive cycle when the above conditions are met for greater than 2 min.

Conditions for Setting the DTC

P0030 and P0036

The ECM detects an open circuit in the heater control circuit of the heated oxygen sensor when the heater is commanded OFF. The condition exists for greater than 7 s.

P0031 and P0037

The ECM detects a short to ground in the heater control circuit of the heated oxygen sensor when the heater is commanded OFF. The condition exists for greater than 7 s.

P0032 and P0038

The ECM detects a short to voltage in the heater circuits of the heated oxygen sensor when the heater is commanded ON. The condition exists for greater than 7 s.

P0053 and P0054

- The ECM detects that the affected HO2S heater low control circuit resistance is not within a specified range at engine start-up.
- DTCs P0053 and P0054 set within 1 s when the above condition is met.

P0135 and P0141

- The ECM detects that the affected HO2S heater current parameter is more than 4.3 A or less than 0.4 A.
- DTCs P0135 and P0141 set within 60 s when the above condition is met.

Action Taken When the DTC Sets

DTC P0030, P0031, P0032, P0036, P0037, P0038, P0053, P0054, P0135, and P0141 are Type B DTCs.

Conditions for Clearing the DTC

DTC P0030, P0031, P0032, P0036, P0037, P0038, P0053, P0054, P0135, and P0141 are Type B DTCs.

Diagnostic Aids

- If the condition is intermittent, move the related harnesses and connectors, with the engine operating, while monitoring the scan tool circuit status parameters for the component. The circuit status parameters will change from OK or Not Run to Malfunction if there is a condition with the circuit or a connection.

- An open fuse in the HO2S heater circuit may be caused by the heater element in one of the sensors. The condition may not be present until the sensor operates for a period of time. If no fault is present in the heater circuit, monitor the amperage of each heater with a scan tool to determine if one of the heater elements is the cause of the open fuse. Inspect the sensor pigtail or the harness for contacting the exhaust system.

Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LUV\)](#), [Engine Controls Schematics \(Chevrolet with LUV\)](#)

Connector End View Reference

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

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 idling.
2. Verify the parameters listed below do not display Malfunction.
 - HO2S 1 or 2 Heater Control Circuit Low Voltage Test Status
 - HO2S 1 or 2 Heater Control Circuit Open Test Status
 - HO2S 1 or 2 Heater Control Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.
 - **If Malfunction is not displayed**
3. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 - **If the DTC sets**

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

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the appropriate B52 Heated Oxygen Sensor. Ignition ON.
2. Verify that a test lamp illuminates between the ignition voltage circuit terminal 1 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**

1. Ignition OFF.
2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK 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 fuse and replace as necessary.
- **If the test lamp illuminates**
3. Verify that a test lamp does not illuminate between the ignition voltage circuit terminal 1 and the control circuit terminal 2.
 - **If the test lamp illuminates**
 1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If the test lamp does not illuminate**
4. Remove the test lamp.
5. Verify the scan tool HO2S 1 or 2 Heater Control Circuit High Voltage Test Status parameter is OK when commanding the HO2S Heater Sensor 1 or 2 ON 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**

NOTE:

- **Less than 10 Ω of additional resistance on the ignition voltage circuit, or control circuit may set a DTC. If there is a resistance on a circuit, the driver will remain ON and the scan tool HO2S High Voltage Test Status parameter will display OK.**
- **Performing this test may set additional DTCs.**

6. Install a 10 A fused jumper wire between the control circuit terminal 2 and the ignition voltage circuit terminal 1.

NOTE:

This test may only be performed once per key cycle. If test is repeated, ignition OFF, allow the engine control module to shut down completely, then ignition ON.

7. Verify the scan tool HO2S 1 or 2 Heater Control Circuit High Voltage Test Status parameter is Malfunction when commanding the HO2S Heater Sensor 1 or 2 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 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.

- **If Malfunction is displayed**

8. Test or replace the B52 Heated Oxygen Sensor.

Component Testing

1. Ignition OFF, disconnect the harness connector at the appropriate B52 Heated Oxygen Sensor.
2. Test for 8-20 Ω between the ignition voltage circuit terminal 1 and the control circuit terminal 2.

- **If not within the specified range**

Replace the B52 Heated Oxygen Sensor.

- **If within the specified range**

3. All OK.

Repair Instructions

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

- [Heated Oxygen Sensor Replacement - Sensor 1](#)
- [Heated Oxygen Sensor Replacement - Sensor 2](#)
- Perform the scan tool Heated Oxygen Sensor Resistance Learn Reset after replacing a HO2S.
- [Control Module References](#) for ECM replacement, programming and setup.

DTC P0033-P0035: TURBOCHARGER BYPASS SOLENOID VALVE CONTROL

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 P0033

Turbocharger Bypass Solenoid Valve Control Circuit

DTC P0034

Turbocharger Bypass Solenoid Valve Control Circuit Low Voltage

DTC P0035

Turbocharger Bypass Solenoid Valve Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P0034*	P0034	-	-
Control	P0033, P0034*	P0033	P0035*	-
* Additional DTCs may set.				

Circuit/System Description

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

Circuit	Description
Ignition	Supplied from a fuse.

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

Component	Description
K20 Engine Control Module	The control module contains a microprocessor used to process input data to control outputs. The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.
Q40 Turbocharger Bypass Solenoid Valve	In the unpowered state, the output port of the valve is connected to the ventilation port (atmospheric pressure). The more voltage applied, the more the valve shifts over from the ventilation port to the vacuum port so that the vacuum at the output port becomes stronger.

The turbocharger bypass valve is a pressure relief valve in the intake system. It short-circuits the inlet and the outlet of the fresh air side of the turbocharger. This is used to maintain the rotational energy of the turbine when the throttle valve is quickly closed and the compressed air would have nowhere to go. The bypass valve allows the air to be pumped in circles which avoids pressure spikes.

Conditions for Running the DTC

- Ignition = On or Engine = Running
- Engine = Not cranking
- System Voltage = Greater than 11 V
- Turbocharger Bypass Solenoid Valve Command = On and Off - At least 1 time(s) during the drive cycle

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

Conditions for Setting the DTC

Control Circuit = Commanded state does not match the actual state - For greater than 4 s

Actions Taken When the DTC Sets

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

Warning Message = Reduced Engine Power

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC

Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LUV\)](#), [Engine Controls Schematics \(Chevrolet with LUV\)](#)

Connector End View Reference

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

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 $\hat{\mathbf{A}}$ On / Vehicle $\hat{\mathbf{A}}$ In Service Mode
2. Perform the scan tool control function: Turbocharger Bypass Solenoid Valve $\hat{\mathbf{A}}$ Increase & Decrease

Verify the scan tool parameter:

- Turbocharger Bypass Solenoid Valve Control Circuit Low Voltage Test Status=OK or Not Run
- Turbocharger Bypass Solenoid Valve Control Circuit Open Test Status=OK or Not Run
- Turbocharger Bypass Solenoid Valve Control Circuit High Voltage Test Status=OK or Not Run

- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

3. Perform the scan tool control function: Turbocharger Bypass Solenoid Valve $\hat{\mathbf{A}}$ Increase & Decrease

Verify a click can be heard or felt at the component when it is turned On and Off: Q40 Turbocharger Bypass Solenoid Valve

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

Refer to: Circuit/System Testing

- **If a click can be heard or felt**

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/Vehicle & All vehicle systems $\hat{\mathbf{A}}$ Off
2. Disconnect the electrical connector: Q40 Turbocharger Bypass Solenoid Valve
3. Ignition $\hat{\mathbf{A}}$ On / Vehicle $\hat{\mathbf{A}}$ In Service Mode
4. Verify a test lamp turns On between the test points: Ignition circuit terminal 2 & Ground

- **If the test lamp does not turn On and the circuit fuse is OK**

1. Ignition/Vehicle $\hat{\mathbf{A}}$ Off & Remove $\hat{\mathbf{A}}$ Test lamp

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

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

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

1. Ignition/Vehicle Â» Off

2. Replace the component: Fuse

3. Ignition Â» On / Vehicle Â» In Service Mode

4. Verify the fuse does not open.

- If the fuse opens and there are components connected to the circuit Â» Disconnect a component and repeat step 4.1
- If the fuse opens with all components disconnected from the circuit Â» Repair the short to ground on the circuit.
- If the fuse does not open after disconnecting a component from the circuit Â» Replace the component disconnected last.

• **If the test lamp turns On**

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

• **If the test lamp turns On**

1. Ignition/Vehicle Â» Off & Remove Â» Test lamp

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

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

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

6. Perform the scan tool control function: Turbocharger Bypass Solenoid Valve Â» Increase

Verify a test lamp turns On between the test points: Control circuit terminal 1 & Ignition circuit terminal 2

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

1. Ignition/Vehicle Â» Off & Remove Â» Test lamp

2. Disconnect the electrical connector: X3 @ K20 Engine Control Module

3. Ignition Â» On / Vehicle Â» In Service Mode

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

- If 1 V or greater Â» Repair the short to voltage on the circuit.
- If less than 1 V

5. Ignition/Vehicle & All vehicle systems Â» Off

6. Test for less than $2\ \Omega$ between the test points: Control circuit terminal 1 @ Component harness & The other end of the circuit

- If $2\ \Omega$ or greater Â» Repair the open/high resistance in the circuit.
- If less than $2\ \Omega$ Â» Replace the component: K20 Engine Control Module

• **If the test lamp turns On**

7. Test or replace the component: Q40 Turbocharger Bypass Solenoid Valve

Component Testing

Static Test

1. Ignition/Vehicle Â» Off

2. Disconnect the electrical connector: Q40 Turbocharger Bypass Solenoid Valve

3. Test for 20 to $27\ \Omega$ between the test points: Control terminal 1 & Ignition terminal 2

- **If not between 20 and 27 Ω**

Replace the component:Q40 Turbocharger Bypass Solenoid Valve

- **If between 20 and 27 Ω**

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

- **If less than infinite resistance**

Replace the component:Q40 Turbocharger Bypass Solenoid Valve

- **If infinite resistance**

5. All OK.

Dynamic Test

1. Ignition/Vehicle $\hat{\text{A}}$ Off
2. Disconnect the electrical connector:Q40 Turbocharger Bypass Solenoid Valve
3. Connect a 10 A fused jumper wire between the test points:Ignition terminal 2 & 12 V

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

4. Momentarily connect a jumper wire between the test points:Control terminal 1 & Ground

Verify the component turns On and Off when connecting and disconnecting the jumper wire:Q40 Turbocharger Bypass Solenoid Valve

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

Replace the component:Q40 Turbocharger Bypass Solenoid Valve

- **If the component turns On and Off**

5. All OK.

Repair Instructions

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

- [Charge Air Bypass Regulator Solenoid Valve Replacement](#) - Q40 Turbocharger Bypass Solenoid Valve
- For control module replacement, programming, and setup refer to:[Control Module References](#)

DTC P0068 OR P1101: THROTTLE BODY AIR FLOW PERFORMANCE/INTAKE AIR FLOW 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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P0068

Throttle Body Air Flow Performance

DTC P1101

Intake Air Flow System Performance

Circuit/System Description

The engine control module (ECM) compares actual airflow based on throttle position (TP) to a calculated airflow based on manifold absolute pressure (MAP) sensor, and mass air flow (MAF).

Conditions for Running the DTC

DTC P0068

- The engine speed is at least 800 RPM.
- The ignition voltage is at least 6.4 V.
- The DTC runs continuously when the above conditions are met.

DTC P1101

- DTC P0102, P0103, P0107, P0111, P0112, P0113, P0116, P0117, P0118, P0335, or P0336 is not set
- The engine speed is between 400-7, 000 RPM
- The engine coolant temperature (ECT) is between -7 to +125Â°C (+19 to +257Â°F).
- The intake air temperature (IAT) is between -20 to +125Â°C (-4 to +257Â°F).
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTCs

The ECM detects that the actual airflow rate is greater than the calculated airflow.

Action Taken When the DTCs Set

- DTC P0068 is a type A DTC.
- DTC P0068 is a type B DTC; with RPO LDD.
- DTC P1101 is a type B DTC.

Conditions for Clearing the DTCs

- DTC P0068 is a type A DTC.
- DTC P0068 is a type B DTC; with RPO LDD.
- DTC P1101 is a type B DTC.

Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LUV\)](#), [Engine Controls Schematics \(Chevrolet with LUV\)](#)

Connector End View Reference

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

Electrical Information Reference

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

Powertrain Component Views

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

DTC Type Reference

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC DTC P0641, P0651, P0697, or P06A3 is not set.
 - **If any of the DTCs are set**
Refer to **DTC P0641, P0651, P0697, or P06A3** for further diagnosis.
 - **If none of the DTCs are set**
3. Ignition ON.
4. 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 %**
5. Verify the scan tool Throttle Position Sensors 1 and 2 Agree/Disagree parameter displays Agree while performing the Throttle Sweep Test with a scan tool.
 - **If Disagree**
Refer to **DTC P0121-P0123, P0222, P0223, or P2135** for further diagnosis.
 - **If Agree**
6. Determine the current vehicle testing altitude.
7. Verify the scan tool MAP Sensor pressure parameter is within the range specified in the **Altitude Versus Barometric Pressure** table.
 - **If the MAP Sensor parameter is not in range**
Refer to **DTC P0106** for further diagnosis.
 - **If the MAP Sensor parameter is within range**
8. Verify the engine is equipped with a turbocharger.
 - **If not equipped with a turbocharger**
Refer to Step 11.
 - **If equipped with a turbocharger**
9. Verify the scan tool Boost Pressure Sensor parameter is within the range specified in the **Altitude Versus Barometric Pressure** table.
 - **If the Boost Pressure Sensor parameter is not in range**
Refer to **DTC P0236** for further diagnosis.
 - **If the Boost Pressure Sensor parameter is within range**
10. Verify the scan tool Boost Pressure Sensor parameter decreases after starting the engine.
 - **If the Boost Pressure Sensor parameter does not decrease**
Refer to **DTC P0236** for further diagnosis.
 - **If the Boost Pressure Sensor parameter is within range**
11. Engine idling, verify the scan tool MAP Sensor pressure parameter is between 26-52 kPa (3.8-7.5 PSI) and changes with accelerator pedal input.
 - **If not between 26-52 kPa (3.8-7.5 PSI) or does not change**

Refer to [DTC P0106](#) for further diagnosis.

- **If between 26-52 kPa (3.8-7.5 PSI) and changes**

12. Verify the scan tool MAF Sensor g/s parameter changes smoothly and gradually as the engine speed is increased and decreased while performing the actions listed below.

1. Engine idling
2. Perform the scan tool snapshot function.
3. Increase the engine speed slowly to 3, 000 RPM and then back to idle.
4. Exit from the scan tool snapshot and review the data.
5. Observe the MAF Sensor parameter frame by frame with a scan tool.

- **If the MAF Sensor parameter does not change smoothly and gradually**

Refer to [DTC P0101](#) for further diagnosis.

- **If the MAF Sensor parameter changes smoothly and gradually**

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

14. Verify the DTC does not set.

- **If the DTC does set**

Refer to Circuit/System Testing for further diagnosis.

- **If the DTC does not set**

15. All OK

Circuit/System Testing

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

1. Verify the integrity of the entire air induction system by verifying that none of the following conditions exist:

- Any damaged components
- Improper operation of turbocharger wastegate actuator or bypass valve; where equipped
- Improperly installed components
- Collapsed, restricted, or damaged components
- Loose clamps, cracks, or other damage
- An air flow restriction
- Restricted air filter
- Splits, kinks, leaks, or improper connections at the vacuum hoses
- Vacuum leaks at the intake manifold, MAP sensor, and throttle body
- Water intrusion
- Any snow or ice buildup, in cold climates
- Contamination of the MAF sensor element
- Missing, restricted, or leaking exhaust components-Refer to [Symptoms - Engine Exhaust](#) for further diagnosis.
- **If a condition is found**

Repair or replace component as appropriate.

- **If no condition is found**

2. Test the engine for a mechanical condition. Refer to [Symptoms - Engine Mechanical](#) for diagnosis.

- **If a condition is found**

Repair or replace component as appropriate.

- If no condition is found

3. All OK

Repair Instructions

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

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

DTC P0096 OR P0111: INTAKE AIR TEMPERATURE (IAT) SENSOR 2 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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0096

Intake Air Temperature (IAT) Sensor 2 Performance

DTC P0111

Intake Air Temperature (IAT) Sensor 1 Performance

Diagnostic Fault Information

IAT Sensor 1

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Sensor	P0112, P0114**, P2199	P0113, P0114**, P2199	P0113, P0114**, P2199*	P0111, P0114**
Low Reference	-	P0097, P0113, P00EA, P2227, P2229	*	-
*Internal ECM or sensor damage may occur if the circuit is shorted to B+. **Where used.				

IAT Sensor 2

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0097, P00F4, P0651, P2199, P2227, P2228	P0096, P0097, P00F4, P2199, P2227, P2228	P0097, P00F4, P0651, P2199, P2227, P2228	-
Sensor	P0097, P00F5, P2199	P0097, P00F4, P2199	P0097, P00F4, P2199*	-
Low Reference	-	P0097, P00F4, P0113, P2227, P2229	*	-
*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

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

Circuit/System Description

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

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

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

The IAT sensor 1 produces an analog signal on pin-8 of the sensor. The IAT sensor 2 produces a frequency modulated signal on pin-1 of the sensor.

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

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

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

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

IAT Sensor 1 - Temperature, Resistance, Voltage Table

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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	-40Â°C (-40Â°F)
Warm	302 Hz	104Â°C (219Â°F)

Conditions for Running the DTCs

P0096 and P0111

- DTCs P0097, P0098, P0111, P0112, P0113, P0117, P0118, P00EA, P00EB, or P1682 are not set.
- The ignition has been OFF at least 8 hours.
- Ignition voltage is at least 11 V.
- These DTCs run once per ignition cycle when the enabling conditions are met.

Conditions for Setting the DTCs

P0096

- The ECM determines the absolute difference between IAT sensor 1 start-up temperature and the IAT sensor 2 start-up temperature is greater than 25Â°C (45Â°F).

AND

- The ECM determines the absolute difference between IAT sensor 2 start-up temperature and the IAT sensor 3 start-up temperature is greater than 25Â°C (45Â°F).

AND

- The ECM determines the absolute difference between IAT sensor 1 start-up temperature and the IAT sensor 3 start-up temperature is less than or equal to 25Â°C (45Â°F).
- This DTC runs once per ignition cycle when the enabling conditions are met.

NOTE: **P0111 Can fail under any of the following 3 sets of conditions.**

P0111 - Condition 1

- The ECM determines the absolute difference between IAT sensor 1 start-up temperature and the IAT sensor 2 start-up temperature is greater than 25Â°C (45Â°F).

AND

- The ECM determines the absolute difference between IAT sensor 1 start-up temperature and the IAT sensor 3 start-up temperature is greater than 25Â°C (45Â°F).

AND

- The ECM determines the absolute difference between IAT sensor 2 start-up temperature and the IAT sensor 3 start-up temperature is less than or equal to 25Â°C (45Â°F).

P0111 - Condition 2

- The ECM determines the IAT sensor 2 start-up temperature is between the IAT sensor 1 and IAT sensor 3 start-up temperatures.

AND

- The ECM determines the absolute difference between IAT sensor 1 start-up temperature and the IAT sensor 3 start-up temperature is greater than 25Â°C (45Â°F).

AND

- The ECM determines the absolute difference between IAT sensor 2 and the IAT sensor 1 start-up temperatures is greater than absolute difference between IAT sensor 2 and the IAT sensor 3 start-up temperatures.

P0111 - Condition 3

- The ECM determines the IAT sensor 3 start-up temperature is between the IAT sensor 1 and IAT sensor 2 start-up temperatures.

AND

- The ECM determines the absolute difference between IAT sensor 1 start-up temperature and the IAT sensor 2 start-up temperature is greater than 25°C (45°F).

AND

- The ECM determines the absolute difference between IAT sensor 3 and the IAT sensor 1 start-up temperatures is greater than absolute difference between IAT sensor 3 and the IAT sensor 2 start-up temperatures.

DTC P0111 runs once an ignition cycle when the any one, of the above 3 enabling sets of conditions is met.

Action Taken When the DTCs Set

DTCs P0096 and P0111 are Type B DTCs.

Conditions for Clearing the DTCs

DTCs P0096 and P0111 are Type B DTCs.

Diagnostic Aids

- With the ignition ON, when the engine is OFF and is cold; properly functioning IAT sensors 1 and 2 will gradually increase the scan tool IAT Sensor 1 and 2 parameters. This is due to the heat that is generated by the multifunction intake air sensor internal heating elements.
- The Humidity sensor and the IAT sensor 2 signals are sent to the ECM on the same circuit. If the IAT Sensor 2 parameter displays the values: 10 Hz; -40°C (-40°F), and there are also Humidity Sensor DTCs, check for a circuit problem.

Reference Information

Schematic Reference

Engine Controls Schematics (Buick with LUY), Engine Controls Schematics (Chevrolet with LUY)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE), COMPONENT CONNECTOR END VIEWS - INDEX (TRAX)

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-38522-A Variable Signal Generator

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

Circuit/System Verification

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

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

Refer to [DTC P0641, P0651, P0697, or P06A3](#) for further diagnosis.

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

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 25Â°C (45Â°F) of each other.
 - Start-Up IAT Sensor 1
 - IAT Sensor 2
 - IAT Sensor 3; where equipped
 - **If not within 25Â°C (45Â°F)**

Refer to Circuit/System Testing.

