

2018 ENGINE PERFORMANCE

Engine Controls And Fuel - 1.6L (LH7) Diesel - Diagnostic Information And Procedures (P0016 - P049D) - Equinox & Terrain

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P0016: CRANKSHAFT POSITION - CAMSHAFT POSITION NOT PLAUSIBLE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0016

Crankshaft Position - Camshaft Position Not Plausible

Circuit/System Description

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

Conditions for Running the DTC

- DTC P0335, P0336, P0340, P0341 = Not set
- Engine = Cranking or Running
- Crankshaft Position Sensor & Camshaft Position Sensor = Synchronized
- Camshaft Position Actuator Solenoid Valve = Park position
- Time since diagnostic ran last = For less than 1 s

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

Conditions for Setting the DTC

The deviation of the relative camshaft position is greater than -10° in one direction or greater than 10° in the other direction (measured in degrees of the crankshaft).

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Reference Information

DTC Type Reference

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

Scan Tool Reference

[Control Module References](#)

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC P0335, P0336, P0340, P0341 is not set.
 - **If any of the DTCs are set**

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

- **Go to next step: If none of the DTCs are set**
3. Engine - Idling - At normal operating temperature
 4. Verify DTC P0016 is not set.
 - **If the DTC is set**
 1. Ignition/Vehicle - Off
 2. Verify the following conditions do not exist:
 - B23 Camshaft Position Sensor - Incorrect installation
 - B26 Crankshaft Position Sensor - Incorrect installation
 - Reluctor Ring - Misaligned @ Crankshaft
 - Timing Chain - Excessive play
 - Timing Chain Tensioner - Incorrect installation
 - If a condition exists - Repair or replace as necessary
 - If none of the conditions exists - Refer to step 2.
 - **Go to next step: If the DTC is not set**
 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

One of the above conditions still exist.
 - **Go to next step: If the DTC is not set**
6. All OK.

Repair Instructions

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

- Refer to [Camshaft Position Sensor Replacement](#)
- Refer to [Crankshaft Position Sensor Replacement](#)
- Refer to [Timing Chain Tensioner Replacement](#)

DTC P003A: TURBOCHARGER BOOST CONTROL POSITION NOT LEARNED

Diagnostic Instructions

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

DTC Descriptor

DTC P003A

Turbocharger Boost Control Position Not Learned

Circuit/System Description

The Engine Control Module (ECM) performs the turbocharger learn procedure automatically when the enabling criteria have been met. After each ignition cycle, and before the enable criteria have been met, the ECM will use the previously learned value. If the ECM does not have a previously learned value, it will default to a stored calibrated value.

The ECM commands the turbocharger vane control solenoid to position the turbocharger vanes, and a turbocharger vane position sensor monitors the actual position of the vanes. The ECM varies the boost dependant upon the load requirements of the engine.

Conditions for Running the DTC

- DTCs P0116, P0117, P0118, P0119, P0128, or P111E is not set.
- The engine speed is 700 to 900 RPM.
- The battery voltage is between 9 - 30 V.
- The ambient temperature is greater than 60°C (140°F).
- The engine coolant temperature (ECT) is 10 to 105°C (158 to 221°F).
- The ECM controls the turbocharger vanes open or closed automatically once per key cycle during a position learn process.
- DTC P003A runs once per key cycle when the above conditions are met.

Conditions for Setting the DTC

The engine control module (ECM) determines that the difference between the turbocharger desired vane position sensor and the actual turbocharger vane position exceed a calibrated threshold during a valid learn event.

Action Taken When the DTC Sets

DTC P003A is a Type A DTC.

Conditions for Clearing the DTC

DTC P003A is a Type A DTC.

Diagnostic Aids

If any service has been performed on the turbocharger or on the turbocharger components, a turbocharger relearn must be performed. Failure to perform the turbocharger learn procedure may cause other DTCs to set.

The turbocharger learn procedure is required when the following service procedures have been performed:

- Turbocharger vane position control solenoid valve replacement
- Turbocharger vane position sensor replacement
- ECM replacement
- Turbocharger replacement
- Any service that disturbs the turbocharger components

Description and Operation

Turbocharger System Description

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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

DTC Type Reference

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

Scan Tool Reference

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

[Circuit/System Verification](#)

NOTE: Once the enable conditions have been met the throttle must remain at idle. Do not change the accelerator pedal during this procedure.

1. Verify that DTC P0045, P0047, P0048, P0234, P226B, P2564, P2565, P2598 or P2599 is not set.

- **If other DTCs are set**

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

- **Go to next step: If no other DTCs are set**

2. Inspect the vacuum system for an inoperative vacuum pump, leaks or loose hoses.

- **If a condition is found**

Repair as necessary.

- **Go to next step: If a condition is not found**

3. Inspect the turbocharger for a mechanical condition.

- **If a condition is found**

Refer to [Turbocharger Replacement](#)

- **Go to next step: If a condition is not found**

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 that DTC P003A does not set.

- **If DTC P003A sets**

Replace the K20 Engine Control Module.

- **Go to next step: If DTC P003A does not set**

5. All OK.

[Repair Instructions](#)

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

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

DTC P0045, P0047, OR P0048: TURBOCHARGER BOOST CONTROL CIRCUIT

[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 P0045

Turbocharger Boost Control Circuit

DTC P0047

Turbocharger Boost Control Circuit Low Voltage

DTC P0048

Turbocharger Boost Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P0047, P2670	P0045	P2671	-
Control	P0047	P0045	P0048	-

Circuit/System Description

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

Circuit	Description
Ignition	Regulated voltage supplied by the control module.
Control	The output circuit is switched to ground to activate the component.

Component	Description
Q41 Turbocharger Vane Position Control 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.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Conditions for Running the DTC

- Ignition/Vehicle - On or the engine is running
- System Voltage = Greater than 11 V
- Boost Pressure Solenoid Control = On and Off at least once during the ignition cycle.

DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

The commanded state of the driver and the actual state of the control circuit do not match for greater than 10 s.

Actions Taken When the DTC Sets

- DTCs listed in the DTC Descriptor Category = Type A DTC
- A message and/or warning indicator may be displayed to the driver.

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Perform the scan tool control function: Turbocharger Vane Position Actuator - 0 to 80%

Verify the scan tool parameter:

- Turbocharger Vane Position Solenoid Valve Circuit Low Voltage Test Status = OK
- Turbocharger Vane Position Solenoid Valve Circuit Open Test Status = OK
- Turbocharger Vane Position Solenoid Valve Circuit High Voltage Test Status = OK
- **If not the specified state**

Refer to: Circuit/System Testing

- **Go to next step: If the specified state**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 4. Verify DTC P0045, P0047, P0048 is not set.
 - **If the DTC sets**

Refer to: Circuit/System Testing

- **Go to next step: If the DTC does not set**
5. All OK.

Circuit/System Testing

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

1. Ignition/Vehicle & All vehicle systems - Off

2. Disconnect the electrical connector: Q41 Turbocharger Vane Position Control 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**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Disconnect the electrical connector: X2 @ K20 Engine Control Module
 3. Test for infinite resistance between the test points: Ignition circuit terminal 2 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance
 4. Test for less than 2 ohms between the test points: Ignition circuit terminal 2 @ Component harness & Terminal 36 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **Go to next step: If the test lamp turns On**
5. Connect a test lamp between the test points: Control circuit terminal 1 & Ignition circuit terminal 2
6. Perform the scan tool control function: Turbocharger Vane Position Actuator - 0 to 80%

Verify the test lamp turns On and changes intensity.

- **If the test lamp is always Off**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Disconnect the electrical connector: X2 @ K20 Engine Control Module
 3. Ignition - On/Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Control circuit terminal 1 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
 5. Ignition/Vehicle - Off
 6. Test for less than 2 ohms between the test points: Control circuit terminal 1 @ Component harness & Terminal 35 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **If the test lamp turns On but does not change intensity**
 1. Ignition/Vehicle - Off & Remove - Test lamp
 2. Disconnect the electrical connector: X2 @ K20 Engine Control Module
 3. Test for infinite resistance between the test points: Control circuit terminal 1 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module
 - **Go to next step: If the test lamp turns On and changes intensity**
7. Replace the component: Q41 Turbocharger Vane Position Control Solenoid Valve

Repair Instructions

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

- Refer to [Turbocharger Wastegate Actuator Vacuum Control Solenoid Valve Replacement](#) - Q41 Turbocharger Vane Position Control Solenoid Valve
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P0046, P2598, OR P2599: TURBOCHARGER BOOST CONTROL POSITION PERFORMANCE

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 P0046

Turbocharger Boost Control Position Performance

DTC P2598

Turbocharger Vane Position Performance - Low Position

DTC P2599

Turbocharger Vane Position Performance - High Position

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5V Reference	P0651, P2564*	P2564	P0651*	-
Signal	P2564	P2565	P2565	P0046, P2598, P2599
Low Reference	-	P2565	-	-
* Additional DTCs may set.				

Typical Scan Tool Data

Turbocharger Vane Position Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: • Ignition - On/Vehicle - In Service Mode Parameter Normal Range: • 0.26 to 4.75 V			
5V Reference	0 V	0 V	5 V
Signal	0 V	0 V	5 V
Low Reference	-	5 V	-

Circuit/System Description

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

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

Component	Description
B112 Turbocharger Vane Position Sensor	The sensor is an analog potentiometer that varies its resistance proportionally with the position of the control rod.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Conditions for Running the DTC

P0046, P2599

- DTC P003A, P0071-P0074, P0117-P0119 = Not set
- Ignition Voltage = Greater than 11 V
- Turbocharger Vane Position Command = Steady State

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

P2598

- DTC P003A, P00EA, P00EB, P00EC, P0117-P0119 = Not set
- Ignition Voltage = Greater than 11 V
- Engine Coolant Temperature = Greater than -7Â°C (19Â°F)
- IAT Sensor 3 = Greater than -7Â°C (19Â°F)
- Engine Speed = Greater than 1, 500 RPM
- Turbocharger Vane Position Command = Steady State

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

Conditions for Setting the DTC

DTC P0046

Actual & Desired Turbocharger Vane Position = Not within 16% of each other - For greater than 8 s

DTC P2598

Actual & Desired Turbocharger Vane Position = Not within 25% of each other - More open than desired - For greater than 4 s

DTC P2599

Actual & Desired Turbocharger Vane Position = Not within 25% of each other - More closed than desired & DTC P0046 is set.

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 Wiring Schematics 1.6L\(LH7\)](#)

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- [Powertrain Component Views](#)

Electrical Information Reference

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DTC Type Reference

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

Scan Tool Reference

[Control Module References](#)

Special Tools

EN-23738-A Vacuum Pump

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

[Circuit/System Verification](#)

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC P0045, P0047, P0048, P2564, P2565 is not set.
 - **If the DTC is set**

Refer to: [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)
 - **Go to next step: If the DTC is not set**
3. Verify the scan tool parameter: Turbocharger Vane Position Sensor = 0-5%
 - **If not in the specified range**

Refer to: Circuit/System Testing
 - **Go to next step: If in the specified range**
4. Clear the DTCs.
5. Engine - Idling
6. Verify the scan tool parameter: Turbocharger Vane Position Sensor = 90-100%
 - **If not in the specified range**

Refer to: Circuit/System Testing
 - **Go to next step: If in the specified range**
7. Perform the scan tool control function: Turbocharger Vane Position - From 20 to 80% and back to 20%.