 - **If within 25Â°C (45Â°F)**
5. Engine idling, verify the following scan tool parameters are between: -38 and +149Â°C (-36 and +300Â°F).
 - IAT Sensor 1
 - IAT Sensor 2
 - IAT Sensor 3; where equipped
 - **If not between: -38 and +149Â°C (-36 and +300Â°F)**

Refer to Circuit System Testing.

 - **If between: -38 and +149Â°C (-36 and +300Â°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. Check the integrity of the entire air induction system and verify that none of the following conditions exist:

- A loose or disconnected charge air cooler hose or pipe; where equipped
- A blocked or obstructed charge air cooler, including: after-market grill covers; where equipped
- Any snow or ice build-up at the charge air cooler in cold climates; where equipped
- Any mud or dirt build-up at the charge air cooler; where equipped
- A restricted or collapsed air intake duct
- An intake manifold leak
- A MAP sensor seal that is leaking, missing, or damaged
- A misaligned or damaged air intake duct
- Any water intrusion in the induction system
- An Intake Manifold Resonator with a leaking seal, or a cracked or broken housing
- **If a condition exists**

Repair or replace component as appropriate.

- **If no condition exists**

2. 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.

3. Test for less than 2 Ω between the low reference circuit terminal 7 and ground.

- **If 2 Ω or greater**

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

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

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

- **If less than 2 Ω**

4. Ignition ON, test for 4.8-5.2 V between the 5 V reference circuit terminal 2 and ground.

- **If less than 4.8 V**

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

2. Test for infinite resistance between the 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 Ω in the signal circuit end to end.

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

- **If greater than 5.2 V**

NOTE:

If the 5 V reference 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 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. Ignition ON, test for 4.8-5.2 V between the 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**
6. Ignition ON, verify the scan tool IAT Sensor 1 parameter is colder than -39°C (-38°F).
 - **If warmer than -39°C (-38°F).**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 8 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°C (-38°F).**
7. Ignition OFF, install a 3 A fused jumper wire between the signal circuit terminal 8 and the low reference circuit terminal 7.
8. Verify the scan tool IAT Sensor 3 parameter is warmer than 150°C (302°F).
 - **If colder than 150°C (302°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 150°C (302°F).**
9. Ignition ON, test for 4.8-5.2 V between the signal 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**
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. Replace the K20 Engine Control Module.
 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**

Test or replace the B75C Multifunction Intake Air sensor.
 - **If no DTCs set**
4. Circuits, ECM, and the sensors test OK, refer to step 18.
- **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 1 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, disconnect the B111B Turbocharger Boost/Intake Air Temperature sensor. It may take up to 2 min for all vehicle systems to power down.
15. Test for less than 2 Ω between the low reference circuit terminal 1 and ground.
 - **If 2 Ω or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open or high resistance in the circuit.
 - If less than 2 Ω replace the K20 Engine Control Module.
 - **If less than 2 Ω**
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 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.

- If greater than 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 appropriate temperature sensor.
18. All OK.

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 (Bosch Sensor), Temperature Versus Resistance - Intake Air Temperature Sensor (Delco Sensor) table for Bosch 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.

All OK

Multifunction Intake Air Sensor

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

- If not within 5%

Replace the B75C Multifunction Intake Air sensor.

- If within 5%

2. All OK.

Turbocharger Boost/Intake Air Temperature sensor

1. Ignition OFF, disconnect the harness connector at the B111B Turbocharger Boost/Intake Air Temperature sensor.

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

2. Test the IAT sensor 3 by varying the sensor temperature while monitoring the sensor resistance. Compare the readings with the Temperature Versus Resistance - Intake Air Temperature Sensor (Bosch Sensor), Temperature Versus Resistance - Intake Air Temperature Sensor (Delco Sensor) table for the appropriate sensor. The resistance values should be in range of the table values.

- If not within the specified range.

Replace the B111B Turbocharger Boost/Intake Air Temperature sensor.

- If within the specified range.

3. All OK

Repair Instructions

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

- [Intake Air Pressure and Temperature Sensor Replacement](#) for turbocharger boost/intake air temperature sensor replacement
- [Mass Airflow Sensor Replacement](#) for multifunction intake air sensor replacement
- [Control Module References](#) for Engine Control Module replacement, programming, and setup.

DTC P0097, P0098, OR P0099: INTAKE AIR TEMPERATURE (IAT) SENSOR 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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0097

Intake Air Temperature (IAT) Sensor 2 Circuit Low Voltage

DTC P0098

Intake Air Temperature (IAT) Sensor 2 Circuit High Voltage

DTC P0099

Intake Air Temperature (IAT) Sensor 2 Circuit Intermittent

Diagnostic Fault Information

IAT Sensor 2

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0097, P00F4, P0651, P2199, P2227, P2228	P0096, P0097, P00F4, P2199, P2227, P2228	P0097, P00F4, P0651, P2199, P2227, P2228	-
Sensor	P0097, P00F5, P2199	P0097, P00F4, P2199	P0097, P00F4, P2199*	-
Low Reference	-	P0097, P00F4, P0113, P2227, P2229	*	-

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

Typical Scan Tool Data

IAT Sensor 2

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Operating Conditions: Engine Running Parameter Normal Range: Varies with ambient temperature			
5 V Reference	-40Â°C (-40Â°F) 10 Hz	-40Â°C (-40Â°F) 10 Hz	-

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Signal	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)* 10 Hz*
Ground	-	-40Â°C (-40Â°F) 10 Hz	-
*Internal ECM or sensor damage may occur if the circuit is shorted to B+			

Circuit/System Description

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

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

The IAT sensor 2 and the humidity sensor share the same circuit. The IAT sensor 2 signal is displayed by the scan tool as Hertz (Hz) and Â°C (Â°F).

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

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

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

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

IAT Sensor 2 - Temperature, Frequency Table

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

Conditions for Running the DTCs

P0097, P0098, and P0099

- The ignition is ON, or the engine is running.
- The Ignition voltage is at least 11 V.
- The DTCs run continuously within the enabling conditions.

Conditions for Setting the DTCs

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

P0097

The ECM detects that the IAT sensor 2 signal is less than 10 Hz, colder than -60Â°C (-76Â°F), for greater than 5 s.

P0098

The ECM detects that the IAT sensor 2 signal is greater than 390 Hz, warmer than 150Â°C (302Â°F), for greater than 5 s.

P0099

The ECM detects that the IAT sensor 2 signal is intermittent or has abruptly changed for longer than 5 s.

Action Taken When the DTC Sets

- DTCs P0097, P0098, and P0099 are Type B DTCs.
- The ECM commands the cooling fans ON.

Conditions for Clearing the MIL/DTCs

DTCs P0097, P0098, and P0099 are Type B DTCs.

Diagnostic Aids

- With the ignition ON, when the engine is cold and not running, properly functioning IAT sensor 2 will gradually increase the scan tool IAT Sensor 2 parameters. 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; -40Â°C (-40Â°F), and there are also Humidity Sensor DTCs, check for a circuit problem.

Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LUY\)](#), **[Engine Controls Schematics \(Chevrolet with LUY\)](#)**

Connector End View Reference

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

Electrical Information Reference

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

Powertrain Component Views

[Powertrain Component Views \(Buick\)](#), **[Powertrain Component Views \(Chevrolet\)](#)**

DTC Type Reference

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

Scan Tool Reference

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

Special Tools

EL-38522-A Variable Signal Generator

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

Circuit/System Verification

1. Ignition ON.

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

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

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

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

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 25Â°C (45Â°F) of each other.

- Start-Up IAT Sensor 1
- IAT Sensor 2
- IAT Sensor 3; where equipped
- **If not within 25Â°C (45Â°F)**

Refer to Circuit/System Testing.

- **If within 25Â°C (45Â°F)**

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

- IAT Sensor 1
- IAT Sensor 2
- IAT Sensor 3; where equipped
- **If not between: -38 and +149Â°C (-36 and +300Â°F)**

Refer to Circuit System Testing.

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

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 Ω between the low reference circuit terminal 7 and ground.

- **If 2 Ω or greater**

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

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

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

- **If less than 2 Ω**

3. Ignition ON, test for 4.8-5.2 V between the 5 V reference circuit terminal 2 and ground.

- **If less than 4.8 V**

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

2. Test for infinite resistance between the 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 5 V reference 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 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**
4. Ignition ON, test for 4.8-5.2 V between the 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**
5. Determine if **EL-38522-A** Variable Signal Generator or equivalent is available.
 - **EL-38522-A, Variable Signal Generator; or equivalent is not available**
 1. Replace the K20 Engine Control Module.
 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 step 9.
 - **If the DTC does not set**
 4. All OK.
 - **EL-38522-A, Variable Signal Generator; or equivalent is available**
 6. Ignition OFF, connect the leads of the **EL-38522-A** Variable Signal Generator as follows:
 - Red lead to the signal circuit terminal 1 at the harness connector
 - Black leads to ground
 - Battery voltage supply lead to B+
 7. 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

8. 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**

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

Component Testing

Multifunction Intake Air Sensor

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

- **If not within 5%**

Replace the B75C Multifunction Intake Air sensor.

- **If within 5%**

2. All OK.

Repair Instructions

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

- [Mass Airflow Sensor Replacement](#) for multifunction intake air sensor replacement.
- [Control Module References](#) for Engine Control Module replacement, programming, and setup.

DTC P00C7: INTAKE AIR PRESSURE MEASUREMENT SYSTEM - MULTIPLE SENSORS 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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P00C7

Intake Air Pressure Measurement System - Multiple Sensors Not Plausible

Circuit/System Description

The Intake Air Pressure Measurement System consists of 3 sensors:

- The barometric pressure (BARO) is measured by the B75C Multifunction Intake Air Sensor
- The manifold absolute pressure (MAP) is measured by the B74 Manifold Absolute Pressure Sensor
- The boost pressure is measured by the B111B Turbocharger Boost/Intake Air Temperature Sensor

Conditions for Running the DTC

- DTCs P0106, P0107, P0108, P2122, P2123, P2127, P2128, P2138 or P2610 are not set.
- The engine is running.
- Time between current ignition cycle and the last time the engine was running is greater than 10 s.

- Manifold pressure between 50 and 115 kPa (7.25 and 16.68 PSI).
- BARO pressure between 50 and 115 kPa (7.25 and 16.68 PSI).
- Turbocharger boost pressure between 50 and 115 kPa (7.25 and 16.68 PSI).
- This DTC runs continuously within the enabling conditions.

Conditions for Setting the DTC

The ECM detects an inconsistency between pressure sensors in the induction system in which a particular sensor cannot be identified as the failed sensor. The difference is greater than 10 kPa (1.5 PSI).

Action Taken When the DTC Sets

DTC P00C7 is a Type B DTC.

Conditions for Clearing the DTC

DTC P00C7 is a Type B DTC.

Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LUV\)](#), [Engine Controls Schematics \(Chevrolet with LUV\)](#)

Connector End View Reference

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

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 DTCs P0106, P0107, P0236, P0237, P0238, P2227, P2228, P2229, or P2230, are 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 is set**
3. Verify none of the following conditions exist:
 - The air intake duct system for loose connecting clamps, cracks, or other damage
 - A damaged Q38 Throttle Body blade or shaft
 - Splits, kinks, or improper connections at the vacuum hoses
 - Faulty positive crankcase ventilation system operation
 - Carbon deposits on the throttle blade.

- Vacuum leaks at the intake manifold, Q38 Throttle Body, Q17 Fuel Injector O-rings, and B111 Intake Manifold Pressure and Air Temperature Sensor.

- **If a condition exist**

Repair as necessary.

4. Ignition ON.

5. Verify the following scan tool parameters are within range of the Altitude vs. Barometric Pressure table. Refer to: [Altitude Versus Barometric Pressure](#) table.

- BARO Sensor
- MAP Sensor
- Turbocharger Boost Sensor
- **If a sensor parameter is not within range**

Refer to the appropriate diagnostic below for further diagnosis.

- Barometric Pressure (BARO) Sensor. Refer to: [DTC P2227-P2230](#)
- Manifold Absolute Pressure (MAP) Sensor. Refer to: [DTC P0106](#)
- Turbocharger Boost Pressure Sensor. Refer to: [DTC P0236](#)
- **If all sensor parameters are within range**

6. All OK

Repair Instructions

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

[Control Module References](#) for Engine Control Module replacement, programming and setup.

DTC P00E9: INTAKE AIR TEMPERATURE (IAT) SENSOR 3 CIRCUIT 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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P00E9

Intake Air Temperature (IAT) Sensor 3 Circuit Performance

Diagnostic Fault Information

IAT Sensor 3

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Sensor	P00EA, P00EB	P00E9, P00EB	P00EB*	P00E9
Low Reference	-	P00E9, P00EB	P00EB*	-

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

Typical Scan Tool Data

IAT Sensor 3

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Operating Conditions: Engine Running			
Parameter Normal Range: Varies with ambient temperature; and engine bay conditions			

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Sensor	130Â°C (266Â°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+

Circuit/System Description

The intake air temperature (IAT) sensor 3 is a variable resistor that changes an engine control module (ECM) supplied 5 V signal. The signal varies with inlet air temperature and is displayed by the scan tool as Â°C (Â°F). The IAT sensor 3 is integrated with the B111B Turbocharger Boost/Intake Air Temperature Sensor in the sensor bore, which is located before the throttle body. The ECM supplies a ground for the IAT sensor 3 low reference circuit.

The IAT sensor 1 and IAT sensor 2 are part of the B75C Multifunction Intake Air Sensor. The IAT sensor 1 produces an analog signal on pin-8 of the sensor. The IAT sensor 2 produces a frequency modulated signal on pin-1 of the sensor.

IAT Sensor 3 - Temperature, Resistance, Voltage Table

IAT Sensor 3	IAT Sensor 3 Resistance	IAT Sensor 3 Signal Voltage
Cold	High	High
Warm	Low	Low

Conditions for Running the DTC

P00E9

- DTCs P0097, P0098, P00EA, P00EB, P0111, P0112, P0113, P0117, P0118, or P1682 are not set.
- The vehicle has been OFF at least 8 hours.
- Ignition voltage is at least 11 V.
- This DTC runs once per ignition cycle when the enabling conditions are met.

Conditions for Setting the DTC

NOTE: P00E9 Can fail under any of the following 3 sets of conditions.

P00E9-Condition 1

- The ECM determines the absolute difference between IAT sensor 1 start-up temperature and the IAT sensor 2 start-up temperature is less or equal to 25Â°C (45Â°F).

AND

- The ECM determines the absolute difference between IAT sensor 3 start-up temperature and the IAT sensor 1 start-up temperature is greater than 25Â°C (45Â°F).

AND

- The ECM determines the absolute difference between IAT sensor 3 start-up temperature and the IAT sensor 2 start-up temperature is greater than 25Â°C (45Â°F).

P00E9-Condition 2

- The ECM determines the IAT sensor 1 start-up temperature is between the IAT sensor 3 and the IAT sensor 2 start-up temperatures

AND

- The ECM determines the absolute difference between IAT sensor 3 start-up temperature and the IAT sensor 2 start-up temperature is greater than 25Â°C (45Â°F).

AND

- The ECM determines the absolute difference between IAT sensor 3 and the IAT sensor 1 start-up temperatures is greater than the absolute difference between IAT sensor 2 and the IAT sensor 1 start-up temperatures.

P00E9-Condition 3

- The ECM determines the IAT sensor 2 start-up temperature is between the IAT sensor 3 and the IAT sensor 1 start-up temperatures

AND

- The ECM determines the absolute difference between IAT sensor 3 and the IAT sensor 1 start-up temperatures is greater than 25Â°C (45Â°F).

AND

- The absolute difference between IAT sensor 3 and the IAT sensor 2 start-up temperatures is greater than the absolute difference between IAT sensor 2 and the IAT sensor 1 start-up temperatures.

DTC P00E9 runs once an ignition cycle when one of the above 3 enabling sets of conditions are met.

Action Taken When the DTC Sets

- DTC P00E9 is Type C DTC, MY14 and newer vehicles.
- DTC P00E9 is Type B DTC, MY13 and older vehicles.

Conditions for Clearing the DTCs

- DTC P00E9 is Type C DTC, MY14 and newer vehicles.
- DTC P00E9 is Type B DTC, MY13 and older vehicles.

Reference Information

Schematic Reference

Engine Controls Schematics (Buick with LUV), **Engine Controls Schematics (Chevrolet with LUV)**

Connector End View Reference

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

Electrical Information Reference

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

Powertrain Component Views

Powertrain Component Views (Buick), **Powertrain Component Views (Chevrolet)**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

EL-38522-A Variable Signal Generator

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

Circuit/System Verification

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

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

Refer to [DTC P0641, P0651, P0697, or P06A3](#) for further diagnosis.

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

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 25Â°C (45Â°F) of each other.
 - Start-Up IAT Sensor 1
 - IAT Sensor 2
 - IAT Sensor 3
 - **If not within 25Â°C (45Â°F)**

Refer to Circuit/System Testing.
 - **If within 25Â°C (45Â°F)**
5. Engine idling, verify the IAT Sensor 3 scan tool parameter is between: -38 and +128Â°C (-36 and +262Â°F).
 - **If not between: -38 and +128Â°C (-36 and +262Â°F)**

Refer to Circuit System Testing.
 - **If between: -38 and +128Â°C (-36 and +262Â°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. Check the integrity of the entire air induction system and verify that none of the following conditions exist:
 - A loose or disconnected charge air cooler hose or pipe
 - A blocked or obstructed charge air cooler, including: after-market grill covers
 - Any snow or ice build-up at the charge air cooler in cold climates
 - Any mud or dirt build-up at the charge air cooler

- A restricted or collapsed air intake duct
- An intake manifold leak
- A MAP sensor seal that is leaking, missing, or damaged
- A misaligned or damaged air intake duct
- Any water intrusion in the induction system
- An Intake Manifold Resonator with a leaking seal, or a cracked or broken housing
- **If a condition exists**

Repair or replace component as appropriate.

- **If no condition exists**

2. 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.

3. Test for less than 2 Ω between the low reference circuit terminal 1 and ground.

- **If 2 Ω or greater**

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

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

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

- **If less than 2 Ω**

4. 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 Ω in the signal circuit end to end.

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

- **If greater than 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**

5. Ignition ON, verify the scan tool IAT Sensor 3 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 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 Ω in the signal circuit end to end.

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

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

6. Ignition OFF, install a 3 A fused jumper wire between the signal circuit terminal 2 and the low reference circuit terminal 1.
7. Verify the scan tool IAT Sensor 3 parameter is warmer than 128Â°C (262Â°F).
 - **If colder than 128Â°C (262Â°F).**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 ECM, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Ignition OFF.
 4. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω, replace the K20 ECM.
 - **If warmer than 128Â°C (262Â°F).**
8. Test or replace the B111B Turbocharger Boost/Intake Air Temperature sensor.

Component Testing

Turbocharger Boost/Intake Air Temperature sensor

1. Ignition OFF, disconnect the harness connector at the B111B Turbocharger Boost/Intake Air Temperature sensor.

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

2. Test the IAT sensor 3 by varying the sensor temperature while monitoring the sensor resistance. Compare the readings with the [Temperature Versus Resistance - Intake Air Temperature Sensor \(Bosch Sensor\)](#), [Temperature Versus Resistance - Intake Air Temperature Sensor \(Delco Sensor\)](#) table for the appropriate sensor. The resistance values should be in range of the table values.

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

Replace the B111B Turbocharger Boost/Intake Air Temperature sensor.

- **If within the specified range.**

3. All OK

Repair Instructions

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

- [Intake Air Pressure and Temperature Sensor Replacement](#) for turbocharger boost/intake air temperature sensor replacement
- [Mass Airflow Sensor Replacement](#) for multifunction intake air sensor replacement
- [Control Module References](#) for Engine Control Module replacement, programming, and setup.

DTC P00EA-P00EC: INTAKE AIR TEMPERATURE (IAT) SENSOR CIRCUIT LOW 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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P00EA

DTC P00EB

Intake Air Temperature (IAT) Sensor 3 Circuit High Voltage

DTC P00EC

Intake Air Temperature (IAT) Sensor 3 Circuit Erratic

Diagnostic Fault Information**IAT Sensor 3**

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Sensor	P00EA, P00EB	P00E9, P00EB	P00EB*	P00E9
Low Reference	-	P00E9, P00EB	P00EB*	-

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

Typical Scan Tool Data**IAT Sensor 3**

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Operating Conditions: Engine Running			
Parameter Normal Range: Varies with ambient temperature; and engine bay conditions			
Sensor	130Â°C (266Â°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+

Circuit/System Description

The intake air temperature (IAT) sensor 3 is a variable resistor that changes an engine control module (ECM) supplied 5 V signal. The signal varies with inlet air temperature and is displayed by the scan tool as Â°C (Â°F). The IAT sensor 3 is integrated with the B111B Turbocharger Boost/Intake Air Temperature Sensor in the sensor bore, which is located before the throttle body. The ECM supplies a ground for the IAT sensor 3 low reference circuit.

The IAT sensor 1 and IAT sensor 2 are part of the B75C Multifunction Intake Air Sensor. The IAT sensor 1 produces an analog signal on pin-8 of the sensor. The IAT sensor 2 produces a frequency modulated signal on pin-1 of the sensor.

Conditions for Running the DTCs**P00EA, P00EB, and P00EC**

- The ignition is ON, or the engine is running.
- The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

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

P00EA

The ECM detects that the IAT sensor 3 signal is warmer than 149Â°C (300Â°F) for at least 5 s.

P00EB

The ECM detects that the IAT sensor 3 signal is colder than -60Â°C (-76Â°F) for at least 5 s.

P00EC

The ECM detects that the IAT sensor 3 signal is intermittent or has abruptly changed for at least 5s.

Action Taken When the DTCs Set

- DTCs P00EA, P00EB, and P00EC are Type B DTCs.
- The ECM commands the cooling fans ON.

Conditions for Clearing the DTCs

DTCs P00EA, P00EB, and P00EC are Type B DTCs.

Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LUY\)](#), [Engine Controls Schematics \(Chevrolet with LUY\)](#)

Connector End View Reference

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

Electrical Information Reference

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

Powertrain Component Views

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

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

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

Refer to [DTC P0641, P0651, P0697, or P06A3](#) for further diagnosis.

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

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 25Â°C (45Â°F) of each other.
 - Start-Up IAT Sensor 1

- IAT Sensor 2
- IAT Sensor 3
- **If not within 25Â°C (45Â°F)**

Refer to Circuit/System Testing.

- **If within 25Â°C (45Â°F)**

5. Engine idling, verify the IAT Sensor 3 scan tool parameter is between: -38 and +128Â°C (-36 and +262Â°F).

- **If not between: -38 and +128Â°C (-36 and +262Â°F)**

Refer to Circuit System Testing.

- **If between: -38 and +128Â°C (-36 and +262Â°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 B111B Turbocharger Boost/Intake Air Temperature sensor.

2. Test for less than 2 Ω between the low reference circuit terminal 1 and ground.

- **If 2 Ω or greater**

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

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

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

- **If less than 2 Ω**

3. 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 Ω in the signal circuit end to end.

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

- **If greater than 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**
4. Ignition ON, verify the scan tool IAT Sensor 3 parameter is colder than -39°C (-38°F).
 - **If warmer than -39°C (-38°F).**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 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 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°C (-38°F).**
 5. Ignition OFF, install a 3 A fused jumper wire between the signal circuit terminal 2 and the low reference circuit terminal 1.
 6. Verify the scan tool IAT Sensor 3 parameter is warmer than 128°C (262°F).
 - **If colder than 128°C (262°F).**
 1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K20 ECM, 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 ECM.
 - **If warmer than 128°C (262°F).**
 7. Test or replace the B111B Turbocharger Boost/Intake Air Temperature sensor.

Component Testing

Turbocharger Boost/Intake Air Temperature sensor

1. Ignition OFF, disconnect the harness connector at the B111B Turbocharger Boost/Intake Air Temperature sensor.

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

2. Test the IAT sensor 3 by varying the sensor temperature while monitoring the sensor resistance. Compare the readings with the [Temperature Versus Resistance - Intake Air Temperature Sensor \(Bosch Sensor\)](#), [Temperature Versus Resistance - Intake Air Temperature Sensor \(Delco Sensor\)](#) table for the appropriate sensor. The resistance values should be in range of the table values.
 - **If not within the specified range.**

Replace the B111B Turbocharger Boost/Intake Air Temperature sensor.
 - **If within the specified range.**
3. All OK

Repair Instructions

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

- [Intake Air Pressure and Temperature Sensor Replacement](#) for turbocharger boost/intake air temperature replacement
- [Control Module References](#) for Engine Control Module replacement, programming, and setup.

DTC P00F4-P00F6: INTAKE AIR HUMIDITY SENSOR

Diagnostic Instructions

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

DTC Descriptors

DTC P00F4

Intake Air Humidity Sensor Circuit Low Voltage

DTC P00F5

Intake Air Humidity Sensor Circuit High Voltage

DTC P00F6

Intake Air Humidity Sensor Circuit Erratic

Diagnostic Fault Information

Intake Air Humidity Sensor

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0097, P00F4, P0651, P2199, P2227, P2228	P0096, P0097, P00F4, P2199, P2227, P2228	P0097, P00F4, P0651, P2199, P2227, P2228	-
Signal	P0097, P00F5, P2199	P0097, P00F4, P2199	P0097, P00F4, P2199*	-
Low Reference	-	P0097, P0113, P00F4, P2227, P2229	*	-

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

Typical Scan Tool Data

Intake Air Humidity

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Operating Conditions: Engine Running Parameter Normal Range: Varies with ambient humidity and temperature; and engine bay conditions			
5 V Reference	0 %	0 %	-
Signal	100 %	0 %	0 %*
Low Reference	-	0 %	*

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

Circuit/System Description

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

- IAT sensor 1
- IAT sensor 2
- Humidity sensor

- MAF sensor
- BARO pressure sensor

The intake air humidity sensor measures the ambient humidity of the air in the sensor bore. The signal varies with intake air humidity and is displayed by the scan tool as duty cycle %. The engine control module (ECM) applies 5 V to the signal circuit. The humidity sensor and the IAT sensor 2 share the same circuit.

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

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

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

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

Conditions for Running the DTCs

P00F4, P00F5, and P00F6

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

Conditions for Setting the DTCs

P00F4

The ECM detects that the humidity sensor signal is less than or equal to 5 % for greater than 5 s.

P00F5

The ECM detects that the humidity sensor signal is greater than or equal to 95 % for greater than 5 s.

P00F6

The ECM detects that the humidity sensor signal is intermittent or has abruptly changed over a period of time greater than 5 s.

Action Taken When the DTC Sets

DTCs P00F4, P00F5, and P00F6 are Type B DTCs.

Conditions for Clearing the MIL/DTC

DTCs P00F4, P00F5, and P00F6 are Type B DTCs.

Diagnostic Aids

- The Intake Air Humidity Signal parameter displays the measured humidity within the air intake system and may differ from atmospheric humidity measured outside the air intake system.
- The humidity sensor and the IAT sensor 2 signals are sent to the ECM on the same circuit. If the Intake Air Humidity parameter displays the value: 0 % or 100 %, and there are also IAT Sensor 2 DTCs, check for a circuit problem.

Reference Information

[Engine Controls Schematics \(Buick with LUV\)](#), [Engine Controls Schematics \(Chevrolet with LUV\)](#)

Connector End View Reference

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

Electrical Information Reference

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

Powertrain Component Views

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

DTC Type Reference

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

Scan Tool Reference

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

Special Tools

EL-38522-A Variable Signal Generator

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

Circuit/System Verification

1. Ignition ON, verify that DTC DTC P0641, P0651, P0697, or P06A3 is not set.

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

Refer to [DTC P0641, P0651, P0697, or P06A3](#) for further diagnosis.

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

NOTE: To minimize the effects of residual engine heat and sensor internal heating elements, perform Steps 2 and 3 of this verification procedure only if the ignition has been OFF for 8 hours or more.

2. Ignition ON.

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

- Start-Up IAT Sensor 1
- IAT Sensor 2
- IAT Sensor 3; where equipped
- **If not within 25Â°C (45Â°F)**

Refer to Circuit/System Testing.

- **If within 25Â°C (45Â°F)**

4. Engine idling, verify the scan tool Intake Air Humidity parameter is between 5 and 90 %.

- **If not between 5 and 90 %**

Refer to Circuit/System Testing.

- **If between 5 and 90 %**
- 5. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the freeze frame/failure records data.
- 6. Verify the DTC does not set.
 - **If the DTC sets**

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

Circuit/System Testing

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

1. Ignition OFF, and all vehicle systems OFF, it may take up to 2 min. for all vehicle systems to power down. Disconnect the harness connector at the B75C Mass Air Flow/Multifunction Intake Air sensor.
2. Test for less than 2 Ω between the low reference circuit terminal 7 and ground.
 - **If 2 Ω or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open or high resistance in the circuit.
 - If less than 2 Ω replace the K20 Engine Control Module.
 - **If less than 2 Ω**
3. Ignition OFF, all vehicle systems OFF, test for less than 2 Ω between the ground circuit terminal 4 and ground.
 - **If 2 Ω or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open or high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 2 Ω**
4. Ignition ON, test for 4.8-5.2 V between the 5 V reference circuit terminal 2 and ground.
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the 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 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 5.2 V**

NOTE: If the 5 V reference 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 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. Ignition ON, test for 4.8-5.2 V between the humidity 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 Ω in the signal circuit end to end.

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

- **If greater than 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. Determine if **EL-38522-A** Variable Signal Generator or equivalent is available.

- **EL-38522-A, Variable Signal Generator; or equivalent is not available**

1. Replace the K20 Engine Control Module.

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 step 10.

- **If the DTC does not set**

4. All OK.

- **EL-38522-A, Variable Signal Generator; or equivalent is available**

7. Ignition OFF, connect the leads of the **EL-38522-A** Variable Signal Generator as follows:

- Red lead to the signal circuit terminal 1 at the harness connector
- Black leads to ground
- Battery voltage supply lead to B+

8. Set the **EL-38522-A** Variable Signal Generator to the following specifications.

- Signal switch to 5 V
- Frequency switch to 250 Hz
- Duty Cycle switch to 50 % (Normal)

9. Ignition ON, verify the scan tool Intake Air Humidity parameter is between 45-55 %.

- **If not between 45-55 %**

Replace the K20 Engine Control Module.

- **If between 45-55 %**

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

Component Testing

Multifunction Intake Air Sensor

1. Test the Intake Air Humidity Sensor by varying the air humidity in the intake duct near the sensor, while observing the scan tool Intake Air Humidity Sensor parameter. The parameter should

change and be within 5-95%.

- **If not within 5-95%.**

Replace the B75C Multifunction Intake Air sensor.

- **If within 5-95%.**

2. All OK

Repair Instructions

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

- [Mass Airflow Sensor Replacement](#) for multifunction intake air sensor replacement.
- [Control Module References](#) for Engine Control Module replacement, programming, and setup.

DTC P0101: MASS AIR FLOW (MAF) SENSOR 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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P0101

Mass Air Flow (MAF) Sensor Performance

Diagnostic Fault Information

MAF Sensor

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Voltage	P0102	P0102, P01101	P0690	P0101
Sensor	P0102, P1101	P0102, P1101	P0102*	P0101, P1101
Ground	-	P0102	-	-

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

Typical Scan Tool Data

MAF Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine running at various operating conditions Parameter Normal Range: 2, 000-10, 000 Hz			
Ignition Voltage	0 Hz	0 Hz	-
Sensor	0 Hz	0 Hz	0 Hz*
Ground	-	0 Hz	-

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

Circuit Description

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

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

The MAF sensor is an air flow meter that measures the amount of air flowing in the sensor bore. The engine control module (ECM) uses the MAF sensor signal to provide the correct fuel delivery for all engine speeds and loads. A small quantity of air entering the engine indicates a deceleration or idle condition. A large quantity of air entering the engine indicates an acceleration or high load condition.

The ECM applies 5 V to the MAF sensor signal circuit. The sensor produces a variable frequency signal based on the inlet air flow through the sensor bore. The signal varies with engine load and is displayed by the scan tool as Hertz (Hz) and grams per second (g/s). Vehicle ignition voltage and ground circuits are also supplied to the MAF sensor.

The intake flow rationality diagnostic provides the within-range rationality check for the mass air flow (MAF), manifold absolute pressure (MAP), and the throttle position sensors. This is an explicit model-based diagnostic containing 4 separate models for the intake system.

The estimates of MAF and MAP obtained from this system of models and calculations are then compared to the actual measured values from the MAF, MAP, and the throttle position sensors and to each other to determine the appropriate DTC to fail.

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

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

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

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

Conditions for Running the DTCs

- DTCs P0096, P0097, P0098, P0102, P0103, P0107, P0111, P0112, P0113, P0116, P0117, P0118, P0119, P0237, P0238, P0335, P0336, P2227, P2228, P2229, or P2230 are not set.
- The engine speed is between 400-6, 000 RPM.
- The engine coolant temperature (ECT) is between -7 and +125°C (+19 and +257°F).
- The intake air temperature (IAT) is between -20 and +100°C (-4 and +212°F).
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

The engine control module (ECM) detects that the actual measured airflow from the MAF, MAP, and throttle position sensors is not within range of the calculated airflow that is derived from the system of models for greater than 2 s.

Action Taken When the DTC Sets

DTC P0101 is a Type B DTC.

Conditions for Clearing the MIL/DTC

DTC P0101 is a Type B DTC.

Diagnostic Aids

- Certain aftermarket air filters may cause this DTC to set.
- Certain aftermarket air induction systems may cause this DTC to set.
- Modifications to the air induction system may cause this DTC to set.
- Driveability concerns and erratic transmission shifting may be caused by an excessively oiled aftermarket air cleaner that is contaminating the MAF sensor.

Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LUV\)](#), [Engine Controls Schematics \(Chevrolet with LUV\)](#)

Connector End View Reference

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

Electrical Information Reference

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

Powertrain Component Views

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

DTC Type Reference

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

Scan Tool Reference

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

Special Tools

EL-38522-A Variable Signal Generator

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

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC DTC P0641, P0651, P0697, or P06A3 is not set.
 - **If any of the DTCs are set**

Refer to [DTC P0641, P0651, P0697, or P06A3](#) for further diagnosis.
 - **If none of the DTCs are set**
3. If you were sent here from DTC P0068, P0106, P0121, P0236, or P1101; refer to Circuit/System Testing.
4. Ignition ON.
5. 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 %**
6. Verify the scan tool Throttle Position Sensors 1 and 2 Agree/Disagree parameter displays Agree while performing the Throttle Sweep Test with a scan tool.
 - **If Disagree**

Refer to [DTC P0121-P0123, P0222, P0223, or P2135](#) for further diagnosis.
 - **If Agree**

7. Determine the current vehicle testing altitude.
8. Verify the scan tool MAP Sensor pressure parameter is within the range specified in the [Altitude Versus Barometric Pressure](#) table.
 - **If the MAP Sensor parameter is not in range**
Refer to [DTC P0106](#) for further diagnosis.
 - **If the MAP Sensor parameter is within range**
9. Verify the engine is equipped with a turbocharger.
 - **If not equipped with a turbocharger**
Refer to Step 12.
 - **If equipped with a turbocharger**
10. Verify the scan tool Boost Pressure Sensor parameter is within the range specified in the [Altitude Versus Barometric Pressure](#) table.
 - **If the Boost Pressure Sensor parameter is not in range**
Refer to [DTC P0236](#) for further diagnosis.
 - **If the Boost Pressure Sensor parameter is within range**
11. Verify the scan tool Boost Pressure Sensor parameter decreases after starting the engine.
 - **If the Boost Pressure Sensor parameter does not decrease**
Refer to [DTC P0236](#) for further diagnosis.
 - **If the Boost Pressure Sensor parameter does decrease**
12. Engine idling, verify the scan tool MAP Sensor pressure parameter is between 26-52 kPa (3.8-7.5 PSI) and changes with accelerator pedal input.
 - **If not between 26-52 kPa (3.8-7.5 PSI) or does not change**
Refer to [DTC P0106](#) for further diagnosis.
 - **If between 26-52 kPa (3.8-7.5 PSI) and changes**
13. Verify the scan tool MAF Sensor g/s parameter changes smoothly and gradually as the engine speed is increased and decreased while performing the actions listed below.
 1. Engine idling
 2. Perform the scan tool snapshot function.
 3. Increase the engine speed slowly to 3, 000 RPM and then back to idle.
 4. Exit from the scan tool snapshot and review the data.
 5. Observe the MAF Sensor parameter frame by frame with a scan tool.
 - **If the MAF Sensor parameter does not change smoothly and gradually**
Refer to Circuit/System Testing.
 - **If the MAF Sensor parameter changes smoothly and gradually**
14. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
15. Verify the DTC does not set.
 - **If the DTC does set**
Refer to Circuit/System Testing for further diagnosis.
 - **If the DTC does not set**
16. All OK

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

1. Check the integrity of the entire air induction system by verifying that none of the following conditions exist:

- Any damaged components
- Improper operation of turbocharger wastegate actuator or bypass valve; where equipped
- Improperly installed components
- Collapsed, restricted, or damaged components
- Loose clamps, cracks, or other damage
- An air flow restriction
- Restricted air filter
- Splits, kinks, leaks, or improper connections at the vacuum hoses
- Vacuum leaks at the intake manifold, MAP sensor, and throttle body
- Water intrusion
- Any snow or ice buildup, in cold climates
- Contamination of the Multifunction Intake Air sensor element
- **If a condition is found**

Repair or replace component as appropriate.

- **If no condition is found**

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

3. Test for less than 2 Ω between the ground circuit terminal 4 and ground.

- **If 2 Ω or greater**

1. Ignition OFF.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 2 Ω**

4. Ignition ON.

5. 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 circuit.

2. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

- **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 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, test all components connected to the ignition circuit, replace as necessary.

- **If a test lamp illuminates**

6. Ignition ON, test for 4.8-5.2 V between the signal circuit terminal 3 and ground.

- **If less than 4.8 V**

1. Ignition OFF, disconnect the harness connector 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 Ω in the signal circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.
- **If greater than 5.2 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Ignition ON, test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
- **If between 4.8-5.2 V**
- 7. 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**
- 8. Ignition OFF, connect the leads of the **EL-38522-A** Variable Signal Generator as follows:
 - Red lead to the signal circuit terminal 3 at the harness connector
 - Black leads to ground
 - Battery voltage supply lead to B+
- 9. Set the **EL-38522-A** Variable Signal Generator to the following specifications.
 - Signal switch to 5 V
 - Frequency switch to 5 kHz
 - Duty Cycle switch to 50 % (Normal)
- 10. Engine idling, verify the scan tool MAF Sensor parameter is between 4, 950-5, 050 Hz.
 - **If not between 4, 950-5, 050 Hz.**

Replace the K20 Engine Control Module.
 - **If between 4, 950-5, 050 Hz.**
- 11. Test or replace the B75C Multifunction Intake Air sensor.

Repair Instructions

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

- [Mass Airflow Sensor Replacement](#) for multifunction intake air sensor replacement.
- [Control Module References](#) for Engine Control Module replacement, programming, and setup.

DTC P0102 OR P0103: MASS AIR FLOW (MAF) SENSOR

Diagnostic Instructions

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

DTC Descriptors

DTC P0102

DTC P0103

Mass Air Flow (MAF) Sensor Circuit High Frequency

Diagnostic Fault Information**MAF Sensor**

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Voltage	P0102	P0102, P01101	P0690	P0101
Sensor	P0102, P1101	P0102, P1101	P0102*	P0101, P1101
Ground	-	P0102	-	-
*Internal ECM or sensor damage may occur if the circuit is shorted to B+.				

Typical Scan Tool Data**MAF Sensor**

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine running at various operating conditions			
Parameter Normal Range: 2, 000-10, 000 Hz			
Ignition Voltage	0 Hz	0 Hz	-
Sensor	0 Hz	0 Hz	0 Hz*
Ground	-	0 Hz	-
*Internal ECM or sensor damage may occur if the circuit is shorted to B+			

Circuit Description

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

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

The MAF sensor is an air flow meter that measures the amount of air flowing in the sensor bore. The engine control module (ECM) uses the MAF sensor signal to provide the correct fuel delivery for all engine speeds and loads. A small quantity of air entering the engine indicates a deceleration or idle condition. A large quantity of air entering the engine indicates an acceleration or high load condition.

The ECM applies 5 V to the MAF sensor signal circuit. The sensor produces a variable frequency signal based on the inlet air flow through the sensor bore. The signal varies with engine load and is displayed by the scan tool as Hertz (Hz) and grams per second (g/s). Vehicle ignition voltage and ground circuits are also supplied to the MAF sensor.

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

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

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

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

Conditions for Running the DTCs

- The engine is running for at least 1 s.
- The engine speed is at least 300 RPM.
- The ignition signal is at least 10 V.
- The above conditions are met for at least 1 s.
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTCs

P0102

The ECM detects that the MAF Sensor signal parameter is less than 1, 837 Hz (about 0.39 g/s) for at least 250 cylinder firing events.

P0103

The ECM detects that the MAF Sensor signal parameter is at least 13, 200 Hz (about 810 g/s) for at least 250 cylinder firing events.

Action Taken When the DTCs Set

DTCs P0102 and P0103 are Type B DTCs.

Conditions for Clearing the MIL/DTCs

DTCs P0102 and P0103 are Type B DTCs.

Diagnostic Aids

Verify that any electrical aftermarket devices are properly connected and grounded. Refer to [Checking Aftermarket Accessories](#).

Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LUV\)](#), [Engine Controls Schematics \(Chevrolet with LUV\)](#)

Connector End View Reference

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

Electrical Information Reference

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

Powertrain Component Views

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

DTC Type Reference

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

Scan Tool Reference

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

EL-38522-A Variable Signal Generator

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

Circuit/System Verification

1. Engine idling, verify the scan tool MAF Sensor parameter is between 1.75-5.5 g/s.
 - **If not between 1.75-5.5 g/s**

Refer to Circuit/System Testing.
 - **If between 1.75-5.5 g/s**
2. Verify the scan tool MAF Sensor g/s parameter changes smoothly and gradually as the engine speed is increased and decreased while performing the actions listed below.
 1. Engine idling
 2. Perform the scan tool snapshot function.
 3. Increase the engine speed slowly to 3,000 RPM and then back to idle.
 4. Exit from the scan tool snapshot and review the data.
 5. Observe the MAF Sensor parameter frame by frame with a scan tool.
 - **If the MAF Sensor parameter does not change smoothly and gradually**

Refer to Circuit/System Testing.
 - **If the MAF Sensor parameter changes smoothly and gradually**
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 does set**

Refer to Circuit/System Testing for further diagnosis.
 - **If the DTC does not set**
5. All OK

Circuit/System Testing

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

1. Ignition OFF, disconnect the harness connector at the B75C Multifunction Intake Air sensor.
2. Test for less than 2 Ω between the ground circuit terminal 4 and ground.
 - **If 2 Ω or greater**
 1. Ignition OFF. Disconnect the sensor chassis ground.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the chassis ground connection.
 - **If less than 2 Ω**
3. Ignition ON.
4. 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 circuit.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.