Verify the difference between the following parameters is less than 3%:

- Desired Turbocharger Vane Position
- Turbocharger Vane Position Sensor
- **If the difference is greater than 3%**

Refer to: Circuit/System Testing

- **Go to next step: If the difference is less than 3%**

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

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

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

9. All OK.

Circuit/System Testing

1. Ignition/Vehicle - Off

2. Disconnect the component: Vacuum Hose @ Turbocharger Wastegate Actuator Vacuum Source Tube - Hose/line going to the component: Turbocharger Wastegate Actuator - Above: Q14 Exhaust Gas Recirculation Valve

3. Install the special tool: EN-23738-A Vacuum Pump - Turbocharger Wastegate Actuator Vacuum Source Tube - Hose/line going to the component: Q41 Turbocharger Vane Position Control Solenoid Valve

4. Engine - Idling

5. Perform the scan tool control function: Turbocharger Vane Position Actuator - 80%

6. Verify the special tool reading: Greater than -60 kPa (-8.7 PSI)

- **If -60 kPa (-8.7 PSI) or less**

Test or replace the component: Q41 Turbocharger Vane Position Control Solenoid Valve

- **Go to next step: If greater than -60 kPa (-8.7 PSI)**

7. Perform the scan tool control function: Turbocharger Vane Position Actuator - 20%

8. Verify the special tool reading: Less than -10 kPa (-1.5 PSI)

- **If -10 kPa (-1.5 PSI) or greater**

Test or replace the component: Q41 Turbocharger Vane Position Control Solenoid Valve

- **Go to next step: If less than -10 kPa (-1.5 PSI)**

9. Ignition/Vehicle - Off

10. Install the special tool: EN-23738-A Vacuum Pump - Turbocharger Wastegate Actuator Vacuum Source Tube - Hose/line going to the component: Turbocharger Vane Position Actuator - B112 Turbocharger Vane Position Sensor

11. Ignition - On/Vehicle - In Service Mode

12. Use the special tool: EN-23738-A Vacuum Pump -58 kPa (-0.5 bar, -8.4 PSI) can be achieved and holds steady for 2 min.

Perform the following action:

- Verify the control rod of the vacuum actuator moves smoothly over the full range.

- Verify the scan tool parameter: Turbocharger Vane Position Sensor = 100%

- **If not the specified values**

1. Ignition/Vehicle - Off

2. Test or inspect for the following: Turbocharger Wastegate Actuator Vacuum Source Tube - Vacuum hoses with kinks, leaks, or improper connections.

- If a condition exists - Repair or replace as necessary

- If no condition exists - Test or replace the component: Turbocharger Vane Position Actuator

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

Repair Instructions

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

- Refer to [Turbocharger Wastegate Actuator Vacuum Control Solenoid Valve Replacement](#) - Q41 Turbocharger Vane Position Control Solenoid Valve
- Refer to [Turbocharger Replacement](#) - Turbocharger Vane Position Actuator
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P007B: CHARGE AIR COOLER TEMPERATURE SENSOR 1 PERFORMANCE

Diagnostic Instructions

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

DTC Descriptors

DTC P007B

Charge Air Cooler Temperature Sensor 1 Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P007C	P007D	P007D*	P007B, P026A
Low Reference	-	P007D	P007D*	P007B, P026A
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.				

Typical Scan Tool Data

Charge Air Cooler Temperature

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON or Engine Running			
Parameter Normal Range: -39 to +198Â°C (-38 to +388Â°F)			
Signal	215Â°C (419Â°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 charge air cooler (CAC) temperature sensor is a variable resistor. The sensor is located in the CAC inlet duct before CAC assembly. Its signal is used by the ECM to measure the temperature of the intake air entering the CAC. The engine control module (ECM) supplies 5 V to the signal circuit and a ground for the low reference circuit. The ECM continuously monitors the sensor signal for an excessively high or low voltage, or for a start-up signal that is not in correlation with the intake air temperature (IAT) sensor 3 start-up signal.

Conditions for Running the DTC

- DTC P00E9, P00EA, P00EB, P00EC, P007C, P007D, P007E, P0181, P0182, P0183, or P2610 is not set.
- Ignition OFF for 8 hours or greater.
- The ignition is On or the engine is operating for less than 10 s
- The ignition voltage is greater than 11 V.
- The difference between the IAT 3 and the fuel temperature is less than 45Â°C (81Â°F).

- The DTC runs continuously when the enabling condition is met.

Conditions for Setting the DTC

NOTE: The scan tool display range is between -40 and +215°C (-40 and +419°F).

- The ECM detects a difference of greater than 20°C (68°F) between CAC inlet temperature sensor signal and the combined average temperature of IAT 3 and the fuel temperature sensors.
- The condition exists for greater than 100 ms.

Action Taken When the DTC Sets

- DTC P007B is Type B DTC.
- The ECM commands reduced engine power.
- The driver information center (DIC) or indicator may display reduced engine power.
- Service Emission System message is displayed on the driver information center (DIC).
- Diesel particulate filter (DPF) regeneration is inhibited.

Conditions for Clearing the DTC

DTC P007B is Type B DTC.

Diagnostic Aids

An inaccurate CAC temperature sensor may cause DTC P0101 to set.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component Views

Powertrain Component Views

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DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

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

- The vehicle sitting in direct sun light or having the block heater ON will skew the results.

1. Ignition On.

2. Verify that DTCs P00E9, P00EA, P00EB, P00EC, P007C, P007D, P007E, P0181, or P2610 are not set.

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

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

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

3. Verify the following scan tool parameters are within 15Â°C (27Â°F) of each other.

- Fuel Temperature Sensor
- IAT Sensor 3
- Charge Air Cooler Temperature
- **If not within 15Â°C (27Â°F)**

Refer to Circuit System Testing.

- **Go to next step: If within 15Â°C (27Â°F)**

4. Engine idling.

5. Verify the scan tool Charge Air Cooler Temperature parameter is between -39 to +215Â°C (-38 to +419Â°F).

- **If not within the specified range**

Refer to Circuit System Testing.

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

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

Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

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

7. All OK.

Circuit/System Testing

NOTE:

- **You must perform the Circuit/System Verification before proceeding with the Circuit/System Testing.**
- **You must perform the Diagnostic Repair Verification after completing the Circuit/System Testing.**

1. Ignition OFF, and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Disconnect the harness connector at the B193A Charge Air Cooler Inlet Temperature Sensor.

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

- **If 5 Ω or greater**

1. Ignition OFF, disconnect the X2 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.
 - **Go to next step: If less than 5 Ω**
3. 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 X2 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 X2 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.
- **Go to next step: If between 4.8 - 5.2 V**
4. Test or replace the B193A Charge Air Cooler Inlet Temperature Sensor.

Component Testing

- Ignition Off.
- Test the B193A Charge Air Cooler Inlet Temperature Sensor by varying the sensor temperature while monitoring the air temperature with a thermometer. Compare the readings with the scan tool Charge Air Cooler Temperature parameter. The values should be within 5%.
 - **If not within the specified range**

Replace the B193A Charge Air Cooler Inlet Temperature Sensor.
 - **Go to next step: If within the specified range**
- All OK.

Repair Instructions

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

- Perform the [Diesel Particulate Filter \(DPF\) Service Regeneration](#) after completing the repair.
- Refer to [Charge Air Temperature Sensor Replacement \(Inlet\)](#), [Charge Air Temperature Sensor Replacement \(Outlet\)](#) for B193A Charge Air Cooler Inlet Temperature Sensor replacement
- Refer to [Control Module References](#) for engine control module replacement, programming, and setup

DTC P007C, P007D OR P007E: CHARGE AIR COOLER TEMPERATURE SENSOR 1 CIRCUIT

Diagnostic Instructions

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

DTC Descriptors

DTC P007C

Charge Air Cooler Temperature Sensor 1 Circuit Low Voltage

DTC P007D

Charge Air Cooler Temperature Sensor 1 Circuit High Voltage

DTC P007E

Charge Air Cooler Temperature Sensor 1 Circuit Erratic

Diagnostic Fault Information

Charge Air Cooler Inlet Temperature Sensor

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P007C	P007D	P007D*	P007B, P026A
Low Reference	-	P007D	P007D*	P007B, P026A
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.				

Typical Scan Tool Data

Charge Air Cooler Temperature

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON or Engine Running Parameter Normal Range: -39 to +198Â°C (-38 to +388Â°F)			
Signal	215Â°C (419Â°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 charge air cooler (CAC) temperature sensor is a variable resistor. The sensor is located in the CAC inlet duct before CAC assembly. Its signal is used by the ECM to measure the temperature of the intake air entering the CAC. The engine control module (ECM) supplies 5 V to the signal circuit and a ground for the low reference circuit. The ECM continuously monitors the sensor signal for an excessively high or low voltage, or for a start-up signal that is not in correlation with the ambient air temperature signal.

Conditions for Running the DTC

P007C or P007D

- The ignition is ON or the engine is operating.
- The ignition voltage is greater than 11 V.
- The DTCs run continuously when the enabling condition is met.

P007E

- DTC P007C or P007D is not set.
- The ignition is ON or the engine is operating.
- The ignition voltage is greater than 11 V.
- The DTCs run continuously when the enabling condition is met.

Conditions for Setting the DTC

NOTE: The scan tool display range is between -40 and +215Â°C (-40 and +419Â°F).

P007C

The CAC temperature sensor 1 signal is warmer than 300Â°C (572Â°F) for greater than 5 s.

P007D

The CAC temperature sensor 1 signal is colder than -40Â°C (-40Â°F) for greater than 5 s.

P007E

The CAC temperature sensor 1 signal is noisy or changes abruptly for greater than 5 s.

Action Taken When the DTC Sets

- DTCs P007C, P007D, and P007E are Type B DTCs.
- The ECM commands reduced engine power.
- The driver information center (DIC) or indicator may display reduced engine power.
- Service Emission System message is displayed on the driver information center (DIC).
- Diesel particulate filter (DPF) regeneration is inhibited.

Conditions for Clearing the DTC

DTCs P007C, P007D, and P007E are Type B DTCs.

Diagnostic Aids

An inaccurate CAC temperature sensor may cause DTC P0101 to set.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component Views

Powertrain Component Views

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: If you were sent here from DTC P026A, refer to Circuit System Testing.

1. Engine idling.
2. Verify the scan tool Charge Air Cooler Temperature parameter is between -39 to +215Â°C (-38 to +419Â°F).

- **If not within the specified range**

Refer to Circuit System Testing.

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

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

4. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

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

5. All OK.

Circuit/System Testing

NOTE: You must perform the Diagnostic Repair Verification after completing the Circuit/System Testing.

1. Ignition OFF, and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Disconnect the harness connector at the B193A Charge Air Cooler Inlet Temperature sensor.

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

- **If 5 Ω or greater**

1. Ignition OFF, disconnect the X2 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.

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

3. 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 X2 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 X2 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.

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

4. Test or replace the B193A Charge Air Cooler Inlet Temperature sensor.

Component Testing

- Test the B193A Charge Air Cooler Inlet Temperature sensor by varying the sensor temperature while monitoring the air temperature with a thermometer. Compare the readings with the scan tool

Charge Air Cooler Outlet Temperature Sensor parameter. The values should be within 5%.

- If not within the specified range, replace the B193A Charge Air Cooler Inlet Temperature sensor.

Repair Instructions

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

- Perform the [Diesel Particulate Filter \(DPF\) Service Regeneration](#) after completing the repair.
- Refer to [Charge Air Temperature Sensor Replacement \(Inlet\)](#) for B193A Charge Air Cooler Inlet Temperature sensor replacement
- Refer to [Control Module References](#) for engine control module replacement, programming, and setup

DTC P0087, P0089, P228C, P228D, OR P2293: FUEL RAIL LOW PRESSURE/FUEL PRESSURE REGULATORS

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 P0087

Fuel Rail Low Pressure

DTC P0089

Fuel Pressure Regulator 1 Performance

DTC P228C

Fuel Pressure Regulator 1 Control Performance - Low Pressure

DTC P228D

Fuel Pressure Regulator 1 Control Performance - High Pressure

DTC P2293

Fuel Pressure Regulator 2 Performance

Circuit/System Description

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

Component	Description
Q18A Fuel Pressure Regulator 1	The fuel pressure regulator is a solenoid valve that restricts the flow of fuel to the high pressure fuel pump and thereby controls the pressure the pump can produce.
Q18B Fuel Pressure Regulator 2	The fuel pressure regulator is the solenoid valve that controls the pressure in the fuel rail.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Conditions for Running the DTC

P0087

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

Frequency the DTC runs = Continuously

P0089

- Engine = Running
- Ignition Voltage = Greater than 11 V
- Fuel Rail Pressure is being controlled by Fuel Pressure Regulator 1.

Frequency the DTC runs = Continuously

P228C, P228D

- Ambient Air Temperature = Warmer than -7°C (19°F)
- BARO Sensor 2 = Greater than 60 kPa (8.7 PSI)
- Engine = Running
- Ignition Voltage = Greater than 11 V
- Fuel level = Greater than 10%
- Fuel Rail Pressure is being controlled by Fuel Pressure Regulator 1.

P2293

- Engine = Running
- Ignition Voltage = Greater than 11 V
- Fuel Rail Pressure is being controlled by Fuel Pressure Regulator 2.

Frequency the DTC runs = Continuously

Conditions for Setting the DTC

P0087, P0089, P2293

Fuel Rail Pressure = Not within a calibrated range - For greater than 1 s

P228C, P228D

Fuel Rail Pressure = Not within a calibrated range - For greater than 6 s

Actions Taken When the DTC Sets

DTC P0087, P0089, P2293 = Type A DTC

DTC P228C, P228D = Type B DTC

Conditions for Clearing the DTC

DTC P0087, P0089, P2293 = Type A DTC

DTC P228C, P228D = Type B DTC

Reference Information

Schematic Reference

[Engine Controls Wiring Schematics 1.6L \(LH7\)](#)

Connector End View Reference

Component View Reference

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- [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 P0090, P0091, P0092, P0191, P0192, P0193, P0627, P0628, P1255, P2293, P2294, P2295, P2296, P2635 is not set.
 - **If any of the DTCs are set**
Refer to: [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)
 - **Go to next step: If none of the DTCs are set**
3. Engine Cranking or Running
4. Verify the scan tool parameter: Fuel Pressure Sensor = 370 to 450 kPa (54 to 65 PSI)
 - **If less than 370 kPa (54 PSI)**
Refer to: [Fuel System Diagnosis](#)
 - **If greater than 450 kPa (65 PSI)**
Refer to: [Fuel Return System Diagnosis](#)
 - **Go to next step: If between 370 and 450 kPa (54 and 65 PSI)**
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**
Refer to: Circuit/System Testing
- **Go to next step: If the DTC is not set**

6. All OK.

Circuit/System Testing

1. Ignition/Vehicle - Off
2. Verify the following conditions do not exist:
 - Q17 Fuel Injector - Leaking/Restricted
Refer to: [Fuel Injector Balance Test with Scan Tool](#)

- Direct Fuel Injection Fuel Rail - Leaking/Restricted

Refer to: [Fuel Leak Diagnosis](#)

- Fuel - Contaminated/Poor Quality

Refer to: [Contaminants-in-Fuel Diagnosis](#)

- Fuel Feed Pipe - Leaking/Restricted

Refer to: [Fuel Leak Diagnosis](#)

- **If a condition exists**

Repair or replace as necessary.

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

3. Perform the scan tool control function: Fuel Pressure Control - Regulator 1 - Increase & Decrease

Verify the scan tool parameter: Fuel Rail Pressure Sensor 1 = The value should change with each command.

- **If the value does not change**

Replace the component: Q18A Fuel Pressure Regulator 1

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

4. Perform the scan tool control function: Fuel Pressure Control - Regulator 2 - Increase & Decrease

Verify the scan tool parameter: Fuel Rail Pressure Sensor 1 = The value should change with each command.

- **If the value does not change**

Replace the component: Q18B Fuel Pressure Regulator 2

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

5. All OK.

Repair Instructions

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

- Refer to [Fuel Injection Fuel Rail Assembly Replacement](#) - Q18B Fuel Pressure Regulator 2
- Refer to [Fuel Injection Pump Metering Valve Replacement](#) - Q18A Fuel Pressure Regulator 1
- Refer to [Fuel Injector Replacement](#)

DTC P0090, P0091, OR P0092: FUEL PRESSURE REGULATOR 1 CONTROL CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0090

Fuel Pressure Regulator 1 Control Circuit

DTC P0091

DTC P0092

Fuel Pressure Regulator 1 Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - High	P0091	P0090	P0690, P16B3	-
Control - Low	P0091	P0090	P0092, P0690, P16B3	-

Circuit/System Description

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

Circuit	Description
Control - High	The output circuit is switched to 12 V to activate the component. The output is PWM controlled.
Control - Low	The output circuit is switched to ground to activate the component. The output is PWM controlled.

Component	Description
G18 High Pressure Fuel Pump	The fuel pressure regulator is a solenoid valve that restricts the flow of fuel to the high pressure fuel pump and thereby controls the pressure the pump can produce.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Conditions for Running the DTC

- DTC Present = No
- Battery Voltage = Greater than 11 V
- Engine Speed = Greater than 50 RPM
- Fuel Rail Pressure is being controlled by Fuel Pressure Regulator 1.
- Ignition On - Engine Running

DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC**P0090**

Low Control = Open - Greater than 0.275 s

P0091

Low Control = Short to Ground - Greater than 0.275 s

P0092

Low Control = Short to Voltage - Greater than 0.275 s

Actions Taken When the DTC Sets

DTC P0090, P0091, P0092 = Type A DTC

Conditions for Clearing the DTC

DTC P0090, P0091, P0092 = Type A DTC

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

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- [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 P0689, P0690, P1682 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. Perform the scan tool control function: Fuel Pressure Regulator 1 - On and Off

Verify the scan tool parameter:

- Fuel Pressure Regulator 1 Control Circuit High Voltage Test Status = OK or Not Run
- Fuel Pressure Regulator 1 Control Circuit Open Test Status = OK or Not Run
- Fuel Pressure Regulator 1 Control Circuit Low Voltage Test Status = OK or Not Run
- **If not the specified state**

Refer to: Circuit/System Testing

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

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

6. All OK.

Circuit/System Testing

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: Q18A Fuel Pressure Regulator 1
3. Connect a test lamp between the test points: Control circuit terminal 1 & Control circuit terminal 2
4. Ignition - On/Vehicle - In Service Mode
5. Perform the scan tool control function: Fuel Pressure Regulator 1 - On and Off

Verify the test lamp turns On and Off.

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

1. Ignition/Vehicle - Off & Remove - Test lamp
2. Disconnect the electrical connector: X1 @ K20 Engine Control Module
3. Ignition - On/Vehicle - In Service Mode
4. Test for less than 1 V between the test points:
 - Control circuit terminal 1 @ Component harness & Ground
 - Control circuit terminal 2 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
5. Test for less than 2 ohms between the test points:
 - Control circuit terminal 1 @ Component harness & Terminal 21 @ Control module harness
 - Control circuit terminal 2 @ Component harness & Terminal 36 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module

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

6. Replace the component: Q18A Fuel Pressure Regulator 1

Repair Instructions

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

- Refer to [Fuel Injection Pump Metering Valve Replacement](#) - Q18A Fuel Pressure Regulator 1
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P0096 OR P0111: INTAKE AIR TEMPERATURE (IAT) SENSOR 1/2 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

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
Signal	P0112, P2199	P0113, P2199	P0111*, P0113*, P0114, P2199	P0111*, P2199
Low Reference	-	P0097, P00F4, P0113, P227D	P0113*, P0114	-

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

IAT Sensor 2 and Intake Air Humidity

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Voltage	P0096, P0097, P00F4, P0102, P2199	P0096, P0097, P00F4, P0102, P2199	-	P0096
Signal	P0097, P00F5, P2199	P0097, P00F4, P2199	P0097*, P00F4*, P2199*	P0096
Ground	-	P0102	-	P0096

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

Typical Scan Tool Data**IAT Sensor 1**

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Operating Conditions: Engine Running Parameter Normal Range: Varies with ambient temperature			
Signal	150Â°C (302Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*
Low Reference	-	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*

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

IAT Sensor 2 and Intake Air Humidity Sensor

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Operating Conditions: Engine Running Parameter Normal Range: Varies with ambient humidity, temperature, and engine bay conditions			
Ignition Voltage	-40Â°C (-40Â°F) 10 Hz 0%	-40Â°C (-40Â°F) 10 Hz 0%	-
Signal	-40Â°C (-40Â°F) 10 Hz 100%	-40Â°C (-40Â°F) 10 Hz 0%	-40Â°C (-40Â°F) 10 Hz* 0%
Ground	-	-40Â°C (-40Â°F) 10 Hz 0%	-

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

Circuit/System Description

The intake air temperature (IAT) sensor 1 is a variable resistor that measures the temperature of the air in the sensor bore. The engine control module (ECM) supplies 5 V to the IAT sensor 1 signal circuit and a ground for the IAT sensor 1 low reference circuit. The signal varies with inlet air temperature and is displayed by the scan tool as $^{\circ}\text{C}$ ($^{\circ}\text{F}$).

The IAT sensor 2 produces a frequency signal, based on the inlet air temperature, which is equal to the humidity present within the sensor bore. The signal varies with inlet air temperature and is displayed by the scan tool as $^{\circ}\text{C}$ ($^{\circ}\text{F}$) and Hertz (Hz), the relative humidity is displayed in percent (%). The ECM supplies a regulated voltage to the signal circuit. The signal circuit is shared by the IAT sensor 2 and the humidity sensor. Ignition voltage and ground circuits are also supplied to the multifunction intake air sensor's internal circuits for these sensors:

- IAT sensor 2
- Humidity sensor
- MAF sensor

The multifunction intake air sensor houses the following:

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

IAT Sensor 1 - Temperature, Resistance, Voltage Table

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

IAT Sensor 2 - Temperature, Frequency Table

IAT Sensor 2	IAT Sensor 2 Frequency	IAT Sensor 2 Temperature
Cold	10 Hz	-40°C (-40°F)
Warm	302 Hz	104°C (219°F)

Conditions for Running the DTCs

P0096 and P0111

- DTCs P0097, P0098, P0099, P00E9, P00EA, P00EB, P00EC, P0112, P0113, P0117, P0118, P16A7, P16BC, or P1682 are not set.
- The vehicle has been OFF at least 8 hours.
- Ignition voltage is at least 11 V for greater than 1 s.
- The DTCs run once per ignition cycle when the conditions above are met.

Conditions for Setting the DTCs

P0096

- The ECM determines the absolute difference between the IAT sensor 2 start-up temperature and the IAT sensor 1 and 3 start-up temperatures is greater than 25°C (45°F).
- The DTCs run once per ignition cycle when the conditions above are met.

P0111

- The ECM determines the absolute difference between IAT sensor 1 start-up temperature and the IAT sensor 2 and 3 start-up temperatures is greater than 25°C (45°F).
- The DTCs run once per ignition cycle when the conditions above are met.

Action Taken When the DTC Sets

- DTC P0096 is a Type B DTC.
- DTC P0111 is a Type B DTC.
- The ECM commands the cooling fans ON.

Conditions for Clearing the DTCs

- DTC P0096 is a Type B DTC.
- DTC P0111 is a Type B DTC.

Diagnostic Aids

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 Wiring Schematics 1.6L (LH7)

Connector End View Reference

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Powertrain Component Views

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38522-A Variable Signal Generator

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

Circuit/System Verification

1. Ignition On.
2. Verify that DTC P00EA, P00EB, P00EC, P0097, P0098, P0099, P00F4, P00F5, P00F6, P0102, P0103, P0112, P0113, P0114, P0641, P0651, P0697, or P06A3 is not set.
 - **If any of the DTCs are set**

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

- **Go to next step: 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
- Start-Up IAT Sensor 2
- Start-Up IAT Sensor 3
- **If not within 25°C (45°F)**

Refer to Circuit/System Testing.