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

- **If greater than 5.2 V**

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. 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**

4. All OK.

- **EL-38522-A, Variable Signal Generator; or equivalent is available**

7. Ignition OFF, connect the leads of the **EL-38522-A** Variable Signal Generator as follows:

- Red lead to the signal circuit terminal 3 at the harness connector
- Black leads to ground
- Battery voltage supply lead to B+

8. Set the **EL-38522-A** Variable Signal Generator to the following specifications.

- Signal switch to 5 V
- Frequency switch to 5 kHz
- Duty Cycle switch to 50 % (Normal)

9. Engine idling, verify the scan tool MAF Sensor parameter is between 4, 950-5, 050 Hz.

- **If not between 4, 950-5, 050 Hz.**

Replace the K20 Engine Control Module.

- **If between 4, 950-5, 050 Hz.**

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

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

- [Mass Airflow Sensor Replacement](#) for multifunction intake air sensor replacement.
- [Control Module References](#) for Engine Control Module replacement, programming, and setup.

DTC P0106: MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR 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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P0106

Manifold Absolute Pressure (MAP) Sensor Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0107, P0697	P0106, P0107	P0108, P0697	P0106
Signal	P0107	P0106, P0107	P0108	P0106
Low Reference	-	P0106, P0108	-	P0106

Typical Scan Tool Data

MAP Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine running at various operating conditions Parameter Normal Range: 12-103 kPa (1.7-14.9 PSI)			
5 V Reference	0 kPa (0 PSI)	0 kPa (0 PSI)	104 kPa (15.1 PSI)
Signal	0 kPa (0 PSI)	0 kPa (0 PSI)	104 kPa (15.1 PSI)*
Low Reference	-	80-103 kPa (11.6-14.9 PSI)	-
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.			

MAP Sensor, if equipped with Turbocharger

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine running at various operating conditions Parameter Normal Range: 12-225 kPa (1.7-32.6 PSI)			
5 V Reference	0 kPa (0 PSI)	0 kPa (0 PSI)	255 kPa (36.9 PSI)
Signal	0 kPa (0 PSI)	0 kPa (0 PSI)	255 kPa (36.9 PSI)*
Low Reference	-	255 kPa (36.9 PSI)	-
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.			

Circuit Description

The manifold absolute pressure (MAP) sensor measures the pressure inside the intake manifold. Pressure in the intake manifold is affected by engine speed, throttle opening, air temperature, barometric pressure (BARO); and if equipped turbocharger output. A diaphragm within the MAP sensor is displaced by the pressure changes that occur from the varying load and operating conditions of the engine. The sensor translates this action into electrical resistance.

The MAP sensor wiring includes 3 circuits. The engine control module (ECM) supplies a regulated 5 volts to the sensor on a 5 V reference circuit. The ECM supplies a ground on a low reference circuit. The MAP sensor provides a signal voltage to the ECM, relative to the pressure changes, on the MAP sensor signal circuit. The ECM converts the signal voltage input to a pressure value.

Under normal operation the greatest pressure that can exist in the intake manifold is at ignition ON, engine OFF, which is equal to the BARO. If equipped, a turbocharger can increase the pressure above BARO, when the vehicle is operated at wide-open throttle (WOT). The lowest manifold pressure occurs when the vehicle is idling or decelerating. The ECM monitors the MAP sensor signal for pressure outside of the normal range.

Conditions for Running the DTC

- DTCs P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0128, P0335, P0336 are not set.
- The engine speed is between 400-6500 RPM.
- The engine coolant temperature (ECT) sensor is between -7 to +125Â°C (19.4 and 257Â°F).
- The intake air temperature (IAT) sensor is between -20 to +125Â°C (-4 and +257Â°F).
- This DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM detects that the MAP Sensor pressure is not within range of the calculated pressure that is derived from a system of models for more than 0.5 s.

Action Taken When the DTC Sets

DTC P0106 is a Type B DTC.

Conditions for Clearing the DTC

DTC P0106 is a Type B DTC.

Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LUV\)](#), **[Engine Controls Schematics \(Chevrolet with LUV\)](#)**

Connector End View Reference

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

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

GE-23738-A Vacuum Pump

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

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 [DTC P0641, P0651, P0697, or P06A3](#) for further diagnosis.
 - **If none of the DTC are set**
3. If you were sent here from DTC P0068, P0101, P0121, P0236, or P1101; refer to Circuit/System Testing.
4. Ignition ON.
5. 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%**
6. Verify the scan tool Throttle Position Sensors 1 and 2 Agree/Disagree parameter displays Agree while performing the Throttle Sweep Test with a scan tool.
 - **If Disagree**

Refer to [DTC P0121-P0123, P0222, P0223, or P2135](#) for further diagnosis.
 - **If Agree**
7. Determine the current vehicle testing altitude.
8. Verify the scan tool MAP Sensor parameter is within the range specified in the [Altitude Versus Barometric Pressure](#) table.
 - **If the MAP Sensor parameter is not in range**

Refer to Circuit/System Testing.
 - **If the MAP Sensor parameter is in range**
9. Verify the engine is equipped with a turbocharger.
 - **If not equipped with a turbocharger**

Refer to Step 12.
 - **If equipped with a turbocharger**
10. Verify the scan tool Boost Pressure Sensor parameter is within the range specified in the [Altitude Versus Barometric Pressure](#) table.
 - **If the Boost Pressure Sensor parameter is not in range**

Refer to [DTC P0236](#) for further diagnosis.
 - **If the Boost Pressure Sensor parameter is in range**
11. Verify the scan tool Boost Pressure Sensor parameter decreases after starting the engine.
 - **If the Boost Pressure Sensor parameter does not decrease**

Refer to [DTC P0236](#) for further diagnosis.
 - **If the Boost Pressure Sensor parameter is within range**

12. Engine idling, verify the scan tool MAP Sensor pressure parameter is between 26-52 kPa (3.8-7.5 PSI) and changes with accelerator pedal input.

- **If not between 26-52 kPa (3.8-7.5 PSI) or does not change**

Refer to Circuit/System Testing.

- **If between 26-52 kPa (3.8-7.5 PSI) and changes**

13. Verify the scan tool MAF Sensor g/s parameter changes smoothly and gradually as the engine speed is increased and decreased while performing the actions listed below.

1. Engine idling
2. Perform the scan tool snapshot function.
3. Increase the engine speed slowly to 3000 RPM and then back to idle.
4. Exit from the scan tool snapshot and review the data.
5. Observe the MAF Sensor parameter frame by frame with a scan tool.

- **If the MAF Sensor parameter does not change smoothly and gradually**

Refer to [DTC P0101](#).

- **If the MAF Sensor parameter does change smoothly and gradually**

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

15. Verify a DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

16. All OK.

Circuit/System Testing

1. Check the integrity of the entire air induction system and verify that none of the following conditions exist:

- Any damaged components
- Improper operation of turbocharger wastegate actuator or bypass valve, if equipped
- Loose or improper installation of the turbocharger and the charge air cooler, including the flexible ductwork, if equipped
- An air flow restriction
- Any vacuum leak
- Improperly routed vacuum hoses
- In cold climates, inspect for any snow or ice buildup at the BARO port on the ECM, if equipped
- A restriction in the MAP Sensor port or the BARO port
- Proper operation of the positive crankcase ventilation system
- Missing, restricted or leaking exhaust components. Refer to [Symptoms - Engine Exhaust](#).
- Engine mechanical condition; for example: low compression or incorrect timing chain installation. Refer to [Symptoms - Engine Mechanical](#).
- **If a condition is found**

Repair or replace the component as appropriate.

- **If no condition is found**

2. 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 B74 Manifold Absolute Pressure Sensor.

3. Test for less than 2 Ω between the low reference circuit terminal 2 and ground.

- **If 2 Ω or greater**

1. Ignition OFF, disconnect 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 $2\ \Omega$**
4. Ignition ON.
5. 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 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.

NOTE: If the signal circuit is shorted to a voltage the ECM or the MAP Sensor may be damaged.

- **If greater than 5.2 V**
 1. Ignition OFF, disconnect the K20 Engine Control Module.
 2. Ignition ON, test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If between 4.8-5.2 V**
6. Ignition ON, verify the scan tool MAP Sensor parameter is less than 0.5 V.
 - **If 0.5 V or greater**
 1. Ignition OFF, disconnect the K20 Engine Control Module.
 2. Ignition ON, test for less than 1 V between the signal circuit terminal 3 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 0.5 V**
 7. Ignition OFF, install a 3 A fused jumper wire between the signal circuit terminal 3 and the 5 V reference circuit terminal 1.
 8. Ignition ON, verify the scan tool MAP voltage parameter is greater than 4.5 V.
 - **If 4.5 V or less**
 1. Ignition OFF, disconnect the K20 Engine Control Module.
 2. Remove the jumper wire, test for infinite resistance between the signal circuit terminal 3 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 or high resistance in the circuit.
 - If less than $2\ \Omega$, replace the K20 Engine Control Module.
 - **If greater than 4.5 V**
 9. Test or replace the B74 Manifold Absolute Pressure Sensor.

Component Testing

NOTE: You must perform the Circuit/System Testing in order to Check the integrity of the MAP Sensor circuits before proceeding with the

Skewed Sensor Test

1. Ignition OFF, remove the B74 Manifold Absolute Pressure Sensor from the engine. Connect the harness to the sensor, if disconnected.
2. Ignition ON, apply 17 kPa (5.0 in Hg) of vacuum to the B74 Manifold Absolute Pressure Sensor, with the **GE-23738-A** . Verify the scan tool MAP Sensor pressure parameter decreases between 13-21 kPa (1.8-3.0 PSI).

- **If the parameter does not decrease between 13-21 kPa (1.8-3.0 PSI).**

Replace the B74 Manifold Absolute Pressure Sensor.

- **If the parameter does decrease between 13-21 kPa (1.8-3.0 PSI).**

3. Apply 34 kPa (10.0 in Hg) of vacuum to the B74 Manifold Absolute Pressure Sensor, with the **GE-23738-A** . Verify the scan tool MAP Sensor pressure parameter decreases between 30-38 kPa (4.4-5.5 PSI).

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

Replace the B74 Manifold Absolute Pressure Sensor.

- **If the parameter does decrease between 30-38 kPa (4.4-5.5 PSI).**

4. All OK.

Erratic Signal Test

1. Ignition OFF, remove the B74 Manifold Absolute Pressure Sensor and disconnect the harness.
2. Install a 3 A fused jumper wire between the 5 V reference circuit terminal 1 of the sensor and the sensor harness.
3. Install a jumper wire between the low reference circuit terminal 2 of the sensor and ground.
4. Install a jumper wire to the signal circuit terminal 3 of the sensor.
5. Connect a DMM between the jumper wire and ground.
6. Ignition ON, observe the DC voltage on the DMM. Slowly apply between 0-15 kPa (0-4.4 in Hg) of vacuum to the sensor with the **GE-23738-A** . Verify the voltage changes, without any spikes or dropouts, between 0.2-4.9 V.

- **If not between 0.2- 4.9 V or has spikes or dropouts**

Replace the B74 Manifold Absolute Pressure Sensor.

- **If between 0.2 -4.9 V and there are no spikes or dropouts**

7. All OK.

Repair Instructions

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

- [Manifold Absolute Pressure Sensor Replacement](#)
- [Control Module References](#) for ECM replacement, programming and setup

DTC P0107 OR P0108: MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR CIRCUIT LOW 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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0107

Manifold Absolute Pressure (MAP) Sensor Circuit Low Voltage

DTC P0108

Manifold Absolute Pressure (MAP) Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0107, P0697	P0106, P0107	P0108, P0697	P0106
Signal	P0107	P0106, P0107	P0108	P0106
Low Reference	-	P0106, P0108	-	P0106

Typical Scan Tool Data**MAP Sensor**

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine running at various operating conditions Parameter Normal Range: 12-103 kPa (1.7-14.9 PSI)			
5 V Reference	0 kPa (0 PSI)	0 kPa (0 PSI)	104 kPa (15.1 PSI)
Signal	0 kPa (0 PSI)	0 kPa (0 PSI)	104 kPa (15.1 PSI)*
Low Reference	-	80-103 kPa (11.6-14.9 PSI)	-
*Internal ECM or sensor damage may occur if the circuit is shorted to B+.			

MAP Sensor, when equipped with Turbocharger

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine running at various operating conditions Parameter Normal Range: 12-225 kPa (1.7-32.6 PSI)			
5 V Reference	0 kPa (0 PSI)	0 kPa (0 PSI)	255 kPa (36.9 PSI)
Signal	0 kPa (0 PSI)	0 kPa (0 PSI)	255 kPa (36.9 PSI)*
Low Reference	-	255 kPa (36.9 PSI)	-
*Internal ECM or sensor damage may occur if the circuit is shorted to B+.			

Circuit Description

The manifold absolute pressure (MAP) sensor measures the pressure inside the intake manifold. Pressure in the intake manifold is affected by engine speed, throttle opening, air temperature, barometric pressure (BARO); and where equipped turbocharger output. A diaphragm within the MAP sensor is displaced by the pressure changes that occur from the varying load and operating conditions of the engine. The sensor translates this action into electrical resistance.

The MAP sensor wiring includes 3 circuits. The engine control module (ECM) supplies a regulated 5 V to the sensor on a 5 V reference circuit. The ECM supplies a ground on a low reference circuit. The MAP sensor provides a signal voltage to the ECM, relative to the pressure changes, on the MAP sensor signal circuit. The ECM converts the signal voltage input to a pressure value.

Under normal operation the greatest pressure that can exist in the intake manifold is at ignition ON, engine OFF, which is equal to the BARO. Where equipped, a turbocharger can increase the pressure above BARO, when the vehicle is operated at wide-open throttle (WOT). The lowest manifold pressure occurs when the vehicle is idling or decelerating. The ECM monitors the MAP sensor signal for pressure outside of the normal range.

Conditions for Running the DTC

P0107

- DTCs P0120, P0121, P0122, P0123, P0220, P0221, P0222, P0223 or P0641 are not set
- The engine speed is between 400-6, 500 RPM.
- The throttle position is greater than or equal to 0% when the engine speed is less than or equal to 1, 000 RPM

or

- The throttle position is greater than or equal to 12.5% when the engine speed is greater than 1, 000 RPM.
- This DTC runs continuously when the above conditions are met.

P0108

- The engine has been running for a length of time that is determined by the start-up coolant temperature. The length of time ranges from 5.5 min at colder than -30Â°C (-22Â°F) to 10 s at greater than 30Â°C (+86Â°F).
- DTCs P0120, P0121, P0122, P0123, P0220, P0221, P0222, P0223 or P0641 are not set
- The throttle position is less than or equal to 1% when the engine speed is less than or equal to 1, 200 RPM.

or

- The throttle position is less than or equal to 20% when the engine speed is greater than 1, 200 RPM.
- This DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

P0107

The ECM detects that the MAP sensor voltage is less than 0.05 V for greater than 5 s.

P0108

The ECM detects that the MAP sensor voltage is more than 4.9 V for greater than 5 s.

Action Taken When the DTC Sets

DTCs P0107 and P0108 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0107 and P0108 are Type B DTCs.

Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LUY\)](#), [Engine Controls Schematics \(Chevrolet with LUY\)](#)

Connector End View Reference

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

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-23738-A Vacuum Pump

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

[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 [DTC P0641, P0651, P0697, or P06A3](#) for further diagnosis.
 - **If none of the DTCs are set**
3. Engine idling, verify the scan tool MAP voltage parameter is between 0.3 and 4.8 V and changes with accelerator pedal input.
 - **If not between 0.3 and 4.8 V or does not change**
Refer to Circuit/System Testing.
 - **If between 0.3 and 4.8 V and changes**
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 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, 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 B74 Manifold Absolute Pressure sensor.
2. Test for less than 2 Ω between the low reference circuit terminal 2 and ground.
 - **If 2 Ω or greater**
 1. Ignition OFF, disconnect the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If less than 2 Ω**
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 K20 Engine Control Module.

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

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

- **If greater than 5.2 V**
 1. Ignition OFF, disconnect the K20 Engine Control Module.
 2. Ignition ON, 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. Ignition ON, verify the scan tool MAP Sensor parameter is less than 0.5 V.
- **If 0.5 V or greater**
 1. Ignition OFF, disconnect the K20 Engine Control Module.
 - 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 0.5 V**
 6. Ignition OFF, install a 3 A fused jumper wire between the signal circuit terminal 3 and the 5 V reference circuit terminal 1.
 7. Ignition ON, verify the scan tool MAP voltage parameter is greater than 4.5 V.
 - **If 4.5 V or less**
 1. Ignition OFF, disconnect the K20 Engine Control Module.
 2. Remove the jumper wire, test for infinite resistance between the signal circuit terminal 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open or high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 4.5 V**
 8. Test or replace the B74 Manifold Absolute Pressure sensor.

Component Testing

NOTE: You must perform the Circuit/System Testing in order to Check the integrity of the MAP sensor circuits before proceeding with the Component Testing.

Skewed Sensor Test

1. Ignition OFF, remove the B74 Manifold Absolute Pressure sensor from the engine. Connect the harness to the sensor, if disconnected.
2. Ignition ON, apply 17 kPa (5.0 inHg) of vacuum to the B74 Manifold Absolute Pressure sensor, with the **GE-23738-A** Vacuum Pump. Verify the scan tool MAP pressure parameter decreases between 13 and 21 kPa (1.8 and 3.0 PSI).
 - **If the parameter does not decrease between 13 and 21 kPa (1.8 and 3.0 PSI).**

Replace the B74 Manifold Absolute Pressure sensor.

- If the parameter does decrease between 13 and 21 kPa (1.8 and 3.0 PSI).

3. Apply 34 kPa (10.0 inHg) of vacuum to the B74 Manifold Absolute Pressure sensor, with the **GE-23738-A** Vacuum Pump. Verify the scan tool MAP pressure parameter decreases between 30 and 38 kPa (4.4 and 5.5 PSI).

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

Replace the B74 Manifold Absolute Pressure sensor.

- If the parameter does decrease between 30 and 38 kPa (4.4 and 5.5 PSI).

4. All OK.

Erratic Signal Test

1. Ignition OFF, remove the B74 Manifold Absolute Pressure sensor and disconnect the harness.
2. Install a 3 A fused jumper wire between the 5 V reference circuit terminal 1 of the sensor and the sensor harness.
3. Install a jumper wire between the low reference circuit terminal 2 of the sensor and ground.
4. Install a jumper wire to the signal circuit terminal 3 of the sensor.
5. Connect a DMM between the jumper wire and ground.
6. Ignition ON, observe the DC voltage on the DMM. Slowly apply between 0 and 15kPa of vacuum to the sensor with the **GE-23738-A** Vacuum Pump. Verify the voltage changes, without any spikes or dropouts, between 0.2 and 4.9 V.

- If not between 0.2 and 4.9 V or has spikes or dropouts

Replace the B74 Manifold Absolute Pressure sensor.

- If between 0.2 and 4.9 V and there are no spikes or dropouts

7. All OK.

Repair Instructions

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

- [Manifold Absolute Pressure Sensor Replacement](#)
- [Control Module References](#) for Engine Control Module replacement, programming and setup

DTC P0112, P0113, OR P0114: INTAKE AIR TEMPERATURE (IAT) SENSOR

Diagnostic Instructions

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

DTC Descriptors

DTC P0112

Intake Air Temperature (IAT) Sensor Circuit Low Voltage

DTC P0113

Intake Air Temperature (IAT) Sensor Circuit High Voltage

DTC P0114

Intake Air Temperature (IAT) Sensor Circuit Intermittent

Diagnostic Fault Information

IAT Sensor 1

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Sensor	P0112, P0114, P2199**	P0113, P0114, P2199**	P0113*, P0114, P2199**	P0111**, P0114
Low Reference	-	P0097, P0113, P00F4**, P2227, P2229	*	-
*Internal ECM or sensor damage may occur if the circuit is shorted to B+. **Where used.				

Typical Scan Tool Data

IAT Sensor 1

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Operating Conditions: Engine Running Parameter Normal Range: Varies with ambient temperature			
Sensor	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+			

Circuit/System Description

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

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

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

The IAT sensor 1 produces an analog signal on pin-8 of the sensor. The IAT sensor 2 produces a frequency modulated signal on pin-1 of the sensor.

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

- IAT sensor 2
- Humidity sensor
- BARO pressure sensor

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

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

IAT Sensor 1 - Temperature, Resistance, Voltage Table

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

Conditions for Running the DTCs

P0112, P0113, and P0114

- The ignition is ON, or the engine is running.
- The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTCs

P0112

The ECM detects that the IAT sensor signal is warmer than 149°C (300°F) for at least 5 s.

P0113

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

The ECM detects that the IAT sensor signal is colder than -60°C (-76°F) for at least 5 s.

P0114

The ECM detects that the IAT sensor signal is intermittent or has abruptly changed for at least 5 s.

Action Taken When the DTCs Set

- DTCs P0112, P0113, and P0114 are Type B DTCs.
- The ECM commands the cooling fans ON.

Conditions for Clearing the DTCs

DTCs P0112, P0113, and P0114 are Type B DTCs.

Diagnostic Aids

With the ignition ON, when the engine is cold and not running, a properly functioning IAT sensor 1 will gradually increase the scan tool IAT Sensor 1 parameter. This is due to the heat that is generated by the multifunction intake air sensor internal heating elements.

Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LUV\)](#), [Engine Controls Schematics \(Chevrolet with LUV\)](#)

Connector End View Reference

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

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

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

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

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

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 25°C (45°F) of each other.
 - Start-Up IAT Sensor 1
 - IAT Sensor 2
 - IAT Sensor 3; where equipped
 - **If not within 25°C (45°F)**

Refer to Circuit/System Testing.

 - **If within 25°C (45°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 does set**

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 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 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 Ω**

3. Ignition ON, test for 4.8-5.2 V between 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 Ω in the signal circuit end to end.

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

- **If greater than 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**

4. 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 8 and ground.

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

3. Test for less than 2 Ω in the signal circuit end to end.

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

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

5. Ignition OFF, install a 3 A fused jumper wire between the signal circuit terminal 8 and the low reference circuit terminal 7.

6. 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 Ω in the signal circuit end to end.

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

- **If warmer than 148 $^{\circ}$ C (298 $^{\circ}$ F).**

7. 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.

- 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 \(Bosch Sensor\)](#), [Temperature Versus Resistance - Intake Air Temperature Sensor \(Delco Sensor\)](#) table for Bosch 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.

- All OK

Repair Instructions

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

- [Mass Airflow Sensor Replacement](#) for multifunction intake air sensor replacement
- [Control Module References](#) for Engine Control Module replacement, programming, and setup.

DTC P0117, P0118, OR P0119: ENGINE COOLANT TEMPERATURE (ECT) SENSOR

Diagnostic Instructions

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

DTC Descriptors

DTC P0117

Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage

DTC P0118

Engine Coolant Temperature (ECT) Sensor Circuit High Voltage

DTC P0119

Engine Coolant Temperature (ECT) Sensor Circuit Intermittent

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0117	P0118, P0119	P0118*, P0119	P0116, P0128
Low Reference	-	P0118, P0119	-	P0128

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

Typical Scan Tool Data

ECT Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine Running Parameter Normal Range: -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)	-

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 5 V to the ECT sensor signal circuit and a ground for the low reference circuit. This diagnostic checks for an open, short to ground or an intermittent circuit condition between the ECM and ECT sensor.

Conditions for Running the DTC

P0117

- The ignition is ON.

OR

- The engine is running.
- This DTC runs continuously within the enabling conditions.

P0118

- The ignition is ON.

OR

- The engine is running for greater than 15 s.

OR

- The engine run time is less than 15 s when the IAT is warmer than -7°C (19°F).
- This DTC runs continuously within the enabling conditions.

P0119

- No active DTCs set.
- The ignition is ON.
- This DTC runs continuously within the enabling conditions.

Conditions for Setting the DTC

P0117

The ECM detects that the ECT is warmer than 149°C (300°F) for greater than 5 s.

P0118

The ECM detects that the ECT is colder than -39°C (-38°F) for greater than 5 s.

P0119

The ECM detects that the ECT is intermittent or has abruptly changed for greater than 3 seconds.

Action Taken When the DTC Sets

- DTC P0117, P0118 or P0119 are a Type B DTC.
- The cooling fans will be commanded ON.
- The Engine Coolant Temperature Gauge is inoperative.
- The AC compressor will be commanded OFF.

Conditions for Clearing the DTC

DTC P0117, P0118 or P0119 are a Type B DTC.

Reference Information

Schematic Reference

Connector End View Reference

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

Description and Operation

[Cooling System Description and Operation \(LUV, LE2\)](#), [Cooling System Description and Operation \(2HO\)](#)

Electrical Information Reference

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

DTC Type Reference

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

Scan Tool Reference

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

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool ECT Sensor parameter is warmer than -40°C (-40°F) and colder than 150°C (302°F) and changes with engine run time.
 - **If colder than -39°C (-38°F) or warmer than 149°C (300°F) or does not change**
Refer to Circuit/System Testing.
 - **If warmer than -40°C (-40°F) and colder than 150°C (302°F) and changes**
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 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°C (-38°F).
 - **If warmer than -39°C (-38°F)**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal B or 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **If colder than -39°C (-38°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°C (300°F).
 - **If 149°C (300°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°C (300°F)**
7. Test or replace the B34 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.

- Engine Coolant Temperature Sensor Replacement (Water Outlet), Engine Coolant Temperature Sensor Replacement (Radiator).
- Engine Control Module Replacement engine control module replacement, programming, and setup

DTC P0121-P0123, P0222, P0223, OR P2135: THROTTLE 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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0121

Throttle Position Sensor 1 Performance

DTC P0122

Throttle Position Sensor 1 Circuit Low Voltage

DTC P0123

Throttle Position Sensor 1 Circuit High Voltage

DTC P0222

Throttle Position Sensor 2 Circuit Low Voltage

DTC P0223

Throttle Position Sensor 2 Circuit High Voltage

DTC P2135

Throttle Position Sensors 1-2 Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
5 V Reference	P06A3	P2135	P0122, P0222	P06A3, P2135	P0068, P0121
Throttle Position Sensor 1 Signal	P0122	P2135	P0122	P0123	P0068, P0121
Throttle Position Sensor 2 Signal	P0222	P2135	P0223	P0223	P0068, P0121
Low Reference	-	P2135	P0123, P0223	-	P0068, P0121

Typical Scan Tool Data

Throttle Position Sensor 1

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine running at various operating conditions Normal Range: 4.75-0.35 V			
5 V Reference	0 V	0 V	5 V
Throttle Position Sensor 1 Signal	0 V	0 V	5 V
Low Reference	-	4-5 V	-

Throttle Position Sensor 2

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine running at various operating conditions Parameter Normal Range: 0.35-4.65 V			
5 V Reference	0 V	0 V	5 V
Throttle Position Sensor 2 Signal	0 V	5 V	5 V
Low Reference	-	5 V	-

Circuit/System Description

The throttle body assembly contains 2 throttle position sensors. The throttle position sensors are mounted to the throttle body assembly and are not serviceable. The throttle position sensors provide a signal voltage that changes relative to throttle blade angle. The engine control module (ECM) supplies the throttle position sensors with a common 5 V reference circuit, a common low reference circuit, and two independent signal circuits.

The throttle position sensors have opposite functionality. throttle position sensor 1 signal voltage decreases and throttle position sensor 2 signal voltage increases as the accelerator pedal increases to wide open throttle (WOT).

Conditions for Running the DTC

P0122, P0123, P0222, and P0223

- DTC P06A3 is not set.
- The run/crank or powertrain relay voltage is greater than 6 V and reduced power is not active.
- The ignition is ON or the engine is operating.
- DTC P0122, P0123, P0222, P0223 run continuously when the above conditions are met.

P0121

- No Active or Pending DTCs.
- The engine speed is between 400-7, 000 RPM.
- The engine coolant temperature (ECT) is between -7 to +125Â°C (19-257Â°F).
- The intake air temperature (IAT) is between -20 to +125Â°C (-4 to +257Â°F).
- DTC P0121 runs continuously when the above conditions are met.

P2135

- DTC P0122, P0123, P0222, P0223, or P06A3 is not set.
- The run/crank or powertrain relay voltage is greater than 6 V and reduced power is not active.
- The ignition is ON or the engine is operating.
- DTC P2135 runs continuously when the above conditions are met.

Conditions for Setting the DTC

P0121

The ECM detects the throttle position sensor is stuck within range for greater than 1 s.

P0122

The ECM detects the throttle position sensor 1 voltage is less than 0.325 V for greater than 1 s.

P0123

The ECM detects the throttle position sensor 1 voltage is greater than 4.75 V for greater than 1 s.

P0222

The ECM detects that the throttle position sensor 2 voltage is less than 0.25 V for greater than 1 s.

P0223

The ECM detects the throttle position sensor 2 voltage is greater than 4.59 V for greater than 1 s.

P2135

The ECM detects the difference between the throttle position sensor 1 and throttle position sensor 2 exceeds a predetermined value for greater than 1 s.

Action Taken When the DTC Sets

- DTC P0122, P0123, P0222, P0223, and P2135 are Type A DTCs.
- DTC P0121 is a Type B DTC.
- The ECM commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- DTCs P0122, P0123, P0222, P0223, and P2135 are Type A DTCs.
- DTC P0121 is a Type B DTC.

Diagnostic Aids

- A high resistance condition on the throttle position and throttle actuator control circuits could cause a DTC to set.
- If the accelerator pedal is pressed to the wide open throttle position, the throttle blade angle or Throttle Position angle is limited to less than 40 percent.

Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LUY\)](#), [Engine Controls Schematics \(Chevrolet with LUY\)](#)

Connector End View Reference

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

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. If you were sent here from DTC P0068, P0101, P0106, or P1101 refer to Circuit/System Testing.
3. Verify that DTC P0641, P0651, P0697, or P06A3 is not set.
 - **If any of the DTCs are set**

Refer to [DTC P0641, P0651, P0697, or P06A3](#) for further diagnosis.
 - **If none of the DTCs are set**
4. Verify the scan tool Throttle Body Idle Airflow Compensation parameter is less than 90 %.

- **90 % or greater**

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

- **If less than 90 %**

5. Verify the scan tool Throttle Position Sensor 1 and Throttle Position Sensor 2 voltage parameters are between 1.0-4.0 V and change with accelerator pedal input.

- **If not between 1.0-4.0 V or does not change**

Refer to Circuit/System Testing

- **If between 1.0-4.0 V and changes**

6. Verify the scan tool Throttle Position Sensor 1 and 2 Agree/Disagree parameter displays Agree while performing the Throttle Sweep Test with a scan tool.

- **If Disagree**

Refer to Circuit/System Testing

- **If Agree**

7. Determine the current vehicle testing altitude.

8. Verify the scan tool MAP Sensor pressure parameter is within range specified in the [Altitude Versus Barometric Pressure](#) table.

- **The MAP Sensor pressure is not in range**

Refer to [DTC P0106](#).

- **The MAP Sensor pressure is within range**

9. Engine idling.

10. Verify the scan tool MAP Sensor pressure parameter is between 26-52 kPa (3.8-7.5 psi) and changes with accelerator pedal input.

- **If not between 26-52 kPa (3.8-7.5 psi) or does not change**

Refer to [DTC P0106](#).

- **If between 26-52 kPa (3.8-7.5 psi) and changes**

11. Verify the scan tool MAF Sensor g/s parameter changes smoothly and gradually as the engine speed is increased and decreased while performing the actions listed below.

1. Engine idling
2. Perform the scan tool snapshot function.
3. Increase the engine speed slowly to 3, 000 RPM and then back to idle.
4. Exit from the scan tool snapshot and review the data.
5. Observe the MAF Sensor parameter frame by frame with a scan tool.

- **The MAF Sensor parameter does not change smoothly and gradually**

Refer to [DTC P0101](#).

- **The MAF Sensor parameter changes smoothly and gradually**

12. Verify the scan tool Boost Pressure Sensor pressure and BARO parameters are within 3 kPa (0.4 psi).

- **The parameters are not within 3 kPa (0.4 psi)**

Refer to [DTC P0236](#).

- **The parameters are within 3 kPa (0.4 psi)**

13. Verify the scan tool MAP Sensor parameter and the Boost Pressure Sensor parameter are within 20 kPa (2.9 psi) during a WOT acceleration at the time of the 1-2 shift.

- **The parameters are not within 20 kPa (2.9 psi)**

- **The parameters are within 20 kPa (2.9 psi)**

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

15. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing

- **If the DTC does not set**

16. All OK

Circuit/System Testing

NOTE: **Disconnecting the throttle body harness connector causes additional DTCs to set.**

1. Ignition OFF, and all vehicle systems OFF, disconnect the harness connector at Q38 Throttle Body. It may take up to 2 minutes for all vehicle systems to power down.

2. Test for less than 5 Ω between the low reference circuit terminal C and ground.

- **If 5 Ω or greater**

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

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

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

- **If less than 5 Ω**

3. Ignition ON.

4. Test for 4.8-5.2 V between the 5 V reference circuit terminal E 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 Ω in the 5 V reference circuit end to end.

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

- **If greater than 5.2 V**

1. Ignition OFF, 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. Ignition ON.

6. Test for less than 1 V between the throttle position sensor 1 signal circuit terminal D and ground.

- **If 1.0 V or greater**

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

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

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

- **If 1.0 V or less**

7. Install a 3 A fused jumper wire between throttle position sensor 1 signal circuit terminal D and the 5 V reference circuit terminal E.
8. Verify the scan tool throttle position sensor 1 voltage parameter is greater than 4.8 V.
 - **If 4.8 V or less**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If 4.8 or greater**
9. Test for 4.8-5.2 V between the throttle position sensor 2 signal circuit terminal F 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 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 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**
10. Test or replace the Q38 Throttle Body.

Repair Instructions

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

Repair Verification

1. Install any components that have been removed or replaced during diagnosis.
2. Perform any adjustments, programming or setup procedures that are required when a component is removed or replaced.
3. Clear the DTCs with a scan tool.
4. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
5. Ignition ON.
6. Verify the Throttle Position Sensors 1 and 2 Agree/Disagree parameter displays Agree while performing the Throttle Sweep Test with a scan tool.
 - **If Disagree**

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

- If DTC sets

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

- If DTC does not set

8. All OK

DTC P0128: ENGINE COOLANT TEMPERATURE (ECT) BELOW THERMOSTAT REGULATING TEMPERATURE

Diagnostic Instructions

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

DTC Descriptor

DTC P0128

Engine Coolant Temperature (ECT) Below Thermostat Regulating Temperature

Diagnostic Fault Information

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

Typical Scan Tool Data

ECT Sensor Temperature

Circuit	Short to Ground	Open	Short to Voltage
Parameter Normal Range: -39 to +139Â°C (-38 to +282Â°F)			
ECT Sensor 1 Signal	140Â°C (284Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)
Low Reference	-	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)

Circuit/System Description

NOTE: The engine coolant temperature sensor is referred to as B34A Engine Coolant Temperature Sensor 1 in schematics and other areas.

The engine control module (ECM) monitors the temperature of the engine coolant for engine control and enabling criteria for some diagnostics. The amount of air flow into an engine is proportional to the amount of heat an engine generates. The ECM monitors the amount of air flow into the engine to calculate engine coolant temperature (ECT). The ECM uses the calculated temperature to determine if the engine has warmed up to the thermostat regulating temperature. If the ECT does not increase normally or does not reach the thermostat regulating temperature, diagnostics that use the ECT as enabling criteria, may not run when expected. If the ECT fails to reach the thermostat regulating temperature, before a predetermined amount of air flow enters the engine, the DTC sets.

Conditions for Running the DTC

- DTCs P00B3, P00B6, P0101, P0102, P0103, P0111, P0112, P0113, P0116, P0117 or P0118 are not set.
- The engine OFF time is greater than 30 min.
- The start-up ECT sensor is between -40Â° to 74Â°C (-40Â° to 165Â°F).
- Commanded Thermostat Heater duty cycle is less than 20%.
- Engine run time between 30 s and 30 m.
- The Ethanol in the fuel is less than 87 %.

- The vehicle has traveled greater than 1 kilometer (0.6 miles).
- The DTC runs once per ignition cycle when the above conditions are met.

Conditions for Setting the DTC

- The ECM determines that the modeled ECT has met the calibrated target of 79Â° C (174 Â°F) and the measured ECT is less than 53Â° C (127Â° F) and the start-up ambient temperature is between 10Â° and 52Â° C (50Â° and 126Â° F), for greater than 1 s.

OR

- The ECM determines that the modeled ECT has met the calibrated target of 59Â° C (138 Â°F) and the measured ECT is less than 13Â° C (55Â° F) and the start-up ambient temperature is between -7Â° and 10Â° C (19Â° and 50Â° F), for greater than 1 s.

Action Taken When the DTC Sets

DTC P0128 is a Type B DTC.

Conditions for Clearing the DTC

DTC P0128 is a Type B DTC.

Diagnostic Aids

- DTC P0128 occurring with insufficient vehicle interior heating is an indication of improper thermostat operation.
- Corrosion in the ECT sensor terminals or the ECT harness connector results in a greater voltage on the ECT sensor signal circuit, which is interpreted by the ECM as a colder ECT.
- A slight to moderate resistance in the ECT sensor signal circuit or low reference circuit will affect this diagnostic. This condition results in a greater voltage on the ECT sensor signal circuit, which is interpreted by the ECM as a colder ECT.

Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LUY\)](#), [Engine Controls Schematics \(Chevrolet with LUY\)](#)

Connector End View Reference

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

Description and Operation

[Cooling System Description and Operation \(LUY, LE2\)](#), [Cooling System Description and Operation \(2HQ\)](#)

Electrical Information Reference

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

DTC Type Reference

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

Scan Tool Reference

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

Circuit/System Verification

1. Verify the DTC P00B7, P0116, P0117, P0118, P0597, P0598, or P0599 is not set.
 - **If a DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)
 - **If a DTC is not set**
2. Verify the cooling system is filled to the correct coolant level. Refer to [Cooling System Draining and Filling](#) , and [Loss of Coolant](#) .
 - **If the coolant level is not correct**

Repair as necessary
 - **If the coolant level is correct**
3. Engine running for 15 min with the A/C OFF, increase the engine speed to 3, 000 RPM.
4. Verify the scan tool ECT Sensor parameter is greater than 79Â°C (174Â°F) when commanding the Engine Coolant Thermostat Heater to 0%.
 - **If less than 79Â°C (174Â°F)**

Replace the Engine Coolant Thermostat.
 - **If greater than 79Â°C (174Â°F)**
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 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 Ω between the low reference circuit terminal A or 2 and ground.
 - **If 5 Ω or greater**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If less than 5 Ω**
3. Ignition ON.
4. Verify the scan tool ECT Sensor parameter is colder than -39Â°C (-38Â°F).
 - **If warmer than -39Â°C (-38Â°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, replace the K20 Engine Control Module.
 - **If colder than -39Â°C (-38Â°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 139Â°C (282Â°F).

- **If 139Â° C (282Â° 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 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω, replace the K20 Engine Control Module.
- **If warmer than 139Â° C (282Â° F)**
7. Test the B34 Engine Coolant Temperature Sensor.

Refer to Component Testing.

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. Refer to [Thermostat Diagnosis](#).

Repair Instructions

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

- [Engine Coolant Temperature Sensor Replacement \(Water Outlet\)](#), [Engine Coolant Temperature Sensor Replacement \(Radiator\)](#).
- [Engine Coolant Thermostat Replacement \(2H0\)](#), [Engine Coolant Thermostat Replacement \(LUV\)](#).
- [Control Module References](#) for engine control module replacement, programming and setup.

DTC P0131, P0132, P0134, P0137, P0138, OR P0140: HO2S 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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0131

HO2S Circuit Low Voltage Sensor 1

DTC P0132

DTC P0134

HO2S Circuit Insufficient Activity Sensor 1

DTC P0137

HO2S Circuit Low Voltage Sensor 2

DTC P0138

HO2S Circuit High Voltage Sensor 2

DTC P0140

HO2S Circuit Insufficient Activity Sensor 2

Diagnostic Fault Information**HO2S 1 or 2**

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
HO2S High Signal	P0131, P0137	P0132, P0134, P0138, P0140	P0132, P0134, P0138, P0140	P0133, P1133
HO2S Low Signal	P0131, P0137, P0171	P0132, P0134, P0138, P0140	P0132, P0134, P0138, P0140	P0133, P1133

Typical Scan Tool Data**HO2S 1 or 2**

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine operating in Closed Loop Parameter Normal Range: 200-800 mV			
High Signal	0 mV	HO2S1 1, 700-2, 100 mV HO2S 2 1, 000-1, 200 mV	HO2S1 1, 700-2, 100 mV HO2S 2 1, 000-1, 200 mV
Low Signal	-	HO2S1 1, 700-2, 100 mV HO2S 2 1, 000-1, 200 mV	HO2S1 1, 700-2, 100 mV HO2S 2 1, 000-1, 200 mV

Circuit/System Description

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

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

Conditions for Running the DTC**DTC P0131 or P0137**

- DTCs P0068, P0106, P0107, P0108, P0122, P0123, P0178, P0179, P0201-P0204, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0411, P0442, P0443, P0446, P0449, P0452, P0453, P0455, P0496, P0498, P0499, P1104, P1248, P1249, P124A, P124B, P16A0, P16A1, P16A2, P16F3, P2100, P2101, P2102, P2103, P2135, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P2440, P2444, P2269 are not set.
- The engine is in Closed Loop status.
- The system voltage is greater than 10 V.
- The scan tool device controls are not active.
- Deceleration fuel cut off not active.
- Fuel composition is less than or equal to 87 percent ethanol.
- DTCs P0131 and P0137 run continuously when the above conditions are met for 5 s.

DTC P0132 or P0138

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0122, P0123, P0178, P0179, P0201-P0204, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0411, P0442, P0455, P0458, P0496, P1104, P1248, P1249, P124A, P124B, P16A0, P16A1, P16A2, P16F3, P2100, P2101, P2102, P2103, P2135, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P2440, P2444, P2269 are not set.
- The system voltage is greater than 10 V.
- The fuel level is greater than 10 percent.
- Engine run time greater than 2.5 min plus a 30 s delay.
- Fuel control is not in power enrichment.
- Fuel composition is less than or equal to 87 percent ethanol.
- DTCs P0132 and P0138 run continuously when the above conditions are met for 9 s.

DTC P0134 or P0140

- DTCs P0068, P0101, P0102, P0103, P0122, P0123, P0178, P0179, P0222, P0223, P1104, P16F3, P2100, P2101, P2102, P2103, P2135, P2269 are not set.
- The system voltage is greater than 10 V.
- Engine run time greater than 2.5 minutes.
- Fuel composition is less than or equal to 87 percent ethanol.
- DTCs P0134 and P0140 run continuously when the above conditions are met for greater than 25 s.

Conditions for Setting the DTC

P0131 or P0137

The engine control module (ECM) detects that the heated oxygen sensor (HO2S) voltage is less than 50 mV for greater than 50 s.

P0132 or P0138

The ECM detects that the heated oxygen sensor (HO2S) voltage is greater than 1 050 mV for greater than 15 s.

P0134 or P0140

The ECM detects that the heated oxygen sensor (HO2S) voltage is greater than 1 700 mV for greater than 100 s.

Action Taken When the DTC Sets

DTCs P0131, P0132, P0134, P0137, P0138 and P0140 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0131, P0132, P0134, P0137, P0138 and P0140 are Type B DTCs.

Schematic Reference

[Engine Controls Schematics \(Buick with LUV\)](#), [Engine Controls Schematics \(Chevrolet with LUV\)](#)

Connector End View Reference

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

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 HO2S heater DTCs are set.
 - **If a DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If a DTC is not set**
3. Engine warm and running. HO2S Heater Command Sensor 2 greater than 30%.
4. Verify the scan tool HO2S 1 or 2 parameters are between 50-1, 050 mV.
 - **If not between 50-1, 050 mV**

Refer to Circuit/System Testing.
 - **If between 50-1, 050 mV**
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 appropriate B52 Heated Oxygen Sensor harness connector. It may take up to 2 minutes for all vehicle systems to power down. Ignition ON.
2. Test for 1.7-3.0 V between the high signal circuit terminal 4 and ground.
 - **If less than 1.7 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 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 Ω in the high signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
- **If greater than 3 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 terminal 4 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
- **If between 1.7-3.0 V**
3. Verify the scan tool HO2S 1 parameter is between 1.7-3.0 V and HO2S 2 parameter is between 1.0-3.0 V.
 - **If less than the specified range**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module. Ignition ON.
 2. Test for infinite resistance between the low signal circuit terminal 3 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 within the specified range**
4. Connect a 3 A fused jumper wire between the high signal circuit terminal 4 and the low signal circuit terminal 3.

NOTE: The low signal circuit is tied to a pull-up circuit within the engine control module. A voltage of 0.0-1.1 V on the low signal circuit is normal.

5. Verify the scan tool HO2S 1 or 2 parameter displays 0.0 V.
 - **If greater than 0.0 V**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module. Ignition ON.
 2. Test for less than 2 Ω in the low signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω
 3. Test for less than 1 V between the low signal circuit terminal 3 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 0.0 V**
6. Verify none of the conditions listed below exist:
 - Water intrusion in the B52 HO2S harness connector
 - Low or high fuel system pressure-Refer to [Fuel System Diagnosis \(LUV\)](#) .
 - Fuel that is contaminated-Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#) .
 - Fuel saturation of the evaporative emission (EVAP) canister
 - Exhaust leaks
 - Engine vacuum leaks
 - **If any of the conditions exist**

Repair as necessary.
 - **If none of the conditions exist**

7. Test or replace the B52 Heated Oxygen Sensor.

Repair Instructions

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

- [Heated Oxygen Sensor Replacement - Sensor 1](#)
- [Heated Oxygen Sensor Replacement - Sensor 2](#)
- Perform the scan tool Heated Oxygen Sensor Resistance Learn Reset after replacing an HO2S.
- [Control Module References](#) for ECM replacement, programming and setup

DTC P0133, P013A, P013B, P013E, P013F, P015A, P015B, P2270, OR P2271: HO2S

Diagnostic Instructions

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

DTC Descriptors

DTC P0133

HO2S Slow Response Sensor 1

DTC P013A

HO2S Slow Response Rich to Lean Sensor 2

DTC P013B

HO2S Slow Response Lean to Rich Sensor 2

DTC P013E

HO2S Delayed Response Rich to Lean Sensor 2

DTC P013F

HO2S Delayed Response Lean to Rich Sensor 2

DTC P015A

HO2S Delayed Response Rich to Lean Sensor 1

DTC P015B

HO2S Delayed Response Lean to Rich Sensor 1

DTC P2270

HO2S Signal Stuck Lean Sensor 2

DTC P2271

HO2S Signal Stuck Rich Sensor 2

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
HO2S High Signal	P0131, P0137	P0132, P0134, P0138, P0140	P0132, P0134, P0138, P0140	P0133, P013A, P013B, P013E, P013F, P015A, P015B
HO2S Low Signal	P0137	P0132, P0134, P0138, P0140	P0132, P0134, P0138, P0140	P0133, P013A, P013B, P013E, P013F, P015A, P015B

Typical Scan Tool Data

HO2S 1 or 2

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine operating in Closed Loop Parameter Normal Range: 200-800 mV			
HO2S 1 or 2 Signal	0 mV	1 700-2 100 mV	1 700-2 100 mV
HO2S 1 or 2 Low Signal	-	1 700-2 100 mV	1 700-2 100 mV

Circuit/System Description

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

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

Conditions for Running the DTC

P0133

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0122, P0123, P0128, P0131, P0132, P0134, P0201-P0204, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0300-P0304, P0411, P0442, P0443, P0446, P0449, P0452, P0453, P0455, P0458, P0459, P0496, P0498, P0499, P1248, P1249, P124A, P124B, P16A0, P16A1, P16A2, P16F3, P2101, P2135, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P2227, P2228, P2229, P2230, P2269, P2440, P2444 are not set.
- The engine coolant temperature (ECT) is hotter than 50°C (122°F).
- The Ignition voltage is greater than 10 V.
- The fuel level is greater than 10 percent.
- The engine run time is greater than 30 s.
- The engine speed is between 1, 000-3, 000 RPM.
- The device controls are not active.
- The HO2S heaters have been ON for greater than 40 s.
- The intake air temperature (IAT) is warmer than -40°C (-40°F).
- The fuel composition is less than 87 percent ethanol.
- The barometric pressure is greater than 70 kPa.
- The fuel control is not in power enrichment.
- Decel fuel cut-off is not active.
- The Mass Airflow (MAF) Sensor parameter is between 15-55 g/s.

- The fuel state is in Closed Loop.
- DTCs P0133 runs once per drive cycle when the above conditions are met for 3 s.

P013A

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0122, P0123, P0128, P013B, P013E, P013F, P0171, P0172, P0178, P0179, P0201-P0204, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0300-P0304, P0411, P1248, P1249, P124A, P124B, P16F3, P16A0, P16A1, P16A2, P2101, P2102, P2103, P2135, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P2269, P2270, P2271, P2440, P2444 are not set.
- The system voltage is greater than 10 V.
- The fuel level is greater than 10 percent.
- DTC P013E, P2270, and P2271 have run and passed.
- Decel fuel cut off is active.
- The accelerator pedal position (APP) is stable.
- This DTC runs once per trip.

P013B

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0122, P0123, P0128, P0171, P0172, P0178, P0179, P0201-P0204, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0300-P0304, P0411, P1248, P1249, P124A, P124B, P16F3, P16A0, P16A1, P16A2, P2101, P2135, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P2269, P2440, P2444 are not set.
- The system voltage is greater than 10 V.
- The fuel level is greater than 10 percent.
- DTCs P013A, P013E, P013F, P2270, and P2271 have run and passed.
- This DTC runs once per trip.

P013E

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0122, P0123, P0128, P013A, P013B, P013F, P0171, P0172, P0178, P0179, P0201-P0204, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0300-P0304, P0411, P1248, P1249, P124A, P124B, P16F3, P16A0, P16A1, P16A2, P2101, P2135, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P2269, P2270, P2271, P2440, P2444 are not set.
- The system voltage is greater than 10 V.
- The fuel level is greater than 10 percent.
- DTC P2270 has run and passed.
- Decel fuel cut off is active.
- The accelerator pedal position (APP) is stable.
- This DTC runs once per trip.

P013F

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0122, P0123, P0128, P013A, P013B, P013E, P0171, P0172, P0178, P0179, P0201-P0204, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0300-P0304, P0411, P1248, P1249, P124A, P124B, P16F3, P16A0, P16A1, P16A2, P2101, P2135, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P2269, P2270, P2271, P2440, P2444 are not set.
- The system voltage is greater than 10 V.
- The fuel level is greater than 10 percent.
- DTCs P013A, P013E, P2270, and P2271 have run and passed.
- This DTC runs once per trip.

P015A

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0122, P0123, P0128, P0131, P0132, P013A, P013B, P013E, P013F, P0171, P0172, P0178, P0179, P0201-P0204, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0300-P0304, P0411, P0442, P0443, P0446, P0449, P0452, P0453, P0455, P0458, P0459, P0496, P0498, P0499, P1248, P1249, P124A, P124B, P16F3, P16A0, P16A1, P16A2, P2101, P2102, P2103, P2135, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P2227, P2228, P2229, P2230, P2269, P2270, P2271, P2440, P2444 are not set.
- The ignition voltage is greater than 10 V.
- The engine coolant temperature (ECT) is greater than 50°C (122°F).
- The intake air temperature (IAT) is warmer than -40°C (-40°F)
- The barometric pressure is greater than 70 kPa.
- The HO2S1 and HO2S2 heaters are on for greater than 60 s.
- The fuel level is greater than 10 percent.
- The engine run time is greater than 30 s.
- The engine speed is between 850-2, 500 RPM to enable and 800-2, 550 RPM to keep enabled.
- The vehicle speed is 68-129 km/h (42-80 mph) to enable and 62-132 km/h (39-82 mph) to keep enabled.
- The engine airflow is between 4-11.5 g/s.
- Device controls are not active.
- The evaporative emission (EVAP) diagnostics are not in control of purge.
- The predicted catalytic converter temperature is between 575-980°C (1, 067-1, 796°F).
- The fuel system is in Closed Loop.
- The DTC runs once per drive cycle when the above conditions are met.

P015B

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0122, P0123, P0128, P0131, P0132, P013A, P013B, P013E, P013F, P015A, P0171, P0172, P0178, P0179, P0201-P0204, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0300-P0304, P0411, P0442, P0443, P0446, P0449, P0452, P0453, P0455, P0458, P0459, P0496, P0498, P0499, P1248, P1249, P124A, P124B, P16F3, P16A0, P16A1, P16A2, P2101, P2102, P2103, P2135, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P2227, P2228, P2229, P2230, P2269, P2270, P2271, P2440, P2444 are not set.
- The ignition voltage is greater than 10 V.
- The engine coolant temperature (ECT) is greater than 50°C (122°F).
- The intake air temperature (IAT) is warmer than -40°C (-40°F)
- The barometric pressure is greater than 70 kPa.
- The HO2S1 and HO2S2 heaters are on for greater than 60 s.
- The fuel level is greater than 10 percent.
- The engine run time is greater than 30 s.
- The engine speed is between 850-2, 500 RPM to enable and 800-2, 550 RPM to keep enabled.
- The vehicle speed is 68-129 km/h (42-80 mph) to enable and 62-132 km/h (39-82 mph) to keep enabled.
- The engine airflow is between 4-11.5 g/s.
- DTC P015A has run and passed.
- Device controls are not active.
- The evaporative emission (EVAP) diagnostics are not in control of purge.
- The predicted catalytic converter temperature is between 575-980°C (1, 067-1, 796°F).
- The fuel system is in Closed Loop.
- The DTC runs once per drive cycle when the above conditions are met.

P2270

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0122, P0123, P0128, P013A, P013B, P013E, P013F, P0171, P0172, P0178, P0179, P0201-P0204, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0300-P0304, P0411, P1248, P1249, P124A, P124B, P16F3, P16A0, P16A1, P16A2, P2101, P2102, P2103, P2135, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P2269, P2271, P2440, P2444 are not set.
- The ignition voltage is greater than 10 V.
- The fuel level is greater than 10 percent.
- The engine speed is between 850-2, 500 RPM to enable and 800-2, 550 RPM to keep enabled.
- The engine airflow is between 4-11.5 g/s.
- The vehicle speed is 68-129 km/h (42-80 mph) to enable and 62-132 km/h (39-82 mph) to keep enabled.
- The engine is in Closed Loop status.
- The HO2S heaters are on for more than 60 s.
- The evaporative emission (EVAP) diagnostics are not in control of purge.
- The predicted catalytic converter temperature is between 575-980°C (1, 067-1, 796°F).
- This DTC runs once per trip when all of the above conditions have been met for 2 s.

P2271

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0122, P0123, P0128, P013A, P013B, P013E, P013F, P0171, P0172, P0178, P0179, P0201-P0204, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0300-P0304, P0411, P1248, P1249, P124A, P124B, P16F3, P16A0, P16A1, P16A2, P2101, P2102, P2103, P2135, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P2269, P2270, P2440, P2444 are not set.
- The ignition voltage is greater than 10 V.
- The fuel level is greater than 10 percent.
- The engine is in Closed Loop status.
- DTCs P013A, P013E, and P2270 have run and passed.
- Decel fuel cut off is active.
- The accelerator pedal position (APP) is stable.
- This DTC runs once per trip when the above conditions are met.

Conditions for Setting the DTC

P0133

- The ECM detects that the HO2S 1 average response time is more than a calculated value.
- DTC P0133 sets within 60 s when the above condition is met.

P013A

The ECM detects that the HO2S 2 average response time during the rich to lean transition is greater than a calculated value.

P013B

The ECM detects that the HO2S 2 average response time during the lean to rich transition is greater than a calculated value.

P013E

The ECM detects that the HO2S 2 sensor cannot achieve voltage below 450 mV within a calibrated time.

P013F

The ECM detects that the HO2S sensor cannot achieve voltage above 350 mV within a calibrated time.

P015A

The ECM detects that the length of time to change from rich to lean is greater than a calibrated value.

P015B

The ECM detects that the length of time to change from lean to rich is greater than a calibrated value.

P2270

The ECM detects that the HO2S 2 sensor cannot achieve a voltage greater than 800 mV within a calibrated time.

P2271

The ECM detects that the HO2S 2 sensor cannot achieve a voltage less than 100 mV within a calibrated time.

Action Taken When the DTC Sets

- DTCs P0133, P013E, P013F, P2270, and P2271 are Type B DTCs.
- DTCs P013A, P013B, P015A, and P015B are Type A DTCs.

Conditions for Clearing the DTC

- DTCs P0133, P013E, P013F, P2270, and P2271 are Type B DTCs.
- DTCs P013A, P013B, P015A, and P015B are Type A DTCs.

Reference Information

Schematic Reference

Engine Controls Schematics (Buick with LUY). Engine Controls Schematics (Chevrolet with LUY).

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX (ENCORE). COMPONENT CONNECTOR END VIEWS - INDEX (TRAX).

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 HO2S heater DTCs are set
 - **If a HO2S heater DTC is set**

Refer to [DTC P0131, P0132, P0134, P0137, P0138, or P0140](#).

- **If no HO2S heater DTC is set**

3. Allow the engine to reach operating temperature, engine running.

4. Verify the scan tool HO2S Sensor 1 or 2 voltage parameters are between 50-1 050 mV.

- **If not between 50-1 050 mV**

Refer to [DTC P0131, P0132, P0134, P0137, P0138, or P0140](#).

- **If between 50-1 050 mV**

5. Verify none of the following conditions exist:

- Lean or rich fuel injectors
- Water intrusion in the HO2S harness connector
- Low or high fuel system pressure-Refer to [Fuel System Diagnosis \(LUV\)](#) .
- Fuel that is contaminated-Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#) .
- Fuel saturation of the evaporative emission (EVAP) canister
- Exhaust leaks
- Engine vacuum leaks
- Engine oil consumptions-Refer to [Symptoms - Engine Cooling](#) .
- Engine coolant consumption-Refer to [Symptoms - Engine Cooling](#) .
- **If any of the above conditions exist**

Repair as necessary.

- **If none of the above conditions exist**

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**

Replace the B52 Heated Oxygen Sensor.

- **If the DTC does not set**

8. All OK.

Repair Instructions

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

- [Heated Oxygen Sensor Replacement - Sensor 1](#)
- [Heated Oxygen Sensor Replacement - Sensor 2](#)
- Perform the scan tool Heated Oxygen Sensor Resistance Learn Reset after replacing a HO2S.
- [Control Module References](#) for ECM replacement, programming and setup

DTC P0171 OR P0172: FUEL TRIM 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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0171

Fuel Trim System Lean

Fuel Trim System Rich**Circuit/System Description**

The engine control module (ECM) controls a Closed Loop air/fuel metering system in order to provide the best possible combination of driveability, fuel economy, and emission control. The ECM monitors the heated oxygen sensor (HO2S) signal voltage, and adjusts the fuel delivery based on the signal voltage while in Closed Loop. A change made to the fuel delivery changes the long and short term fuel trim values. The short term fuel trim values change rapidly in response to the HO2S signal voltages. These changes fine tune the engine fueling. The long term fuel trim values change in response to trends in the short term fuel trim. The long term fuel trim makes coarse adjustments to fueling in order to re-center and restore control to short term fuel trim. The ideal fuel trim values are around 0 %. A positive fuel trim value indicates that the ECM is adding fuel in order to compensate for a lean condition. A negative fuel trim value indicates that the ECM is reducing the amount of fuel in order to compensate for a rich condition.

Conditions for Running the DTC

- DTCs P0030, P0053, P0101, P0102, P0103, P0106, P0107, P0108, P0131-P0135, P015A, P015B, P0178, P0179, P0201-P0204, P0236, P0237, P0238, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0300-P0304, P0411, P0442, P0455, P0458, P0496, P0506, P0507, P1248, P1249, P124A, P124B, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P2227, P2228, P2229, P2230, P2269, P2440, P2444, or P2A00 are not set.
- The engine is in Closed Loop status.
- The catalyst monitor diagnostic intrusive test, post 02 diagnostic intrusive test, device control, and evaporative emission leak test are not active.
- The engine coolant temperature (ECT) is between -20 and +150°C (-4 and +302°F).
- The intake air temperature (IAT) is between -20 and +150°C (-4 and +302°F).
- The manifold absolute pressure (MAP) is between 5-255 kPa (0.7-37 psi).
- The engine speed is between 400-6, 600 RPM.
- The mass air flow (MAF) is between 0.5-510g/s.
- The barometric pressure (BARO) is greater than 70 kPa (10.2 psi).
- The fuel level is greater than 10 %.
- This diagnostic runs continuously when the above conditions have been met.

Conditions for Setting the DTC

- The average long term fuel trim weighted average value is greater +28% or less than -28%.
- The above condition is present for approximately 3 min after the Conditions for Running the DTC have been met.

Action Taken When the DTC Sets

DTCs P0171 and P0172 are Type B DTCs.

Conditions for Clearing the MIL/DTC

DTCs P0171 and P0172 are Type B DTCs.

Diagnostic Aids

- Allow the engine to reach operating temperature. With the engine running, observe the HO2S parameter with a scan tool. The HO2S value should vary from approximately 40 mV to approximately 900 mV, and respond to fueling changes.
- The normal Short Term Fuel Trim and Long Term Fuel Trim parameters should be between +10 and -10 % with 0 % the optimum, with the engine running at operating temperature.
- Any un-metered air into the engine causes this DTC to set. Thoroughly inspect all areas of the engine for vacuum leaks.

- A MAF sensor condition can cause this DTC without setting a MAF DTC. If there is a MAF sensor condition, the MAF sensor parameters will appear to be within range.
- Verify that the air filter is the correct one for this application, the engine oil fill cap is in place and is tight, and the engine oil dip stick is fully seated.
- 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

Component View Reference

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

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 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 P0171 or P0172 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 P0171 or P0172 is not set.
 - **If any of the DTCs set**
Refer to Circuit/System Testing.
 - **If none of the DTCs set**
6. All OK.

Circuit/System Testing

1. Ignition ON.
2. Verify the manifold absolute pressure sensor is within the range specified for your altitude. Refer to [Altitude Versus Barometric Pressure](#)

- **If not within the specified range**

Refer to [DTC P0106](#)

- **If within the specified range**

3. Engine running at the operating temperature.

4. Verify the Long Term Fuel Trim parameter is between -10 % and +10 %.

- **If greater than +10 %**

1. Ignition OFF.

2. Inspect for the conditions listed below:

- Mass air flow (MAF) sensor signal skewed. If the Short Term Fuel Trim parameter changes greater than 20 % when the MAF sensor is disconnected, refer to [DTC P0101](#).
- Fuel contamination. Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#) .
- Missing, restricted, or leaking exhaust components. Refer to [Symptoms - Engine Exhaust](#) .
- Malfunctioning fuel injectors. Refer to [Fuel Injector Diagnosis](#) .
- Split, kinked, or improperly connected vacuum hoses
- Insufficient fuel in the tank
- Low fuel pressure. Refer to [Fuel System Diagnosis \(LUV\)](#) .
- Vacuum leaks at the intake manifold, the throttle body, and the injector O-rings.
- Leaks in the air induction system and the air intake ducts
- Missing air filter element
- Cracked EVAP canister
- Evaporative pipes obstructed or leaking
- Leaks in the crankcase ventilation system.
 - If a condition is found, repair as necessary.
 - If no condition is found, test the engine for a mechanical condition. Refer to [Symptoms - Engine Mechanical](#) .