- **Go to next step: If within 25°C (45°F)**

5. Engine running.

6. 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
- **If not between: -38 and $+149^{\circ}\text{C}$ (-36 and $+300^{\circ}\text{F}$)**

Refer to Circuit/System Testing.

- **Go to next step: If between: -38 and $+149^{\circ}\text{C}$ (-36 and $+300^{\circ}\text{F}$)**

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

8. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

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

9. 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 restricted or collapsed air intake duct
- An intake manifold leak
- A misaligned or damaged air intake duct
- Any water intrusion in the induction system
- **If a condition exists**

Repair or replace component as necessary.

- **Go to next step: 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.

3. Disconnect the harness connector at the B75C Multifunction Intake Air sensor.

4. Test for less than $5\ \Omega$ between the low reference circuit terminal 3 and ground.

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

1. Disconnect the harness connector X1 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 Ω replace the K20 Engine Control Module.
 - **Go to next step: If less than 5 Ω**
5. Test for less than 5 Ω between the ground circuit terminal 7, and ground.
 - **If 5 Ω or greater**
 1. Ignition Off.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open or high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **Go to next step: If less than 5 Ω**
 6. Ignition On.
 7. Verify the scan tool Intake Air Temperature Sensor 1 parameter is colder than -39°C (-38°F).
 - **If warmer than -39°C (-38°F).**
 1. Ignition Off, disconnect the harness connector X1 at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **Go to next step: If colder than -39°C (-38°F).**
 8. Ignition Off, connect a 3 A fused jumper wire between the IAT 1 signal circuit terminal 1 and the low reference circuit terminal 3.
 9. Ignition On.
 10. Verify the scan tool Intake Air Temperature Sensor 1 parameter is warmer than 148°C (298°F).
 - **If 148°C (298°F) or colder**
 1. Ignition Off, remove the jumper wire, disconnect the harness connector X1 at the K20 Engine Control Module.
 2. Ignition On.
 3. 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.
 4. Ignition Off.
 5. 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.
 - **Go to next step: If warmer than 148°C (298°F).**

NOTE: The intake air temperature sensor 2 signal circuit is pulled up with low current voltage within the controller. Normally, a voltage can be measured on the circuit with a DMM, but the current will not be high enough to illuminate a test lamp.

11. Verify the scan tool Intake Air Humidity Sensor parameter is less than 1%.
 - **If 1% or greater**
 1. Ignition Off, disconnect the harness connector X1 at the K20 Engine Control Module.
 2. Test for infinite resistance between the IAT 2 signal circuit terminal 8 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **Go to next step: If less than 1%**
12. Ignition Off, connect a 3 A fused jumper wire between the IAT 2 signal circuit terminal 8 and the low reference circuit terminal 3.
13. Ignition On.
14. Verify the scan tool Intake Air Humidity Sensor parameter is greater than 99%.
 - **If 99% or less**

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

1. Ignition Off, remove the jumper wire and disconnect the harness connector X1 at the K20 Engine Control Module.
2. Ignition On.
3. Test for less than 1 V between the IAT 2 signal circuit terminal 8 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
4. Ignition Off.
5. 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.
- **Go to next step: If greater than 99%**
15. Test or replace the B75C Multifunction Intake Air sensor.

Component Testing

Multifunction Intake Air Sensor

1. Vehicle OFF, disconnect the harness connector at the B75C Multifunction Intake Air Sensor.
2. Connect a DMM between the IAT sensor 1 signal terminal 1 and the low reference terminal 3.

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

3. Test the IAT sensor 1 by varying the sensor temperature while monitoring the sensor resistance. Compare the readings with the [Temperature Versus Resistance - Intake Air Temperature Sensor](#) table. The resistance values should be in range of the table values.
 - **If not within the specified range**

Replace the B75C Multifunction Intake Air Sensor.
 - **Go to next step: If within the specified range**
4. All OK.

Multifunction Intake Air Sensor

1. Test the IAT Sensor 2 by varying the sensor temperature while monitoring the air temperature with a thermometer. Compare the readings with the scan tool IAT Sensor 2 parameter. The values should be within 5%.
 - **If not within the specified range**

Replace the B75C Multifunction Intake Air Sensor.
 - **Go to next step: If within the specified range**
2. All OK.

IAT 2 Circuit Testing with EL-38522-A

NOTE: In-correct diagnosis will result if Circuit/System Testing is not completed before performing the following test.

1. Perform the following test using a **EL-38522-A** Variable Signal Generator or equivalent, if available.
2. Ignition Off, connect the leads of the **EL-38522-A** Variable Signal Generator as follows:
 1. Red lead to the signal circuit terminal 8 at the harness connector
 2. Black leads to ground

3. Battery voltage supply lead to B+
3. 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 250 Hz
4. Ignition On.
5. Verify the scan tool IAT Sensor 2 parameters listed below are within the ranges listed below:
- IAT Sensor 2 is between 248 - 252 Hz

NOTE: Changing the frequency should cause a warmer or colder IAT 2 temperature.

- IAT Sensor 2 is between 70 - 76°C (160 - 166°F)

NOTE: Increasing or decreasing the duty cycle should have an inverse affect on humidity.

- Intake Air Humidity Sensor is between 48 - 52%
- **If a parameter is not within the specified range**

1. Ignition Off, disconnect the harness connector X1 at the K20 Engine Control Module.
 2. 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.
- **Go to next step: If all the parameters are within the specified range**

6. All OK.

Repair Instructions

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

- Refer to [Mass Airflow Sensor Replacement](#) for B75C Multifunction Intake Air Sensor replacement
- Refer to [Control Module References](#) for engine control module replacement, programming, and setup.

DTC P00C7: INTAKE AIR PRESSURE MEASUREMENT SYSTEM

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P00C7

Intake Air Pressure Measurement System - Multiple Sensors Not Plausible

Circuit/System Description

This system consists of the following components:

- B65 Intake Manifold Pressure and Air Temperature Sensor
- B75C Multifunction Intake Air Sensor - BARO Sensor 2
- K20 Engine Control Module - BARO Sensor 1

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

Conditions for Running the DTC

Condition 1

- DTC P0107, P0108, P2228, P2229, P227C, P227D = Not pending
- DTC P0106, P0107, P0108, P2227, P2228, P2229, P2230, P227B, P227C, P227D, P227E = Not set
- Engine = Not Running
- Time between current ignition cycle and the last time the engine was running = Greater than 5 s
- Manifold Absolute Pressure = 50 to 115 kPa (7.3 to 16.7 PSI)
- Barometric Pressure - BARO Sensor 1 = 50 to 115 kPa (7.3 to 16.7 PSI)
- Barometric Pressure - BARO Sensor 2 = 50 to 115 kPa (7.3 to 16.7 PSI)

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

Condition 2

- DTC P0101, P0102, P0103, P0107, P0108, P0116, P0117, P0118, P0119, P0128, P0201, P0202, P0203, P0204, P020A, P020B, P020C, P020D, P0216, P02EE, P02EF, P02E8, P02E9, P02F0, P02F1, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0335, P0336, P062B, P062D, P111E, P122D, P1248, P1249, P124A, P124B, P126A, P16A0, P16A1, P16A2, P2147, P2148, P2150, P2151, P2227, P2228, P2229, P2230, P227B, P227C, P227D, P227E = Not set
- Ignition Voltage = Greater than 11 V
- Engine = Running
- Engine Speed = Less than 950 RPM
- Intake Air Flow Valve Position = Greater than 90%
- Calculated Fuel Flow = Less than a predefined threshold
- Engine Coolant Temperature = Warmer than 70°C (158°F)

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

Conditions for Setting the DTC

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

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

- [Wiring Repairs](#)

DTC Type Reference

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

Scan Tool Reference

[Control Module References](#)

[Circuit/System Verification](#)

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC P0106, P0107, P0108, P2227, P2228, P2229, P2230, P227B, P227C, P227D, P227E is not set.

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

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

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

3. Verify the following conditions do not exist:

- Q38 Throttle Body - Loose Clamps/Visible Damage
- Air Cleaner Element - Dirty/Restricted
- Intake Air Duct & Intake Manifold - Cracked/Loose Clamps/Visible Damage
- B75C Multifunction Intake Air Sensor - Cracked/Loose Clamps/Visible Damage
- Air Inlet Valve - BARO Sensor 1 @ K20 Engine Control Module/Leaking/Missing/Clogged/Visible Damage
- O-Ring @ B65 Intake Manifold Pressure and Air Temperature Sensor/Leaking/Missing/Visible Damage
- Positive Crankcase Ventilation System - Leaking/Incorrect connection/Restricted
- Vacuum Hoses - Kinked/Leaking/Incorrect connection/Restricted
- Vacuum leak @ Engine/Intake Manifold/Q38 Throttle Body
- **If a condition exists**

Repair or replace as necessary.

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

4. Verify the scan tool parameter:

- BARO Sensor 1 = [Altitude Versus Barometric Pressure](#) - The value should be within the range listed in the table.
- BARO Sensor 2 = [Altitude Versus Barometric Pressure](#) - The value should be within the range listed in the table.
- MAP Sensor = [Altitude Versus Barometric Pressure](#) - The value should be within the range listed in the table.
- **If not in the specified range**
- {BARO Sensor 1} Refer to: [DTC P2227-P2230](#)
- {BARO Sensor 2} Refer to: [DTC P227B](#)
- {MAP Sensor} Refer to: [DTC P0106](#)
- **Go to next step: If in the specified range**

5. All OK.

[Repair Instructions](#)

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

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

DTC Descriptor

DTC P00E9

Intake Air Temperature (IAT) Sensor 3 Circuit Performance

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			
Signal	150Â°C (302Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*
Low Reference	-	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*
* Internal ECM or sensor damage may occur if the circuit is shorted to B+			

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 intake manifold air temperature and is displayed by the scan tool as Â°C (Â°F). The IAT sensor 3 is integrated with the manifold absolute pressure sensor in the intake manifold. The ECM provides a ground for the IAT sensor 3 low reference circuit.

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

- DTC P0097, P0098, P00EA, P00EB, P0112, P0113, P0117, P0118, or P0119 is not set.
- The vehicle has been Off at least 8 hours.
- Ignition voltage is at least 11 V.
- The DTC runs once per ignition cycle when the enabling conditions are met.

Conditions for Setting the DTC

Condition 1

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

AND

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

AND

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

Condition 2

- The ECM determines the Start-Up IAT Sensor 1 temperature is between the Start-Up IAT Sensor 3 temperature and the Start-Up IAT Sensor 2 temperature.

AND

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

AND

- The absolute difference between Start-Up IAT Sensor 3 temperature and the Start-Up IAT Sensor 1 temperature is greater than the absolute difference between the Start-Up IAT Sensor 2 temperature and the Start-Up IAT Sensor 1 temperature.

Condition 3

- The ECM determines the Start-Up IAT Sensor 2 temperature is between the Start-Up IAT Sensor 3 temperature and the Start-Up IAT Sensor 1 temperature.

AND

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

AND

- The absolute difference between Start-Up IAT Sensor 3 temperature and the Start-Up IAT Sensor 2 temperature is greater than the absolute difference between Start-Up IAT Sensor 2 temperature and the Start-Up IAT Sensor 1 temperature.

Action Taken When the DTC Sets

DTC P00E9 is a Type B DTC.

Conditions for Clearing the DTCs

DTC P00E9 is a Type B DTC.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

Powertrain Component Views

Powertrain Component Views

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Circuit/System Verification

1. Ignition On.
2. Verify that DTC P00EA, P00EB, P00EC, P0097, P0098, P0099, P0112, P0113, P0114, P0641, P0651, P0697, or P06A3 is not set.