- **If less than -10 %**

1. Ignition OFF.

2. Inspect for the conditions listed below:

- Mass air flow (MAF) sensor signal skewed. If the Short Term Fuel Trim parameters for both banks changes greater than 20 % when the MAF sensor is disconnected, refer to [DTC P0101](#).
- Fuel contamination. Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](#) .
- Missing, restricted, or leaking exhaust components. Refer to [Symptoms - Engine Exhaust](#) .
- Malfunctioning fuel injectors. Refer to [Fuel Injector Diagnosis](#)
- Collapsed or restricted air intake duct
- Excessive fuel pressure. Refer to [Fuel System Diagnosis \(LUV\)](#).
- Dirty or restricted air filter
- Objects blocking the throttle body
- Improper operation of the evaporative emissions control system
- Excessive fuel in the crankcase. Change the engine oil as necessary.
 - If a condition is found, repair as necessary.
 - If no condition is found, test the engine for a mechanical condition. Refer to [Symptoms - Engine Mechanical](#) .

- **If between -10 % and +10 %**

5. All OK.

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

Perform the scan tool Fuel Trim Reset after completing the repair.

DTC P018B-P018D: FUEL PRESSURE SENSOR (CHASSIS CONTROL MODULE)

Diagnostic Instructions

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

DTC Descriptors

DTC P018B

Fuel Pressure Sensor Performance

DTC P018C

Fuel Pressure Sensor Circuit Low Voltage

DTC P018D

Fuel Pressure Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P018C, P0641, P06A6	P018C	P018D	P06A6
Signal	P018C	P018C	P018D	P018B
Low Reference	-	P018D	-	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 engine is running.
- DTCs 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 engine has been running for at least 5 seconds.

Conditions for Setting the DTC

The chassis control module does not detect a change in the fuel pressure of at least 30 kPa (4.4 psi) when the fuel pump is operating. The fuel pressure sensor performance diagnostic provides a means to detect fuel pressure sensor output that is stuck within the normal operating range of the sensor.

Action Taken When the DTC Sets

DTCs P018B, P018C and P018D are Type A DTCs.

Conditions for Clearing the DTC

DTCs P018B, P018C and P018D are Type A DTCs.

Diagnostic Aids

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

Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LUV\)](#), [Engine Controls Schematics \(Chevrolet with LUV\)](#)

Connector End View Reference

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

Description and Operation

[Fuel System Description \(LUV\)](#)

Electrical Information Reference

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

DTC Type Reference

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

Scan Tool Reference

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

Circuit/System Verification

1. Engine running.
2. Verify the scan tool Fuel Pressure Sensor Voltage parameter is between 0.2-4.8 V.
 - **If not between 0.2-4.8 V**

Refer to Circuit/System Testing.
 - **If between 0.2-4.8 V**
3. All OK.

Circuit/System Testing

NOTE: Verify that the fuel tank is not empty. Only perform this diagnostic if there is at least 2 gallons of fuel in the fuel tank. Clear the DTC, and start and run the engine. Verify that the DTC resets before proceeding with the circuit system testing. If the DTC does not reset, refer to diagnostic aids.

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 Ω between the low reference circuit terminal 2 and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF, disconnect the harness connector at the K38 Chassis Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K38 Chassis Control Module.
 - **If less than 10 Ω**
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 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the 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 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the 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.

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

DTC P0201, P0202, P0203, P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, OR P0271: CYLINDER INJECTOR CONTROL

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0201

Cylinder 1 Injector Control Circuit

DTC P0202

Cylinder 2 Injector Control Circuit

DTC P0203

Cylinder 3 Injector Control Circuit

DTC P0204

Cylinder 4 Injector Control Circuit

DTC P0261

Cylinder 1 Injector Control Circuit Low Voltage

DTC P0262

Cylinder 1 Injector Control Circuit High Voltage

DTC P0264

Cylinder 2 Injector Control Circuit Low Voltage

DTC P0265

Cylinder 2 Injector Control Circuit High Voltage

DTC P0267

Cylinder 3 Injector Control Circuit Low Voltage

DTC P0268

Cylinder 3 Injector Control Circuit High Voltage

DTC P0270

Cylinder 4 Injector Control Circuit Low Voltage

DTC P0271

Cylinder 4 Injector Control Circuit High Voltage

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*, P0261*, P0264*, P0267*, P0270*	P0201**, P0202**, P0203**, P0204**, P0261**, P0264**, P0267**, P0270**	-	-
Injector 1 Control	P0201, P0261	P0201, P0300	P0262, P0300	-
Injector 2 Control	P0202, P0264	P0202, P0300	P0265, P0300	-
Injector 3 Control	P0203, P0267	P0203, P0300	P0268, P0300	-
Injector 4 Control	P0204, P0270	P0204, P0300	P0271, P0300	-
* Open fuse, cranks no start. ** Cranks no start if the condition is between the fuse and the splice.				

Circuit/System Description

The engine control module (ECM) enables the appropriate fuel injector pulse for each cylinder. Ignition voltage is supplied to the fuel injectors. The ECM controls each fuel injector by grounding the control circuit via a solid state device called a driver. The ECM monitors the status of each driver. If the ECM detects an incorrect voltage for the commanded state of the driver, a fuel injector control circuit DTC sets.

Conditions for Running the DTC

- The engine is running for greater than 1 s.
- The ignition voltage is greater than 11 V.
- The DTCs run continuously when the above conditions are met for greater than 5 s.

Conditions for Setting the DTC

The control module detects an incorrect voltage on the fuel injector control circuit for greater than 5 s.

Action Taken When the DTC Sets

DTCs P0201, P0202, P0203, P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, and P0271 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0201, P0202, P0203, P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, and P0271 are Type B DTCs.

Diagnostic Aids

Performing the Fuel Injector Diagnosis may help isolate an intermittent condition. Refer to [Fuel Injector Diagnosis](#).

Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LUV\)](#), [Engine Controls Schematics \(Chevrolet with LUV\)](#)

Connector End View Reference

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

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 Tool

CH 34730-2C Noid Light, if available

[Circuit/System Verification](#)

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

[Circuit/System Testing](#)

1. Ignition OFF, disconnect the harness connector at the appropriate Q17 Fuel Injector, ignition ON.
2. Verify a test lamp illuminates between the ignition circuit terminal 1 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 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**
3. Ignition OFF, connect the test lamp to the affected fuel injector connector.
 4. Engine cranking.
 5. Verify the test lamp turns ON and OFF.
 - **If the test lamp is always OFF**
 1. Ignition OFF, remove the test lamp, disconnect the X2 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 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If the test lamp is always ON**
 1. Ignition OFF, remove the test lamp, disconnect the X2 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 turns ON and OFF**
 6. Test or replace the appropriate Q17 Fuel Injector.

Component Testing

Fuel Injector Diagnosis

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

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

DTC P0231, P0232, OR P023F: FUEL PUMP CONTROL (CHASSIS CONTROL MODULE)

Diagnostic Instructions

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

DTC Descriptors

DTC P0231

Fuel Pump Control Circuit Low Voltage

DTC P0232

Fuel Pump Control Circuit High Voltage

DTC P023F

Fuel Pump Control Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	P0231	P023F	P0232	P023F, 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 supplies a varying voltage to the fuel tank pump module in order to maintain the desired fuel line pressure.

Conditions for Running the DTC

P0231, P023F

The ignition voltage is between 9-18 V.

P0232

The control enable voltage signal supplied for the ECM to chassis control module is inactive for 4 seconds after engine has been shut off.

Conditions for Setting the DTC

The chassis control module detects a fault on the fuel pump voltage circuit that is less than 11 V or greater than 18 V.

Action Taken When the DTC Sets

DTCs P0231, P0232, and P023F are Type A DTCs.

Conditions for Clearing the DTC

DTCs P0231, P0232, and P023F are Type A DTCs.

Diagnostic Aids

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

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 \(Buick with LUV\)](#), [Engine Controls Schematics \(Chevrolet with LUV\)](#)

Connector End View Reference

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

Description and Operation

[Fuel System Description \(LUV\)](#)

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 A7 Fuel Pump and Level Sensor Assembly. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF, disconnect the harness connector at the K38 Chassis Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K38 Chassis Control Module.
 - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 1 and the low reference circuit terminal 2.
4. Ignition ON.
5. 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 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , 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**
6. Replace the A7 Fuel Pump and Level Sensor Assembly.

Repair Instructions

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

- [Fuel Tank Fuel Pump Module Replacement \(AWD\) Fuel Tank Fuel Pump Module Replacement \(FWD\)](#)
- [Control Module References](#) for chassis control module replacement, programming and setup

DTC P0234 OR P0299: ENGINE OVERBOOST/ UNDERBOOST

Diagnostic Instructions

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

DTC Descriptors

DTC P0234

Engine Overboost

DTC P0299

Engine Underboost

Circuit Description

The boost pressure sensor is integrated with the turbocharger boost/intake air temperature sensor. The boost pressure sensor measures the range of pressures between the turbocharger and the throttle body. The sensor used on this engine is a three atmosphere sensor. Pressure in this portion of the induction system is affected by engine speed, throttle opening, turbocharger boost pressure, Intake air temperature (IAT), barometric pressure (BARO), and the efficiency of the charge air cooler.

The sensor provides a signal voltage to the engine control module (ECM), relative to the pressure changes. Under normal operation the greatest pressure that can exist in this portion of the induction system at ignition On, engine Off is equal to the BARO. When the engine is operated at wide-open throttle (WOT) the turbocharger can increase the pressure to near 240 kPa (34.8 psi). The pressure is equal to the BARO when the engine is idling or decelerating.

Conditions for Running the DTC

- DTCs P0010, P0011, P0013, P0014, P0033, P0034, P0035, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0121, P0122, P0123, P0128, P0222, P0223, P0234, P0236, P0237, P0238, P0243, P0245, P0246, P0299, P16F3, P2101, P2227, P2228, P2229 or P2230 are not set.
- Engine speed between 1, 600-6, 000 RPM.
- Engine speed between 2, 000-3, 500 RPM-open loop boost control
- Desired boost pressure between 140-300 kPa (20.03-43.5 PSI) and steady
- Ambient pressure between 60-120 kPa (8.70-17.40 PSI)
- Coolant temperature between -40 to +130Â°C (-40 to +266Â°F)
- Intake air temperature between -40 to +80Â°C (-40 to +176Â°F)
- The conditions exist for greater than 2 s

Conditions for Setting the DTC

P0234

- The ECM detects that the actual boost pressure is greater than the desired boost pressure.
- The condition exists for greater than 1.4 s in open loop control.
- The condition exists for greater than 10 s in closed loop control.

P0299

- The ECM detects that the actual boost pressure is less than the desired boost pressure for greater than 1.4 s.
- The ECM detects that the rate of the actual boost pressure increase is less than desired for greater than 1 s.

Action Taken When the DTC Sets

- DTCs P0234 and P0299 are Type A DTCs.

- The ECM will disable boost control and limit the system to mechanical boost only, resulting in a substantial decrease in engine power.

Conditions for Clearing the DTC

DTCs P0234 and P0299 are Type A DTCs.

Diagnostic Aids

- The charged air cooler is connected to the turbocharger and to the throttle body by flexible duct work that requires the use of special high torque fastening clamps. These clamps cannot be substituted. In order to prevent any type of air leak when servicing the duct work, the tightening specifications and proper positioning of the clamps is critical, and must be strictly adhered to.
- Insufficient preload between the wastegate lever and actuator rod may allow the wastegate to open slightly when commanded closed, and result in P0299 being set.
- Oil ingestion or contamination of the wastegate solenoid valve may cause DTC P0299 to set.
- Charge air cooler icing may cause DTC P0299 to set.

Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LUV\)](#), [Engine Controls Schematics \(Chevrolet with LUV\)](#)

Connector End View Reference

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

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

Special Tools

GE-23738-A Vacuum Pump

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

Circuit/System Verification

1. Ignition On.
2. Verify DTC P0033, P0034, P0035, P0236, P0237, P0238, P0243, P0245, P0246 or, P2261 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 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 MAP 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 P0106](#).

- **If the parameters are within 3 kPa (0.4 psi).**

5. 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).**

6. Engine running, verify the wastegate actuator rod moves when increasing engine speed to wide open throttle (WOT) and abruptly back to idle.

- **If the rod does not move**

Refer to Circuit/System Testing.

- **If the rod moves**

7. Ignition On, engine Off, verify a click is heard or felt from the Q40 Turbocharger Bypass Solenoid Valve when commanding the Turbocharger Bypass Solenoid Valve On and Off with a scan tool.

- **If a click is not heard or felt**

Refer to Circuit/System Testing.

- **If a click is heard or felt**

8. Verify a series of clicks, which increase in frequency, are heard or felt from the Q42 Turbocharger Wastegate Solenoid Valve when commanding the Turbocharger Wastegate Solenoid Valve between 15-100 % with a scan tool.

- **If a series of clicks in increasing frequency are not heard or felt**

Refer to Circuit/System Testing.

- **If a series of clicks in increasing frequency is heard or felt**

9. Verify the scan tool MAP Sensor parameter and the Boost Pressure Sensor parameter are within 20 kPa (2.9 psi) during a WOT acceleration at the time of the 1-2 shift.

- **If not within 20 kPa (2.9 psi)**

Refer to Circuit/System Testing.

- **If within 20 kPa (2.9 psi)**

10. Verify the scan tool Desired Boost Pressure parameter and the Boost Pressure Sensor parameter are within 15.2 kPa (2.2 psi) during a WOT acceleration at the time of the 1-2 shift.

- **If the not within 15.2 kPa (2.2 psi)**

Refer to Circuit/System Testing.

- **If within 15.2 kPa (2.2 psi)**

11. 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.

12. Verify a DTC does not set.

- **If a DTC sets**

Refer to Circuit/System Testing

- **If a DTC does not set**

13. All OK

Circuit/System Testing

P0234

1. Ignition Off.

2. Verify the conditions listed below do not exist:

- Restricted, blocked or incorrect routing of hoses going to the components listed below:
 - Turbocharger
 - Turbocharger wastegate solenoid valve
 - Turbocharger wastegate actuator
- **If a condition exists**

Repair the condition or replace the turbocharger as necessary

- **If none of the conditions exist**

NOTE: The hose is attached between the turbocharger inlet and the Q42 Turbocharger Wastegate Solenoid Valve.

3. Disconnect the turbocharger wastegate solenoid valve hose at the turbocharger and apply 51 kPa (15 inches Hg) of vacuum to the hose with the **GE 23738-A**. Ignition On.
4. Verify the pressure decreases to 0 kPa (0 inches Hg) when commanding the Turbocharger Wastegate Solenoid Valve to 15 % with a scan tool.

- **If the pressure does not decrease to 0 kPa (0 inches Hg)**

Test or replace the Q42 Turbocharger Wastegate Solenoid Valve

- **If the pressure decreases to 0 kPa (0 inches Hg)**

5. Connect the turbocharger wastegate solenoid valve hose to the turbocharger.
6. Disconnect the wastegate solenoid valve hose from the turbocharger wastegate actuator and connect the exhaust/pressure port of the **GE 23738-A**, or a suitable hand pressure pump, to the actuator.
7. Remove the retaining clip and disconnect the wastegate actuator rod from the wastegate lever.
8. Verify the wastegate actuator rod moves when applying pressure to the actuator.
- **If the actuator does not move**

Replace the turbocharger

- **If the actuator moves**

9. Verify the conditions listed below do not exist with the turbocharger assembly. Refer to **Turbocharger Cleaning and Inspection**

- Restricted or damaged wastegate poppet valve.
- Foreign material.
- Excessive coking.
- **If a condition exists**

Repair the condition or replace the turbocharger as necessary

- **If none of the conditions exist**

P0299

1. Verify the conditions listed below do not exist:

- Loose clamps, cracks or other damage in the air intake duct system
- Collapsed intake duct system
- Debris or restrictions in the intake duct system, including the air cleaner dirty side
- Restricted or aftermarket air filter
- Any air flow restriction
- Any air leak between the turbocharger and the throttle body, including the charge air cooler assembly
- Splits, kinks or improper connections at the vacuum hoses
- Any vacuum leak
- Restricted, leaking or incorrect routing of hoses going to the components listed below:
 - Turbocharger wastegate solenoid valve
 - Turbocharger bypass solenoid valve
 - Intake manifold and turbocharger vacuum reservoir on the bottom of intake manifold
 - Turbocharger
 - Turbocharger wastegate actuator
 - Turbocharger bypass valve
- Exhaust leak between the turbocharger and the exhaust manifold
- Loose or incorrect installation of any components
- Evidence of oil contamination in the wastegate solenoid valve and/or vacuum hoses

Refer to [Intake Manifold Cleaning and Inspection](#) for inspection of the positive crankcase ventilation (PCV) diaphragm and check valve.

- Increased or excessive crankcase pressure

Refer to [Engine Compression Test](#) for additional diagnosis.

- **If a condition exists**

Repair or replace the affected component as necessary.

- **If none of the conditions exist**

NOTE: The hose is attached between the turbocharger inlet and the Q42 Turbocharger Wastegate Solenoid Valve.

2. Ignition Off, disconnect the turbocharger wastegate solenoid valve hose at the turbocharger and apply 51 kPa (15 inches Hg) of vacuum to the hose with the **GE 23738-A**. Ignition On.

3. Verify the pressure decreases to 0 kPa (0 inches Hg) when commanding the Turbocharger Wastegate Solenoid Valve to 15 % with a scan tool.

- **If the pressure does not decrease to 0 kPa (0 inches Hg)**

Test or replace the Q42 Turbocharger Wastegate Solenoid Valve

- **If the pressure decreases to 0 kPa (0 inches Hg)**

4. Connect the turbocharger wastegate solenoid valve hose to the turbocharger.

5. Disconnect the wastegate solenoid valve hose from the turbocharger wastegate actuator and connect the exhaust/pressure port of the **GE 23738-A**, or a suitable hand pressure pump, to the actuator.

6. Verify the wastegate actuator rod moves when applying pressure to the actuator.

- **If the actuator does not move**

Replace the turbocharger

- **If the actuator moves**

7. Disconnect the Q40 Turbocharger Bypass Solenoid Valve vacuum hose at the turbocharger bypass valve on the turbocharger.
8. Connect the **GE 23738-A** to the hose.
9. Idle engine for at least 15 s.
10. Engine Off, ignition On.
11. Verify the vacuum decreases to 0 kPa (0 inches Hg) when engine is turned Off and increases to greater than 45 kPa (13 inches Hg) for at least 5 s when the Turbocharger Bypass Solenoid Valve is commanded On with a scan tool.

- **If not within the specified range**

NOTE: **The vacuum reservoir (tank) is integral to intake manifold and is located underneath the manifold.**

1. Ignition Off, disconnect the vacuum hose from the turbocharger vacuum reservoir.
2. Connect the **GE 23738-A** to the vacuum reservoir and apply 34 kPa (10 inches Hg) of vacuum.
3. Verify the reservoir holds vacuum for at least 10 s.
 - If the vacuum is not held for at least 10 s

Replace the intake manifold
 - If the vacuum is held for at least 10 s
4. Reconnect the vacuum hose to the turbocharger vacuum reservoir.
5. Disconnect the vacuum hose that runs between the intake manifold and the Q40 Turbocharger Bypass Solenoid Valve hose at the intake manifold and connect the **GE 23738-A** to the hose.

NOTE: **Allow engine idle to stabilize before continuing.**

6. Engine idling, verify the vacuum is greater than 45 kPa (13 inches Hg).
 - If 45 kPa (13 inches Hg) or less

Replace the intake manifold
 - If greater than 45 kPa (13 inches Hg)
7. Connect the **GE 23738-A** to the output port on the Q40 Turbocharger Bypass Solenoid Valve.

NOTE: **The Q40 Turbocharger Bypass Solenoid Valve is supplied with vacuum from both the intake manifold and the vacuum reservoir at idle. The vacuum supply hose from the intake manifold must be disconnected before proceeding, to allow vacuum to bleed off when changing command states.**

8. Engine idling, command the Turbocharger Bypass Solenoid Valve On and Off with a scan tool.
9. Verify the vacuum toggles between 0 kPa (0 inches Hg) to greater than 45 kPa (13 inches Hg).
 - If not within the specified range

Test or replace the Q40 Turbocharger Bypass Solenoid Valve
 - If within the specified range

Replace the vacuum line between the Q40 Turbocharger Bypass Solenoid Valve and the turbocharger bypass valve.

- **If within the specified range**

12. Verify the conditions listed below do not exist.

- Insufficient preload between the wastegate lever and actuator rod.
- Cracked or damaged turbine blades.
- Worn turbine blades due to contact with housing.

NOTE: **Excessive oil is not necessarily an indication of turbocharger failure.**

- Oil intrusion in turbocharger, hoses or charge air cooler. Refer to [Turbocharger Cleaning and Inspection](#)
- Restricted wastegate, turbine, ports or passages.
- Foreign material.
- Damaged or restricted bypass valve assembly.
- Missing, restricted or leaking exhaust components. Refer to [Symptoms - Engine Exhaust](#)
- Restricted turbocharger oil supply line
- Restricted charge air cooler
- **If a condition exists**

Repair or replace the turbocharger as necessary

- **If none of the conditions exist**

13. Replace the turbocharger.

Component Testing

Static Test

1. Ignition Off, disconnect the harness connector at the appropriate solenoid Valve.
2. Test for 20-27 Ω between terminal 1 and terminal 2 of the solenoid valve.

- **If not between 20-27 Ω**

Replace the solenoid Valve.

- **If between 20-27 Ω**

3. All OK

Dynamic Test

1. Install a 10 A fused jumper wire between the Ignition terminal 2 and 12 V. Install a jumper wire between the control terminal 1 and ground.
2. Verify the solenoid clicks.

- **If the solenoid does not click**

Replace the solenoid Valve.

- **If the solenoid clicks**

3. All OK

Repair Instructions

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

- [Charge Air Bypass Regulator Solenoid Valve Replacement](#) for turbocharger bypass solenoid valve replacement.