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

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

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

NOTE: To minimize the effects of residual engine heat and 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 scan tool parameters listed below are within 25Â°C (45Â°F).
 - Start-Up IAT Sensor 1
 - Start-Up IAT Sensor 2
 - Start-Up IAT Sensor 3
 - **If not within the specified range**

Refer to Circuit/System Testing.

 - **Go to next step: If within the specified range**
5. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the freeze frame/failure records data.
6. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.

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

7. All OK

Circuit/System Testing

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

1. Verify the conditions listed below do not exist with the air induction system:
 - 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 the component as necessary.

- **Go to next step: If none of the conditions exist**

2. Test or replace the B65 Intake Manifold Pressure and Air Temperature Sensor

Component Testing

Intake Manifold Pressure and Air Temperature Sensor

1. Ignition Off, disconnect the harness connector at the B65 Intake Manifold Pressure and Air Temperature Sensor.
2. Verify the resistance between terminals 1 - 3 of the sensor is within the range specified in the [Temperature Versus Resistance - Intake Air Temperature Sensor](#) table, while varying the sensor between known temperatures.

- **If not within the specified range**

Replace the B65 Intake Manifold Pressure and Air Temperature Sensor.

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

3. All OK.

Repair Instructions

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

- Refer to [Intake Air Pressure and Temperature Sensor Replacement](#) for B65 Intake Manifold Pressure and Air Temperature Sensor replacement.
- Refer to [Control Module References](#) for engine control module replacement, programming, and setup

DTC P00EA, P00EB, OR P00EC: INTAKE AIR TEMPERATURE (IAT) SENSOR 3 CIRCUIT

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 P00EA

Intake Air Temperature (IAT) Sensor 3 Circuit Low Voltage

DTC P00EB

Intake Air Temperature (IAT) Sensor 3 Circuit High Voltage

DTC P00EC

Intake Air Temperature (IAT) Sensor 3 Circuit Erratic

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P00EA	P00EB	P00EB*	P00E9
Low Reference	-	P00EB**	P00EA, P00EC*	-
* Internal control module or component damage may occur if the circuit shorts to B+.				
** Additional DTCs may set.				

Typical Scan Tool Data

IAT Sensor 3

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine = Idling Parameter Normal Range: -39 to +129°C (-38 to +264°F)			
Signal	150°C (302°F)	-40°C (-40°F)	-40°C (-40°F)
Low Reference	-	-40°C (-40°F)	-40°C (-40°F)

Circuit/System Description

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

Component	Description
B65 Intake Manifold Pressure and Air Temperature Sensor	The intake air temperature sensor 3 and the intake manifold pressure sensor are integrated in the same housing, which is located behind the throttle body.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.

Conditions for Running the DTC

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

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

Conditions for Setting the DTC**P00EA**

IAT Sensor 3 = Warmer than 149°C (300°F) - For greater than 5 s

P00EB

IAT Sensor 3 = Colder than -39°C (-38°F) - For greater than 5 s

P00EC

IAT Sensor 3 = Signal noisy or erratic - For greater than 5 s

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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

DTC Type Reference

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

Scan Tool Reference

[Control Module References](#)

[Circuit/System Verification](#)

NOTE: If you were sent here from DTC P0096, P00E9, P0101, P0111 - Refer to: **Circuit/System Testing.**

1. Ignition - On/Vehicle - In Service Mode
2. Verify the scan tool parameter: IAT Sensor 3 = -39 to 149°C (-38 to 300°F)
 - **If not between -39 and 149°C (-38 and 300°F)**

Refer to: Circuit/System Testing

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

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: B65 Intake Manifold Pressure and Air Temperature Sensor
 - Wiggle the harness and connector: X2 @ K20 Engine Control Module
 - **If the value spikes or drops out**
- Repair as necessary - Wiring/Terminal(s)/Electrical Connector(s)
- **Go to next step: If the value does not spike or drop out**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**
- Refer to: Circuit/System Testing
- **Go to next step: If the DTC does not set**
5. All OK.

[Circuit/System Testing](#)

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

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: B65 Intake Manifold Pressure and Air Temperature Sensor
3. Test for less than 5 ohms between the test points: Low Reference circuit terminal 3 & Ground

- **If 5 ohms or greater**
 1. Disconnect the electrical connector: X2 @ K20 Engine Control Module
 2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 3 @ Component harness & Terminal 80 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **Go to next step: If less than 5 ohms**
- 4. Ignition - On/Vehicle - In Service Mode
- 5. Verify the scan tool parameter: IAT Sensor 3 = Colder than -39Â°C (-38Â°F)
 - **If 39Â°C (38Â°F) or warmer**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: X2 @ K20 Engine Control Module
 3. Test for infinite resistance between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance - Replace the component: K20 Engine Control Module
 - **Go to next step: If colder than -39Â°C (-38Â°F)**
- 6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Low Reference circuit terminal 3
- 7. Verify the scan tool parameter: IAT Sensor 3 = Warmer than 149Â°C (300Â°F)
 - **If 149Â°C (300Â°F) or colder**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the electrical connector: X2 @ K20 Engine Control Module
 3. Ignition - On/Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 1 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
 5. Ignition/Vehicle - Off
 6. Test for less than 2 ohms between the test points: Signal circuit terminal 1 @ Component harness & Terminal 26 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **Go to next step: If warmer than 149Â°C (300Â°F)**
- 8. Test or replace the component: B65 Intake Manifold Pressure and Air Temperature Sensor

Repair Instructions

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

- Refer to [Intake Air Pressure and Temperature Sensor Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P0097, P0098, P0099, P00F4, P00F5, OR P00F6: INTAKE AIR TEMPERATURE (IAT) SENSOR 2 CIRCUIT/INTAKE AIR HUMIDITY SENSOR CIRCUIT

Diagnostic Instructions

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

DTC Descriptors

DTC P0097

Intake Air Temperature (IAT) Sensor 2 Circuit Low Voltage

DTC P0098

Intake Air Temperature (IAT) Sensor 2 Circuit High Voltage

DTC P0099

Intake Air Temperature (IAT) Sensor 2 Circuit Intermittent

DTC P00F4

Intake Air Humidity Sensor Circuit Low Voltage

DTC P00F5

Intake Air Humidity Sensor Circuit High Voltage

DTC P00F6

Intake Air Humidity Sensor Circuit Erratic

Diagnostic Fault Information**IAT 2 and Intake Air Humidity**

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P0096, P0097, P00F4, P2199	P0096, P0097, P00F4, P0102, P2199	-	P0096
Signal	P0097, P00F5, P2199	P0097, P00F4, P2199	P0096*, P0097, P00F4, P2199	P0096
Low Reference	-	P0096, P0097, P00F4, P0102, P2199	-	P0096

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

Typical Scan Tool Data**Intake Air Humidity Sensor**

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

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

IAT 2

Circuit	Short to Ground	Open or High Resistance	Short to Voltage
Operating Conditions: Engine Running Parameter Normal Range: Varies with ambient temperature			
Ignition	-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) 10 Hz	-40Â°C (-40Â°F) 10 Hz	-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 IAT sensor 2 produces a frequency signal, based on the inlet air temperature, which is equal to the humidity present within the sensor bore. The signal varies with inlet air temperature and is displayed by the scan tool as Â°C (Â°F) and Hertz (Hz) and the relative humidity is displayed in percent (%). The ECM supplies a regulated voltage to the signal circuit. The signal circuit is shared by the IAT sensor 2 and the humidity sensor. Ignition voltage and ground circuits are also supplied to the multifunction intake air sensor's internal circuits for these sensors:

- IAT sensor 2
- Humidity sensor
- MAF sensor

The multifunction intake air sensor houses the following:

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

Conditions for Running the DTCs

- DTC P0685, P0686, P0687, P0689, P0690 or P1682 is not set.
- The ignition is ON, or the engine is running.
- The Ignition voltage is 11 V or greater.
- The DTCs run continuously within the enabling conditions.

Conditions for Setting the DTCs

P0097

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

The ECM detects that the IAT sensor 2 signal is less than 13 Hz, colder than -60Â°C (-76Â°F), for greater than 4 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 4 s.

P0099

The ECM detects that the absolute difference in 10 consecutive 100 ms samples of IAT sensor 2 signal is greater than 100Â°C (180Â°F), for greater than 4 s.

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 monitors the humidity sensor signal every 0.1 s, to determine if the signal has changed more than 80%. The DTC fails when the condition exists for greater than 4 s.

Action Taken When the DTC Sets

- DTC P0097, P0098, P0099, P00F4, P00F5, and P00F6 are Type B DTCs.
- The ECM commands the cooling fans ON.

Conditions for Clearing the MIL/DTC

DTC P0097, P0098, P0099, 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.
- With the ignition ON, the engine OFF, if the engine is cold, a properly functioning humidity sensor will gradually increase the scan tool Intake Air Humidity Signal parameter. This is due to the heat that is generated by the multifunction intake air sensor heating elements.
- The humidity sensor and the IAT sensor 2 signals are sent to the ECM on the same circuit. If the 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

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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Powertrain Component Views

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- **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

EL-38522-A Variable Signal Generator

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

Circuit/System Verification

1. Ignition On.
2. Verify that DTC P0102, P0103, P0641, P0651, P0697, or P06A3 is not set.
 - **If any of the DTCs are set**

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

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

NOTE: On vehicles equipped with Auto Start/Stop, it may be necessary to **OPEN the hood to enable the engine to idle.**

3. 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.

- **Go to next step: If between 5 and 90%**

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.

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

6. All OK

Circuit/System Testing

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

1. Ignition Off, disconnect the harness connector at the B75C Multifunction Intake Air sensor.
2. Test for less than 5 Ω between the ground circuit terminal 7 and ground.

- **If 5 Ω or greater**

1. 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.

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

NOTE: The intake air temperature sensor 2 signal circuit is pulled up with low current voltage within the controller. Normally, a voltage can be measured on the circuit with a DMM, but the current will not be high enough to illuminate a test lamp.

3. Verify the scan tool Intake Air Humidity Sensor parameter is less than 1%.

- **If 1% or greater**

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

2. Test for infinite resistance between the IAT 2 signal circuit terminal 8 and ground.

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

- **Go to next step: If less than 1%**
- 4. Ignition Off, connect a 3 A fused jumper wire between the IAT 2 signal circuit terminal 8 and the ground circuit terminal 7.
- 5. Ignition On.
- 6. Verify the scan tool Intake Air Humidity Sensor parameter is greater than 99%.
 - **If 99% or less**

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

1. Ignition Off, remove the jumper wire and disconnect the harness connector X1 at the K20 Engine Control Module.
2. Ignition On.
3. Test for less than 1 V between the IAT 2 signal circuit terminal 8 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V.
4. Ignition Off.
5. 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.
- **Go to next step: If greater than 99%**
7. Test or replace the B75C Multifunction Intake Air sensor.

Component Testing

Multifunction Intake Air Sensor

1. Verify the scan tool Intake Air Humidity Sensor parameter is between 5 - 95%, and changes, when varying the air humidity in the intake duct near the sensor.
 - **If not within the specified range or does not change**

Replace the B75C Multifunction Intake Air Sensor.
 - **Go to next step: If within the specified range and changes**
2. All OK.

IAT 2 Circuit Testing with EL-38522-A

NOTE: In-correct diagnosis will result if Circuit/System Testing is not completed before performing the following test.

1. Perform the following test using a **EL-38522-A** Variable Signal Generator or equivalent, if available.
2. Ignition Off, connect the leads of the **EL-38522-A** Variable Signal Generator as follows:
 1. Red lead to the signal circuit terminal 8 at the harness connector
 2. Black leads to ground
 3. Battery voltage supply lead to B+
3. 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 250 Hz
4. Ignition On.
5. Verify the scan tool IAT Sensor 2 parameters listed below are within the ranges listed below:
 - IAT Sensor 2 is between 248 - 252 Hz

NOTE: Changing the frequency should cause a warmer or colder IAT 2 temperature.

- IAT Sensor 2 is between 70 - 76Â°C (160 - 166Â°F)

NOTE: Increasing or decreasing the duty cycle should have an inverse affect on humidity.

- Intake Air Humidity Sensor is between 48 - 52%
- **If a parameter is not within the specified range**
 1. Ignition Off, disconnect the harness connector at the K20 Engine Control Module.
 2. 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.
- **Go to next step: If all the parameters are within the specified range**

6. All OK.

Repair Instructions

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

- Refer to [Mass Airflow Sensor Replacement](#) for B75C Multifunction Intake Air Sensor replacement
- Refer to [Control Module References](#) for engine control module replacement, programming, and setup.

DTC P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1700, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, OR P26C9: CONTROL MODULE REQUESTED MIL ILLUMINATION

Diagnostic Instructions

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

DTC Descriptor

DTC P00FF

Body Control Module Requested MIL Illumination

DTC P069E

Fuel Pump Control Module Requested MIL Illumination

DTC P06EC

Fuel Injector Control Module Requested MIL Illumination

DTC P0700

Transmission Control Module Requested MIL Illumination

DTC P0800

Active Transfer Case Control Module Requested MIL Illumination

DTC P0AC4

Hybrid/EV Powertrain Control Module Requested MIL Illumination

DTC P1E00

Hybrid/EV Powertrain Control Module 2 Requested MIL Illumination

DTC P2561

Air Conditioning (A/C) Control Module Requested MIL Illumination

DTC P25A2

Brake System Control Module Requested MIL Illumination

DTC P25AF

Coolant Temperature Control Module Requested MIL Illumination

DTC P25C9

Brake System Control Module 2 Requested MIL Illumination

DTC P26C8

Chassis Control Module Requested MIL Illumination

DTC P26C9

Auxiliary Chassis Control Module Requested MIL Illumination

Circuit/System Description

Control modules constantly monitor the vehicle for any condition which may adversely affect vehicle performance. If a condition is detected, the module sets a DTC and sends a serial data message to the engine control module (ECM). The ECM sets a DTC to inform the technician that the module has set a DTC. The serial data message sent by the module also contains a request for the ECM to illuminate the malfunction indicator lamp (MIL).

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

Conditions for Running the DTC

- The ignition is ON or the engine is running.
- These DTCs run continuously.

Conditions for Setting the DTC

The ECM receives a serial data message from a specific module indicating that DTC has set in the module.

Action Taken When the DTC Sets

DTCs P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, and P26C9 are Type A DTCs.

Conditions for Clearing the MIL/DTC

DTCs P00FF, P069E, P06EC, P0700, P0800, P0AC4, P1E00, P2561, P25A2, P25AF, P25C9, P26C8, and P26C9 are Type A DTCs.

Diagnostic Aids

Communication codes, U-codes, and P-codes that set in a module can request a DTC to be set in the ECM.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- Do not replace the engine control module for these informational DTCs.
- Correct any engine control and communication DTCs before diagnosing these DTCs.

1. Vehicle in Service Mode.
2. Verify there are no engine control or communication DTCs set.
 - If a DTC is set
Refer to Diagnostic Trouble Code (DTC) List - Vehicle .
 - Go to next step: If a DTC is not set
3. Verify there are no DTCs set in any other control module.
 - If a DTC is set
Refer to Diagnostic Trouble Code (DTC) List - Vehicle .
 - Go to next step: If a DTC is not set
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
5. Verify the DTC does not set.
 - If the DTC sets
Refer to Diagnostic Trouble Code (DTC) List - Vehicle .
 - Go to next step: If the DTC does not set
6. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

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.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0101

Mass Air Flow (MAF) Sensor Performance

Diagnostic Fault Information

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Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Voltage	P0103	P0102	P0103	P0101
Signal	P0102	P0102	P0103	P0101
Ground	-	P0102	-	-

Typical Scan Tool Data

MAF Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine running at idle, engine coolant temperature (ECT) sensor warmer than 60Â°C (140Â°F) Parameter Normal Range: 10 - 40 g/s Operating Conditions: Engine running at idle, ECT sensor colder than 60Â°C (140Â°F) Parameter Normal Range: 30 - 40 g/s			
Ignition Voltage	0.0 g/s	0.0 g/s	-
Signal	0.0 g/s	0.0 g/s	0.0 g/s
Ground	-	0.0 g/s	-

Circuit Description

The mass air flow (MAF) sensor is integrated with the multifunction intake air sensor. The MAF sensor is an air flow meter that measures the amount of air 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 scan tool Induction System Leak Indication parameter is calculated by dividing the mass air flow sensor signal reading, by the estimated air flow.

The estimated air flow is based on the following signal readings:

- Engine speed
- Manifold absolute pressure (MAP)
- Intake manifold temperature (IAT 3) sensor

When the EGR valve is closed, the ideal Induction System Leak Indication parameter is 1.0:1; the normal range is between 0.75:1 and 1.25:1.

A scan tool Induction System Leak Indication parameter greater than 1.25:1, when the EGR valve is commanded closed, may indicate:

- A leak after the turbocharger
- An inaccurate boost pressure sensor
- An inaccurate IAT sensor 3
- A skewed MAF sensor

A scan tool Induction System Leak Indication parameter less than 0.80:1, when the EGR valve is commanded closed, may indicate:

- A leak before the turbocharger
- An inaccurate boost pressure sensor
- An inaccurate IAT sensor 3
- A skewed MAF sensor
- A leaking EGR valve, when it is commanded closed
- A leaking positive crankcase valve (PCV) system

The ECM applies 5 V to the MAF sensor on the MAF sensor signal circuit. The sensor uses the voltage to produce 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). Ignition voltage and ground circuits are also supplied to the multifunction intake air sensor internal circuits for the sensors listed below.

The multifunction intake air sensor houses the following:

- Intake Air Temperature (IAT) sensor 1
- IAT sensor 2
- Humidity sensor
- MAF sensor
- Turbocharger inlet air pressure (TCIAP) sensor - BARO 2

Conditions for Running the DTC

- DTCs P00C7, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0128, P0201, P0202, P0203, P0204, P020A, P020B, P020C, P020D, P0216, P02EE, P02EF, P02E8, P02E9, P02F0, P02F1, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0405, P0406, P049D, P0502, P0503, P062B, P062D, P0722, P0723, P111E, P122D, P124A, P124B, P1248, P1249, P126A, P16A0, P16A1, P16A2, P2147, P2148, P2150, P2151, P2227, P2228, P2229, or P2230 is not set.
- The engine speed is between 700 and 1,200 RPM.
- The ignition voltage is greater than 11 V.
- The barometric pressure (BARO) is greater than 69.5 kPa (10.09 PSI).
- The ambient air temperature is warmer than -7°C (19°F).
- The IAT 1 is warmer than -7°C (19°F).
- The engine coolant temperature (ECT) is 40 to 130°C (104 to 266°F).
- The intake airflow valve position is greater than 85%.
- The EGR position is less than 1%.
- The vehicle speed is less than 3 kph (2 mph).
- The DTCs run continuously when the enabling conditions are met for greater than 1 s.

Conditions for Setting the DTC

- The ECM determines that the actual airflow is not within a predetermined range when the EGR valve is commanded closed.
- The condition exists for greater than 8 s

Action Taken When the DTC Sets

DTC P0101 is Type B DTC.

Conditions for Clearing the DTC

DTC P0101 is 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.
- An inaccurate MAF sensor, an intake air flow restriction, any unmetered air that enters the engine downstream of the MAF sensor, or an air induction leak may cause this DTC to set.
- An aftermarket exhaust system may reduce engine back-pressure excessively and cause this DTC to set.
- A faulty EGR valve that does not close fully, may set this DTC.
- An inaccurate CAC temperature sensor may cause this DTC to set.
- 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.

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
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- **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

EL-38522-A Variable Signal Generator

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

Circuit/System Verification

1. Ignition On.
2. Verify that DTCs P00C7, P00EA, P00EB, P00EC, P0097, P0098, P0099, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0128, P0201, P0202, P0203, P0204, P020A, P020B, P020C, P020D, P0216, P02EE, P02EF, P02E8, P02E9, P02F0, P02F1, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0405, P0406, P049D, P0502, P0503, P062B, P062D, P0722, P0723, P111E, P122D, P124A, P124B, P1248, P1249, P126A, P16A0, P16A1, P16A2, P2147, P2148, P2150, P2151, P2227, P2228, P2229, and P2230 are not set.

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

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

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

NOTE:

- **To minimize the effects of residual engine heat, perform Step 3 of this verification procedure only if the ignition has been OFF for 8 hours or more.**
- **The vehicle sitting in direct sun light or having the block heater ON will skew the results.**

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

- Start-Up IAT Sensor 1
- Start-Up IAT Sensor 2
- Start-Up IAT Sensor 3
- **If a parameter is not within 25Â°C (45Â°F) of the others**

Refer to the appropriate procedure listed below for further diagnosis.

- Refer to **DTC P0096 or P0111** for IAT 1 or IAT 2.
 - Refer to **DTC P00E9** for IAT 3.
 - **Go to next step: If all are within 25Â°C (45Â°F)**
4. Engine running at a warm stabilized idle, perform the following:
1. Command the EGR Valve to 0% with a scan tool.
 2. Verify the Induction System Leak Indication parameter is between 0.75:1 and 1.25:1 for at least 10 s.
- **If not stable or between 0.75:1 and 1.25:1 after 10 s**
- Refer to Circuit/System Testing.
- **Go to next step: If stable and between 0.75:1 and 1.25:1 after 10 s**
5. Ignition On, engine Off, verify the scan tool MAP Sensor and BARO Sensor 2 parameters are within 4 kPa (0.58 PSI) of each other.
- **If not within 4 kPa (0.58 PSI).**
- Refer to **DTC P0106** for further diagnosis.
- **Go to next step: If within 4 kPa (0.58 PSI).**
6. 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. Increase the engine speed slowly to 3, 000 RPM and then back to idle.
 3. Exit from the scan tool data list and review the stored data within the Stored Data function of the scan tool.
 4. Observe the MAF Sensor parameter frame by frame.
- **If the MAF Sensor parameter does not change smoothly and or gradually**
- Refer to Circuit/System Testing.
- **Go to next step: If the MAF Sensor parameter changes smoothly and gradually**
7. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
- Verify the DTC does not set.
- **If the DTC sets**
- Refer to Circuit/System Testing.
- **Go to next step: If the DTC does not set**
8. All OK.

Circuit/System Testing

NOTE:

- **You must perform the Circuit/System Verification before proceeding with the Circuit/System Testing.**
- **You must perform the Diagnostic Repair Verification after completing the Circuit/System Testing.**

1. Verify none of the following conditions exist:
 - A dirty or deteriorating air filter element
 - A leaking, loose, disconnected, or cracked positive crankcase ventilation (PCV) valve, pipe, or seal
 - A loose or disconnected charge air cooler hose or pipe

- A restricted or collapsed air intake duct
- A misaligned or damaged air intake duct
- Any objects blocking the air inlet probe of the Mass Air Flow/Intake Air Temperature sensor
- Any contamination or debris on the sensing elements in the probe of the Mass Air Flow/Intake Air Temperature sensor
- A cracked or damaged mass air flow sensor housing
- Any water intrusion in the induction system
- Any snow or ice build-up at the air cleaner, mass air flow sensor, charge air cooler, or manifold absolute pressure sensor, in cold climates
- An intake manifold leak
- A manifold absolute pressure sensor seal that is leaking, missing, or damaged
- An Intake Manifold Resonator with a leaking seal, or a cracked or broken housing
- A restriction in the exhaust system. Refer to [Restricted Exhaust](#) .
- A leak in the exhaust system. Refer to [Exhaust Leakage](#) .
- **If a condition exists**

Repair as necessary.