- [Intake Manifold Replacement](#)
- [Turbocharger Replacement](#)
- [Turbocharger Wastegate Regulator Solenoid Valve Replacement](#) for turbocharger wastegate solenoid valve replacement.
- [Control Module References](#) for ECM replacement, programming and setup

DTC P0236: TURBOCHARGER BOOST SENSOR 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.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P0236

Turbocharger Boost Sensor Performance

Circuit Description

The boost pressure sensor is integrated with the turbocharger boost/intake air temperature sensor. The boost pressure sensor measures the range of pressures between the turbocharger and the throttle body. The sensor used on this engine is a three atmosphere sensor. Pressure in this portion of the induction system is affected by engine speed, throttle opening, turbocharger boost pressure, Intake air temperature (IAT), barometric pressure (BARO), and the efficiency of the charge air cooler.

The sensor provides a signal voltage to the engine control module (ECM), relative to the pressure changes. Under normal operation the greatest pressure that can exist in this portion of the induction system at ignition ON, engine OFF is equal to the BARO. When the engine is operated at wide-open throttle (WOT) the turbocharger can increase the pressure to near 240 kPa (34.8 psi). The pressure is equal to the BARO when the engine is idling or decelerating.

Conditions for Running the DTC

- DTC P0096, P0097, P0098, P0102, P0103, P0107, P0108, P0111, P0112, P0113, P0116, P0117, P0118, P0119, P0128, P0237, P0238, P0335, P0336, P2227, P2228, P2229, or P2230 is not active.
- Engine speed is between 400-7, 000 RPM.
- Engine Coolant Temperature (ECT) is between -7 to +125°C (19.4-257°F).
- Intake Air Temperature (IAT) is between -20 to +125°C (-4 to +257°F).
- The DTC runs continuously when the above conditions have been met.

OR

- DTC P0106, P0107, P0108, P0237, P0238, P2227, P2228, P2229, P2230, or P2610 is not active.
- DTC P0107, P0108, P0237, P0238, P2228, or P2229 is not pending.
- Ignition is ON.
- Engine is OFF
- The time between current ignition cycle and the last time the engine was running is greater than 6 s.
- The DTC runs continuously when the above conditions have been met.

Conditions for Setting the DTC

- The ECM detects that various combinations of Turbocharger Intake Flow Rationality Diagnostic Failure models, derived from engine speed, the BARO sensor, the MAF sensor, the MAP sensor, the throttle position sensor and the turbocharger boost pressure sensor have failed when the engine is running.

OR

- The ECM detects that the boost pressure sensor signal is less than 50 kPa (7.3 psi) or greater than 115 kPa (16.7 psi) when the ignition is ON and the engine is NOT rotating.

Action Taken When the DTC Sets

- DTC P0236 is a Type A DTC.
- The ECM will disable boost control and limit the system to mechanical boost only, resulting in a substantial decrease in engine power.

Conditions for Clearing the MIL/DTC

DTC P0236 is a Type A DTC.

Diagnostic Aids

- The charge air cooler is connected to the turbocharger and to the throttle body by flexible duct work that requires the use of special high torque fastening clamps. These clamps cannot be substituted. In order to prevent any type of air leak when servicing the duct work, the tightening specifications and proper positioning of the clamps is critical, and must be adhered to strictly.
- Use a smoke generating device or a solution of dish soap and water in a spray bottle to pinpoint any suspected air leaks in the induction system and in the charge air cooler assembly.

Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LUY\)](#), [Engine Controls Schematics \(Chevrolet with LUY\)](#)

Connector End View Reference

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

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 / Vehicle ⤴ In Service Mode
2. Verify that DTC P0237, P0238, P0641, P0651, P0697, or P06A3 is not set.

- **If the DTC is set**

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

- **If the DTC is not set**

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

- **90% or greater**

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

- **If less than 90%**

4. Verify the scan tool Throttle Position Sensors 1 and 2 Agree/Disagree parameter displays Agree while performing the Throttle Sweep Test with a scan tool.

- **If Disagree**

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

- **If Agree**

5. Verify the scan tool BARO parameter is within the range specified in the [Altitude Versus Barometric Pressure](#) table, for the current vehicle testing altitude.

- **BARO is not in range**

Refer to [DTC P2227-P2230](#) .

- **BARO is within range**

6. Verify the scan tool MAP Sensor pressure and BARO parameters are within 3 kPa (0.4 psi).

- **The parameters are not within 3 kPa (0.4 psi).**

Refer to [DTC P0106](#).

- **The parameters are within 3 kPa (0.4 psi).**

7. Engine idling.

8. Verify the scan tool MAP Sensor pressure parameter is between 26-52 kPa (3.8-7.5 psi) and changes with accelerator pedal input.

- **If not between 26-52 kPa (3.8-7.5 psi) or does not change**

Refer to [DTC P0106](#).

- **If between 26-52 kPa (3.8-7.5 psi) and changes**

9. Verify the scan tool MAF Sensor g/s parameter changes smoothly and gradually as the engine speed is increased and decreased while performing the actions listed below.

1. Engine ⌘ Idling - At normal operating temperature
2. Increase the engine speed slowly to 3k RPM and then back to idle.
3. Perform the scan tool function:Review Stored Data
4. Observe the scan tool parameter frame by frame with a scan tool:MAF Sensor

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

- **The MAF Sensor parameter does not change smoothly and gradually**

Refer to [DTC P0101](#).

- **The MAF Sensor parameter changes smoothly and gradually**

10. Verify the scan tool Boost Pressure Sensor pressure and BARO parameters are within 3 kPa (0.4 psi).

- **The parameters are not within 3 kPa (0.4 psi).**

Refer to Circuit/System Testing

- **The parameters are within 3 kPa (0.4 psi).**

11. Verify the scan tool MAP Sensor parameter and the Boost Pressure Sensor parameter are within 20 kPa (2.9 psi) during a WOT acceleration at the time of the 1-2 shift.

- **The parameters are not within 20 kPa (2.9 psi)**

Refer to Circuit/System Testing.

- **The parameters are within 20 kPa (2.9 psi)**

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

13. Verify a DTC does not set.

- **If a DTC sets**

Refer to Circuit/System Testing.

- **If a DTC does not set**

14. All OK.

Circuit/System Testing

1. Verify the conditions listed below do not exist:

- Restricted air filter
- Loose clamps, cracks, or other damage in the air intake duct system
- Collapsed or restricted air intake duct system
- Leaking charge air cooler
- Restricted charge air cooler, including moisture build up in the cooler that may intermittently freeze in cold climates
- Splits, kinks or improper connections at the vacuum hoses
- Missing, restricted or leaking exhaust components - Refer to [Symptoms - Engine Exhaust](#)
- Vacuum leaks at the intake manifold and throttle body
- **If a condition exists**

Repair as necessary.

- **If none of the conditions exist**

2. Replace the B111B Turbocharger Boost/Intake Air Temperature Sensor.

Repair Instructions

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

- [Intake Air Pressure and Temperature Sensor Replacement](#) for B111B Turbocharger Boost/Intake Air Temperature Sensor replacement.
- [Control Module References](#) for engine control module replacement, programming, and setup

DTC P0237 OR P0238: TURBOCHARGER BOOST SENSOR

Diagnostic Instructions

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

DTC Descriptor

DTC P0237

Turbocharger Boost Sensor Circuit Low Voltage

Turbocharger Boost Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0236, P0237, P0651	P0237	P0236, P0237, P0651	P0236
Signal	P0236, P0237	P0236, P0237	P0236, P0238	P0236
Low Reference	-	P00EB, P0236, P0238	-	-

Typical Scan Tool Data

Boost Pressure Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine=Running			
Parameter Normal Range: 240 kPa (34.8 PSI)Maximum			
5 V Reference	0 kPa (0 PSI)	0 kPa (0 PSI)	269 kPa (39 PSI)
Signal	0 kPa (0 PSI)	0 kPa (0 PSI)	269 kPa (39 PSI)
Low Reference	-	269 kPa (39 PSI)	-

Circuit/System Description

For an overview of the component/system, refer to: [Turbocharger 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
B111B Turbocharger Boost/Intake Air Temperature Sensor	The assembly has several functions: - Pressure - The signal voltage increases when the pressure increases. - Temperature - The sensor measures the intake air temperature and pressure between the turbocharger and the throttle body. - The temperature sensor is a negative temperature coefficient thermistor, a resistor which changes based on temperature. - Low temperature produces a high resistance: 1.2 kΩ @40 °C (104°F) - High temperature produces a low resistance: 97 Ω @130 °C (266°F)
K20 Engine Control Module	The control module contains a microprocessor used to process input data to control outputs. The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Conditions for Running the DTC

- Ignition = On or Engine = Running
- Frequency the DTC runs = Continuously - After the running conditions are met - For greater than 5 s

Conditions for Setting the DTC

P0237

Boost Pressure Sensor = Less than 1.0 V - For greater than 5 s

P0238

Boost Pressure Sensor = Greater than 4.7 V - For greater than 5 s

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type A DTC

Reduced Engine Power = Active

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC

Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LUV\)](#), [Engine Controls Schematics \(Chevrolet with LUV\)](#)

Connector End View Reference

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

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 P0641, P0651, P0697, P06A3, P06D2 is not set.
 - If any of the DTCs are set

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

3. Verify the scan tool parameter: Boost Pressure Sensor = 1.0 and 4.7 V

- **If not between 1.0 and 4.7 V**

Refer to: Circuit/System Testing

- **If between 1.0 and 4.7 V**

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

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: B111B Turbocharger Boost/Intake Air Temperature Sensor
- Wiggle the harness and connector: K20 Engine Control Module
- **If the value spikes or drops out**

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

- **If the value does not spike or drop out**

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

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

- **If the DTC is not set**

6. All OK.

Circuit/System Testing

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

1. Ignition/Vehicle & All vehicle systems → Off

2. Disconnect the electrical connector: B111B Turbocharger Boost/Intake Air Temperature Sensor

3. Test for less than 5 Ω between the test points: Low Reference circuit terminal 1 & Ground

- **If 5 Ω or greater**

1. Disconnect the electrical connector: X1 @ K20 Engine Control Module

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

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

- **If less than 5 Ω**

4. Ignition → On / Vehicle → In Service Mode

5. Test for 4.8 to 5.2 V between the test points: 5V Reference circuit terminal 3 & Low Reference circuit terminal 1

- **If less than 4.8 V**

1. Ignition/Vehicle → Off

2. Disconnect the electrical connector: X1 @ K20 Engine Control Module

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

- If less than infinite resistance Â» Repair the short to ground on the circuit.
 - If infinite resistance
4. Test for less than 2 Ω between the test points: 5 V Reference circuit terminal 3 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 Ω or greater Â» Repair the open/high resistance in the circuit.
 - If less than 2 Ω Â» Replace the component:K20 Engine Control Module
 - **If greater than 5.2 V**
 1. Ignition/Vehicle Â» Off
 2. Disconnect the electrical connector: X1 @ K20 Engine Control Module
 3. Ignition Â» On / Vehicle Â» In Service Mode
 4. Test for less than 1 V between the test points: 5 V Reference circuit terminal 3 @ Component harness & Ground
 - If 1 V or greater Â» Repair the short to voltage on the circuit.
 - If less than 1 V Â» Replace the component:K20 Engine Control Module
 - **If between 4.8 and 5.2 V**
6. Verify the scan tool parameter:Boost Pressure Sensor =Less than 0.2 V
 - **If 0.2 V or greater**
 1. Ignition/Vehicle Â» Off
 2. Disconnect the electrical connector: X1 @ K20 Engine Control Module
 3. Ignition Â» On / Vehicle Â» In Service Mode
 4. Test for less than 1 V between the test points:Signal circuit terminal 4 @ Component harness & Ground
 - If 1 V or greater Â» Repair the short to voltage on the circuit.
 - If less than 1 V Â» 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:Signal circuit terminal 4 & 5 V Reference circuit terminal 3
 8. Verify the scan tool parameter:Boost Pressure Sensor = Greater than 4.7 V
 - **If 4.7 V or less**
 1. Ignition/Vehicle Â» Off & Remove Â» Jumper wire(s)
 2. Disconnect the electrical connector: X1 @ K20 Engine Control Module
 3. Test for infinite resistance between the test points:Signal circuit terminal 4 @ Component harness & Ground
 - If less than infinite resistance Â» Repair the short to ground on the circuit.
 - If infinite resistance
 4. Test for less than 2 Ω between the test points:Signal circuit terminal 4 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 Ω or greater Â» Repair the open/high resistance in the circuit.
 - If less than 2 Ω Â» Replace the component:K20 Engine Control Module
 - **If greater than 4.7 V**
 9. Test or replace the component:B111B Turbocharger Boost/Intake Air Temperature Sensor

Repair Instructions

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

- [Intake Air Pressure and Temperature Sensor Replacement](#) - B111B Turbocharger Boost/Intake Air Temperature Sensor
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P0243, P0245, OR P0246: TURBOCHARGER WASTEGATE SOLENOID VALVE

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 P0243

Turbocharger Wastegate Solenoid Valve Control Circuit

DTC P0245

Turbocharger Wastegate Solenoid Valve Control Circuit Low Voltage

DTC P0246

Turbocharger Wastegate Solenoid Valve Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P0245*, **	P0243*	-	P0234
Control	P0245	P0243	P0246	P0234, P0299
* Additional DTCs may set. ** Opens the fuse that supplies voltage to the component.				

Circuit/System Description

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

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

Component	Description
K20 Engine Control Module	The control module contains a microprocessor used to process input data to control outputs. The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.
Q42 Turbocharger Wastegate Solenoid Valve	In the unpowered state, the output port of the valve is connected to the ventilation port (atmospheric pressure). The more voltage applied, the more the valve shifts over from the ventilation port to the pressure supply port so that the pressure at the output port becomes stronger. A wastegate is a valve that diverts exhaust gases away from the turbine wheel of a turbocharger directly into the exhaust system. The primary function of the wastegate is to regulate the maximum boost pressure and to protect the engine and the turbocharger. The wastegate valve is actuated by a pressure actuator, which is controlled by a solenoid valve.

Conditions for Running the DTC

- Ignition = On or Engine = Running
- Engine= Not cranking
- System Voltage = Greater than 11 V
- Turbocharger Wastegate Solenoid Valve Command = On and Off - At least 1 time(s) during the drive cycle

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

Conditions for Setting the DTC

Control Circuit = Commanded state does not match the actual state - For greater than 4 s

Actions Taken When the DTC Sets

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

Warning Message = Reduced Engine Power

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC

Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LUY\)](#), [Engine Controls Schematics \(Chevrolet with LUY\)](#)

Connector End View Reference

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

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 Â» On / Vehicle Â» In Service Mode
2. Perform the scan tool control function: Turbocharger Wastegate Solenoid Valve Â» Increase & Decrease

Verify the scan tool parameter:

- Turbocharger Wastegate Solenoid Valve Control Circuit Low Voltage Test Status= OK or Not Run
- Turbocharger Wastegate Solenoid Valve Control Circuit Open Test Status = OK or Not Run
- Turbocharger Wastegate Solenoid Valve Control Circuit High Voltage Test Status = OK or Not Run
- **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

3. Perform the scan tool control function: Turbocharger Wastegate Solenoid Valve » Increase & Decrease

Verify a click can be heard or felt at the component when it is turned On and Off: Q42 Turbocharger Wastegate Solenoid Valve

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

Refer to: Circuit/System Testing

- **If a click can be heard or felt**

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/Vehicle & All vehicle systems » Off
2. Disconnect the electrical connector: Q42 Turbocharger Wastegate Solenoid Valve
3. Ignition » On / Vehicle » In Service Mode
4. Verify a test lamp turns On between the test points: Ignition circuit terminal 2 & Ground
 - **If the test lamp does not turn On and the circuit fuse is OK**
 1. Ignition/Vehicle » Off & Remove » Test lamp
 2. Test for less than 2 Ω between the test points: Ignition circuit terminal 2 & Output terminal @ Fuse
 - If 2 Ω or greater » Repair the open/high resistance in the circuit.
 - If less than 2 Ω » Verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not turn On and the circuit fuse is open**
 1. Ignition/Vehicle » Off
 2. Replace the component: Fuse
 3. Ignition » On / Vehicle » In Service Mode
 4. Verify the fuse does not open.
 - If the fuse opens and there are components connected to the circuit » Disconnect a component and repeat step 4.1
 - If the fuse opens with all components disconnected from the circuit » Repair the short to ground on the circuit.
 - If the fuse does not open after disconnecting a component from the circuit » Replace the component disconnected last.
 - **If the test lamp turns On**
5. Verify a test lamp does not turn On between the test points: Control circuit terminal 1 & Ignition circuit terminal 2
 - **If the test lamp turns On**
 1. Ignition/Vehicle » Off & Remove » Test lamp
 2. Test for infinite resistance between the test points: Control circuit terminal 1 @ Component harness & Ground

- If less than infinite resistance $\hat{A}$ » Repair the short to ground on the circuit.
 - If infinite resistance $\hat{A}$ » Replace the component:K20 Engine Control Module
 - **If the test lamp does not turn On**
6. Perform the scan tool control function: Turbocharger Bypass Solenoid Valve $\hat{A}$ » Increase

Verify a test lamp turns On between the test points:Control circuit terminal 1 & Ignition circuit terminal 2

- **If the test lamp does not turn On**
 1. Ignition/Vehicle $\hat{A}$ » Off & Remove $\hat{A}$ » Test lamp
 2. Disconnect the electrical connector: X3 @ K20 Engine Control Module
 3. Ignition $\hat{A}$ » On / Vehicle $\hat{A}$ » In Service Mode
 4. Test for less than 1 V between the test points: Control circuit terminal 1 @ Component harness & Ground
 - If 1 V or greater $\hat{A}$ » Repair the short to voltage on the circuit.
 - If less than 1 V
 5. Ignition/Vehicle & All vehicle systems $\hat{A}$ » Off
 6. Test for less than 2 Ω between the test points: Control circuit terminal 1 @ Component harness & The other end of the circuit
 - If 2 Ω or greater $\hat{A}$ » Repair the open/high resistance in the circuit.
 - If less than 2 Ω $\hat{A}$ » Replace the component:K20 Engine Control Module
 - **If the test lamp turns On**
7. Test or replace the component:Q42 Turbocharger Wastegate Solenoid Valve

Component Testing

Static Test

1. Ignition/Vehicle $\hat{A}$ » Off
2. Disconnect the electrical connector:Q42 Turbocharger Wastegate Solenoid Valve
3. Test for 20 to 27 Ω between the test points:Control terminal 1 & Ignition terminal 2
 - **If not between 20 and 27 Ω**

Replace the component:Q42 Turbocharger Wastegate Solenoid Valve
 - **If between 20 and 27 Ω**
4. Test for infinite resistance between the test points:Each terminal of the component & The component's housing
 - **If less than infinite resistance**

Replace the component:Q42 Turbocharger Wastegate Solenoid Valve
 - **If infinite resistance**
5. All OK.

Dynamic Test

1. Ignition/Vehicle $\hat{A}$ » Off
2. Disconnect the electrical connector:Q42 Turbocharger Wastegate Solenoid Valve
3. Connect a 10 A fused jumper wire between the test points:Ignition terminal 2 & 12 V

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

- 4.
5. Momentarily connect a jumper wire between the test points:Control terminal 1 & Ground

Verify the component turns On and Off when connecting and disconnecting the jumper wire:Q42 Turbocharger Wastegate Solenoid Valve

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

Replace the component:Q42 Turbocharger Wastegate Solenoid Valve

- **If the component turns On and Off**

6. All OK.

Repair Instructions

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

- [Turbocharger Wastegate Regulator Solenoid Valve Replacement](#) - Q42 Turbocharger Wastegate Solenoid Valve
- For control module replacement, programming, and setup refer to:[Control Module References](#)

DTC P025A: FUEL PUMP CONTROL MODULE ENABLE CIRCUIT (CHASSIS CONTROL MODULE)

Diagnostic Instructions

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

DTC Descriptor

DTC P025A

Fuel Pump Control Module Enable Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	P025A	P025A	-	P025A

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 line pressure.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

The serial data message from the ECM to the chassis control module does not agree with the state of the control enable voltage signal supplied from the ECM to the chassis control module for more than 2 seconds.

Action Taken When the DTC Sets

DTC P025A is a Type A DTC.

Conditions for Clearing the DTC

DTC P025A is a Type A DTC.

Diagnostic Aids

Beginning in the 2014 model year the K27 Fuel Pump Control Module (FPCM) will now be called the chassis control module (CCM). The component code for the chassis control module will be K38. The chassis control module name will be used in Service Information, the Global Diagnostic System and the Service Programming System.

Reference Information

Schematic Reference

[Engine Controls Schematics \(Buick with LUV\)](#), [Engine Controls Schematics \(Chevrolet with LUV\)](#)

Connector End View Reference

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

Description and Operation

[Fuel System Description \(LUV\)](#)

Electrical Information Reference

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

DTC Type Reference

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

Scan Tool Reference

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

Circuit/System Testing

NOTE: Verify that the fuel tank is not empty. Only perform this diagnostic if there is at least 2 gallons of fuel in the fuel tank. Clear the DTC, and start and run the engine. Verify that the DTC resets before proceeding with the circuit system testing. If the DTC does not reset, refer to [Strategy Based Diagnosis](#).

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the K38 Chassis Control Module, ignition ON.
2. Connect a test lamp between the control circuit terminal 20 and ground.
3. 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 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
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 engine control module.
 - **If the test lamp is always ON**

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 the test lamp turns ON and OFF**
4. Test or replace the K38 Chassis Control Module.

Repair Instructions

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

[Control Module References](#) for ECM or chassis control module replacement, programming and setup

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