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

2. Engine idling at operating temperature, command the EGR Valve to 0% with a scan tool.
3. Verify the Induction System Leak Indication parameter is between 0.75:1 and 1.25:1 for at least 10 s.

- **If not stable or between 0.75:1 and 1.25:1 after 10 s**

1. Verify the Q14 Exhaust Gas Recirculation Valve is in the closed position, by visual inspection. Refer to [Exhaust Gas Recirculation Valve Replacement](#) .

- If the Q14 Exhaust Gas Recirculation Valve is not closed.

Replace the Q14 Exhaust Gas Recirculation Valve and gaskets.

- If the Q14 Exhaust Gas Recirculation Valve is closed.

2. Test the charge air cooler system and air inlet system for leaks. Perform the [Charge Air Cooler Diagnosis \(Leak Test\)](#) [Charge Air Cooler Diagnosis \(Smoke Test\)](#) .

- If a condition exists.

Repair or replace the component as necessary.

- **Go to next step: If stable and between 0.75:1 and 1.25:1 after 10 s**

4. Ignition Off and all systems Off. Disconnect the harness connector at the B75C Multifunction Intake Air Sensor.

5. Test for less than 5 Ω between the ground circuit terminal 7 and ground.

- **If 5 Ω or greater**

1. 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.

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

6. Ignition On, verify a test lamp illuminates between the voltage supply circuit terminal 5 and ground.

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

1. Ignition Off, remove the test lamp, and disconnect harness connector X2 at the K20 Engine Control Module.

2. Test for infinite resistance between the voltage supply 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 voltage supply circuit, end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **Go to next step: If the test lamp illuminates**
 7. Ignition On, test for 4.8 - 5.2 V between the signal circuit terminal 6 and ground.
 - **If less than 4.8 V**
 1. Ignition Off, disconnect the harness connector X1 at the K20 Engine Control Module.
 2. Test for 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 harness connector X1 at the K20 Engine Control Module.
2. Ignition On.
3. Test for less than 1 V between the signal circuit terminal 6 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.
- **Go to next step: If between 4.8 - 5.2 V**
8. Ignition Off, connect the leads of the **EL-38522-A** Variable Signal Generator as follows:
 - Red lead to the signal circuit terminal 6 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
 - Duty Cycle switch to 50% (Normal)
 - Frequency switch to 5 KHz
10. Engine idling.
11. 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.
 - **Go to next step: If between 4, 950 - 5, 050 Hz.**
12. Replace the B75C Multifunction Intake Air sensor.

Repair Instructions

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

- Perform the [Diesel Particulate Filter \(DPF\) Service Regeneration](#) after completing the repair.
- Refer to [Mass Airflow Sensor Replacement](#) for B75C Multifunction Intake Air sensor replacement.
- Refer to [Control Module References](#) for ECM replacement, programming, and setup

DTC P0102 OR P0103: MASS AIR FLOW (MAF) SENSOR CIRCUIT LOW/HIGH FREQUENCY

Diagnostic Instructions

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

DTC Descriptors

DTC P0102

Mass Air Flow (MAF) Sensor Circuit Low Frequency

DTC P0103

Mass Air Flow (MAF) Sensor Circuit High Frequency

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Voltage	P0103	P0102	P0103	P0101
Signal	P0102	P0102	P0103	P0101
Ground	-	P0102	-	-

Typical Scan Tool Data

MAF Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine running at idle, engine coolant temperature (ECT) sensor warmer than 60Â°C (140Â°F) Parameter Normal Range: 10 - 40 g/s			
Operating Conditions: Engine running at idle, ECT sensor colder than 60Â°C (140Â°F) Parameter Normal Range: 30 - 40 g/s			
Ignition Voltage	0.0 g/s	0.0 g/s	-
Signal	0.0 g/s	0.0 g/s	0.0 g/s
Ground	-	0.0 g/s	-

Circuit Description

The mass air flow (MAF) sensor is integrated with the multifunction intake air sensor. The MAF sensor is an air flow meter that measures the amount of air 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 on the MAF sensor signal circuit. The sensor uses the voltage to produce 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). Ignition voltage and ground circuits are also supplied to the multifunction intake air sensor internal circuits for these sensors:

The multifunction intake air sensor houses the following:

- Intake Air Temperature (IAT) sensor 1
- IAT sensor 2
- Humidity sensor
- MAF sensor
- Turbocharger inlet air pressure (TCIAP) sensor - BARO 2

Conditions for Running the DTC

- The engine speed is greater than 49 RPM.
- The ignition voltage is greater than 11 V.
- The DTCs run continuously when the enabling conditions are met for greater than 1 s.

Conditions for Setting the DTC

P0102

The ECM detects that the MAF sensor signal is less than 276 Hz.

P0103

The ECM detects that the MAF sensor signal is greater than 14, 400 Hz.

Action Taken When the DTC Sets

DTCs P0102 and P0103 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0102 and P0103 are Type B DTCs.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38522-A Variable Signal Generator

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

Circuit/System Verification

1. Engine idling at normal operating temperature.
2. Verify the scan tool MAF Sensor parameter is between 5 - 40 g/s.

- **If not between 5 - 40 g/s**

Refer to Circuit/System Testing.

- **Go to next step: If between 5 - 40 g/s**

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 a DTC does not set.
 - **If the DTC sets**

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

Circuit/System Testing

1. Ignition OFF and all systems OFF. Disconnect the harness connector at the B75C Multifunction Intake Air Sensor.
2. Test for less than 5 Ω between the ground circuit terminal 7 and ground.
 - **If 5 Ω or greater**
 1. 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.
 - **Go to next step: If less than 5 Ω**
3. Ignition ON, verify a test lamp illuminates between the ignition voltage circuit terminal 5 and ground.
 - **If the test lamp does not illuminate**
 1. Ignition OFF, remove the test lamp and disconnect harness connector X2 at the K20 Engine Control Module.
 2. Test for infinite resistance between the voltage supply 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 voltage supply circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **Go to next step: If the test lamp illuminates**
4. Ignition ON, test for 4.8 - 5.2 V between the MAF signal circuit terminal 6 and ground.
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect harness connector X1 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 X1 at the K20 Engine Control Module.
2. Ignition ON, test for less than 1 V between the signal circuit terminal 6 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.
- **Go to next step: If between 4.8 - 5.2 V**
5. Ignition OFF, connect the leads of the **EL-38522-A** Variable Signal Generator as follows:

- Red lead to the signal circuit terminal 6 at the harness connector
 - Black leads to ground
 - Battery voltage supply lead to B+
- 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 5 KHz
 - 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.
 - **Go to next step: If between 4, 950 - 5, 050 Hz.**
 - Replace the B75C Multifunction Intake Air sensor.

Repair Instructions

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

- Perform the [Diesel Particulate Filter \(DPF\) Service Regeneration](#) after completing the repair.
- Refer to [Mass Airflow Sensor Replacement](#) for B75C Multifunction Intake Air sensor replacement
- Refer to [Control Module References](#) for ECM 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0106

Manifold Absolute Pressure (MAP) Sensor Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open	Short to Voltage	Signal Performance
5 V Reference	P0651**	P0107	P0651**	-
Signal	P0107	P0108	P0108	-
Low Reference	P0108	P00EB, P0108	*	-
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.				
** Additional DTCs may set.				

Typical Scan Tool Data

MAP Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition On at sea level Parameter Normal Range: 96 - 104 kPa (13.9 - 15.1 PSI)			
5 V Reference	0 kPa (0 PSI) 0.0 V	0 kPa (0 PSI) 0.0 V	98 kPa (14.2 PSI) 1.25 V

Circuit	Short to Ground	Open	Short to Voltage
Signal	0 kPa (0 PSI) 0.0 V	435 kPa (63 PSI) 4.98 V	435 kPa (63 PSI) 4.98 V
Low Reference	-	435 kPa (63 PSI) 4.98 V	*
* 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. Integrated within this sensor is also the intake air temperature sensor (IAT).

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.

Integrated within the MAP sensor is a 4th circuit for the intake air temperature (IAT). A signal voltage is supplied to the ECM relative to intake air temperature. The low reference is shared with the MAP sensor low reference. The IAT is diagnosed within it's own DTC.

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

Condition 1

- Before the ECM can report that DTC P0106 failed, DTCs P0107, P0108, P2228, P2229, P227C, or P227D must run and pass.
- DTC P0106, P0107, P0108, P2227, P2228, P2229, P2230, or P2610 is not set.
- The ignition is On, engine Off.
- The time between the current ignition cycle and the previous drive cycle is greater than 5 s.
- DTC P0106 runs continuously when the conditions above exist.

Condition 2

- DTC P0101, P0102, P0103, P0107, P0108, P0116, P0117, P0118, P0119, P0128, P0201, P0202, P0203, P0204, P020A, P020B, P020C, P020D, P0216, P02EE, P02EF, P02E8, P02E9, P02F0, P02F1, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0335, P0336, P062B, P062D, P111E, P122D, P1248, P1249, P124A, P124B, P126A, P16A0, P16A1, P16A2, P2147, P2148, P2150, P2151, P2227, P2228, P2229, P2230, P227C, or P227D is not set.
- The engine is operating.
- The ignition voltage is greater than 11 V.
- The engine speed is less than 1, 100 RPM.
- The intake airflow valve position is greater than 90%.
- The engine coolant temperature (ECT) is warmer than 70Â°C (158Â°F)
- DTC P0106 runs continuously when the conditions above exist.

Conditions for Setting the DTC

- The ECM detects that the MAP Sensor pressure is greater or less than a threshold as compared to the pressure inputs from the BARO and TCIAP (BARO 2) sensors.

- The condition exists for greater than 5 s.

Action Taken When the DTC Sets

DTC P0106 is a Type A DTC.

Conditions for Clearing the DTC

DTC P0106 is a Type A DTC.

Diagnostic Aids

- A skewed or stuck engine coolant temperature (ECT) or intake air temperature (IAT) will cause the calculated models to be inaccurate and may cause this DTC to run when it should not. Refer to [Temperature Versus Resistance - Intake Air Temperature Sensor](#) .
- A skewed MAP sensor may cause the first and second intake manifold models to disagree with the actual MAP sensor measurements. Use the scan tool and compare the MAP Sensor parameter to a known good vehicle, under various operating conditions.

Reference Information

Schematic Reference

[Engine Controls Wiring Schematics 1.6L \(LH7\)](#)

Connector End View Reference

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- [Wiring Repairs](#)

DTC Type Reference

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

Scan Tool Reference

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

Special Tools

GE-23738-A Vacuum Pump

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

Circuit/System Verification

1. Ignition On.
2. Verify that DTCs P0101, P0102, P0103, P0107, P0108, P0116, P0117, P0118, P0119, P0128, P0201, P0202, P0203, P0204, P020A, P020B, P020C, P020D, P0216, P02EE, P02EF, P02E8,

P02E9, P02F0, P02F1, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0335, P0336, P062B, P062D, P0641, P0651, P0697, P06A3, P111E, P122D, P1248, P1249, P124A, P124B, P126A, P16A0, P16A1, P16A2, P2147, P2148, P2150, P2151, P2227, P2228, P2229, P2230, P227C, P227D, or P227E are not set.

- **If any of DTCs are set**

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

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

3. Verify the scan tool MAP Sensor parameter is within the range listed in the following table:

[Altitude Versus Barometric Pressure](#) .

- **If not in the specified range**

Refer to Circuit/System Testing.

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

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 DTCs are not set.

- **If the DTCs sets**

Refer to Circuit/System Testing

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

5. 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 vane position actuator
- Loose or improper installation of the turbocharger and the charge air cooler, including the inlet and outlet ducts
- 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
- A restriction in the MAP Sensor 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 necessary.

- **Go to next step: 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 B65 Intake Manifold Pressure and Air Temperature Sensor.

3. Test for less than 5 Ω between the low reference circuit terminal 3 and ground.

- **If 5 Ω or greater**

1. Disconnect the harness connector X2 at the K20 Engine Control Module.

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

- If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **Go to next step: If less than 5 Ω**
4. Ignition On.
5. 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 harness connector X2 at the K20 Engine Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground 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 harness connector X2 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.
 - **Go to next step: If between 4.8 - 5.2 V**
6. Verify the scan tool MAP Sensor voltage parameter is greater than 4.7 V.
- **If 4.7 V or less**
 1. Ignition Off, disconnect the harness connector X2 at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **Go to next step: If greater than 4.7 V**

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

7. Connect a 3 A fused jumper wire between the signal circuit terminal 4 and the low reference circuit terminal 3.
8. Verify the scan tool MAP Sensor voltage parameter is less than 0.2 V.
- **If 0.2 V or greater**
 1. Ignition Off, remove the jumper wire, disconnect the harness connector X2 at the K20 Engine Control Module.
 2. Ignition On.
 3. Test for less than 1 V between the signal circuit terminal 4 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 4. Ignition Off.
 5. 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.
 - **Go to next step: If less than 0.2 V**
9. Test or replace the B65 Intake Manifold Pressure and Air Temperature 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 B65 Intake Manifold Pressure and Air Temperature 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 B65 Intake Manifold Pressure and Air Temperature 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 B65 Intake Manifold Pressure and Air Temperature Sensor.

- **Go to next step: 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 B65 Intake Manifold Pressure and Air Temperature 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 B65 Intake Manifold Pressure and Air Temperature Sensor.

- **Go to next step: If the parameter does decrease between 30 - 38 kPa (4.4 - 5.5 PSI).**

4. All OK.

Erratic Signal Test

1. Ignition Off, disconnect the harness connector and remove the B65 Intake Manifold Pressure and Air Temperature Sensor.
2. Install a 3 A fused jumper wire between the 5 V reference circuit terminal 2 of the sensor and the sensor harness.
3. Install a jumper wire between the low reference circuit terminal 3 of the sensor and ground.
4. Install a jumper wire to the signal circuit terminal 4 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** .
7. 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 B65 Intake Manifold Pressure and Air Temperature Sensor.

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

8. All OK.

Repair Instructions

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

- Refer to [Intake Air Pressure and Temperature Sensor Replacement](#) for B65 Intake Manifold Pressure and Air Temperature Sensor replacement.
- Refer to [Control Module References](#) for ECM replacement, programming and setup

DTC P0107 OR P0108: MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR CIRCUIT LOW/HIGH VOLTAGE

Diagnostic Instructions

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

DTC 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	Short to Voltage	Signal Performance
5 V Reference	P0651**	P0107	P0651**	-
Signal	P0107	P0108	P0108	-
Low Reference	P0108	P0108**	*	-
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.				
** Additional DTCs may set.				

Typical Scan Tool Data**MAP Sensor**

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition On at sea level			
Parameter Normal Range: 96 - 104 kPa (13.9 - 15.1 PSI)			
5 V Reference	0 kPa (0 PSI) 0.0 V	0 kPa (0 PSI) 0.0 V	98 kPa (14.2 PSI) 1.25 V
Signal	0 kPa (0 PSI) 0.0 V	435 kPa (63 PSI) 4.98 V	435 kPa (63 PSI) 4.98 V
Low Reference	-	435 kPa (63 PSI) 4.98 V	*
* 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. Integrated within this sensor is also the intake air temperature sensor (IAT).

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.

Integrated within the MAP sensor is a 4th circuit for the intake air temperature (IAT). A signal voltage is supplied to the ECM relative to intake air temperature. The low reference is shared with the MAP sensor low reference. The IAT is diagnosed within it's own DTC.

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

- The ignition is ON, or the engine is operating.
- The DTCs run continuously when the conditions above exist.

Conditions for Setting the DTC

P0107

The ECM detects that the MAP sensor pressure is less than 7.5 kPa (1.08 PSI), for greater than 4 s.

P0108

The ECM detects that the MAP sensor pressure is greater than 421.5 kPa (61.1 PSI), for greater than 4 s.

Action Taken When the DTC Sets

DTC P0107 and P0108 are Type B DTCs.

Conditions for Clearing the DTC

DTC P0107 and P0108 are Type B DTCs.

Diagnostic Aids

- A skewed or stuck engine coolant temperature (ECT) or intake air temperature (IAT) will cause the calculated models to be inaccurate and may cause this DTC to run when it should not. Refer to [Temperature Versus Resistance - Intake Air Temperature Sensor](#).
- A skewed MAP sensor may cause the first and second intake manifold models to disagree with the actual MAP sensor measurements. Use the scan tool and compare the MAP Sensor parameter to a known good vehicle, under various operating conditions.

Reference Information

Schematic Reference

[Engine Controls Wiring Schematics 1.6L \(LH7\)](#)

Connector End View Reference

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DTC Type Reference

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

Scan Tool Reference

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

Special Tools

GE-23738-A Vacuum Pump

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

Circuit/System Verification

NOTE: If you were sent here from P0106 proceed to step 2 of Circuit/System Testing.

1. Ignition On.
2. Verify that DTCs P0641, P0651, P0697 or P06A3 is not set.
 - **If a DTC is set**
Refer to [DTC P0641, P0651, P0697, or P06A3](#) for further diagnosis.
 - **Go to next step: If a DTC is not set**
3. Engine running, verify the scan tool MAP sensor parameter is between 20 - 300 kPa (2.9 - 43.5 PSI) and changes with accelerator input.
 - **If not within range or does not change**
Refer to Circuit/System Testing.
 - **Go to next step: If within range 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 from the Freeze Frame/Failure Records data.
Verify the DTC is not set.

- **If the DTCs sets**
Refer to Circuit/System Testing
- **Go to next step: If the DTC does not set**

5. 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 actuators or solenoid valves
 - Loose or improper installation of the turbocharger and the charge air cooler, including the flexible ductwork
 - 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
 - A restriction in the MAP Sensor port
 - Proper operation of the positive crankcase ventilation system
 - **If a condition is found**
Repair or replace the component as appropriate.
 - **Go to next step: 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 B65 Intake Manifold Pressure and Air Temperature Sensor.
3. Test for less than 5 Ω between the low reference circuit terminal 3 and ground.
 - **If 5 Ω or greater**

1. Disconnect the harness connector X2 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.
 - **Go to next step: If less than $5\ \Omega$**
 4. Ignition On.
 5. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 2 and ground.
 - **If less than 4.8 V**
 1. Ignition Off, disconnect harness connector X2 at the K20 Engine Control Module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than $2\ \Omega$ in the 5 V reference circuit end to end.
 - If $2\ \Omega$ or greater, repair the open/high resistance in the circuit.
 - If less than $2\ \Omega$, replace the K20 Engine Control Module.
 - **If greater than 5.2 V**
 1. Ignition Off, disconnect harness connector X2 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.
 - **Go to next step: If between 4.8 - 5.2 V**
 6. Verify the scan tool MAP Sensor voltage parameter is greater than 4.7 V.
 - **If 4.7 V or less**
 1. Ignition Off, disconnect the harness connector X2 at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **Go to next step: If greater than 4.7 V**
- NOTE:** If the signal circuit is shorted to a voltage the ECM or the MAP Sensor may be damaged.
7. Connect a 3 A fused jumper wire between the signal circuit terminal 4 and the low reference circuit terminal 3.
 8. Verify the scan tool MAP Sensor voltage parameter is less than 0.2 V.
 - **If 0.2 V or greater**
 1. Ignition Off, remove the jumper wire, disconnect the harness connector X2 at the K20 Engine Control Module.
 2. Ignition On.
 3. Test for less than 1 V between the signal circuit terminal 4 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 4. Ignition Off.
 5. 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.
 - **Go to next step: If less than 0.2 V**
 9. Test or replace the B65 Intake Manifold Pressure and Air Temperature Sensor.

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 B65 Intake Manifold Pressure and Air Temperature 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 B65 Intake Manifold Pressure and Air Temperature 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 B65 Intake Manifold Pressure and Air Temperature Sensor.

- **Go to next step: 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 B65 Intake Manifold Pressure and Air Temperature 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 B65 Intake Manifold Pressure and Air Temperature Sensor.

- **Go to next step: If the parameter does decrease between 30 - 38 kPa (4.4 - 5.5 PSI).**

4. All OK.

Erratic Signal Test

1. Ignition OFF, disconnect the harness connector and remove the B65 Intake Manifold Pressure and Air Temperature Sensor.
2. Install a 3 A fused jumper wire between the 5 V reference circuit terminal 2 of the sensor and the sensor harness.
3. Install a jumper wire between the low reference circuit terminal 3 of the sensor and ground.
4. Install a jumper wire to the signal circuit terminal 4 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 B65 Intake Manifold Pressure and Air Temperature Sensor.

- **Go to next step: 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.

- Refer to [Intake Air Pressure and Temperature Sensor Replacement](#) for B65 Intake Manifold Pressure and Air Temperature Sensor replacement.
- Refer to [Control Module References](#) for ECM replacement, programming and setup

DTC P0112, P0113, OR P0114: INTAKE AIR TEMPERATURE (IAT) SENSOR 1 CIRCUIT

Diagnostic Instructions

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

DTC Descriptors

DTC P0112

Intake Air Temperature (IAT) Sensor 1 Circuit Low Voltage

DTC P0113

Intake Air Temperature (IAT) Sensor 1 Circuit High Voltage

DTC P0114

Intake Air Temperature (IAT) Sensor 1 Circuit Intermittent

Diagnostic Fault Information

IAT Sensor 1

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0112, P2199	P0113, P2199	P0111*, P0113*, P0114, P2199	P0111*, P2199
Low Reference	-	P0097, P00F4, P0113, P227D	P0113*, P0114	-
* 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	Short to Voltage
Operating Conditions: Engine running			
Parameter Normal Range: Varies with ambient temperature			
Signal	150Â°C (302Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*
Low Reference	-	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*
* Internal ECM or sensor damage may occur if the circuit is shorted to B+			

Circuit/System Description

The intake air temperature (IAT) sensor 1 is a variable resistor that measures the temperature of the air in the sensor bore. The engine control module (ECM) supplies 5 V to the IAT sensor 1 signal circuit and a ground for the IAT sensor 1 low reference circuit. The signal varies with inlet air temperature and is displayed by the scan tool as Â°C (Â°F).

The multifunction intake air sensor houses the following:

- IAT sensor 1
- IAT sensor 2
- Humidity sensor
- Mass Air Flow (MAF) sensor
- Turbocharger inlet air pressure (TCIAP) sensor - BARO 2

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 and P0113

- The engine run time is greater than 0 s.

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

P0114

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

Conditions for Setting the DTCs

P0112

The ECM detects that the IAT sensor 1 signal is warmer than 149Â°C (300Â°F) for greater than 4 s.

P0113

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

The ECM detects that the IAT sensor 1 signal is colder than -60Â°C (-76Â°F) for greater than 4 s.

P0114

- The ECM detects that the IAT sensor 1 signal has changed greater than 80Â°C (128Â°F) within 1 s.
- The condition exists for a cumulative of 4 s or greater.

Action Taken When the DTCs Set

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

Conditions for Clearing the DTCs

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

Diagnostic Aids

With the ignition On, the engine Off, if the engine is cold, 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 MAF sensor heating elements.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component Views

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Control Module References for scan tool information

Circuit/System Verification

1. Engine idling.
2. Verify the scan tool IAT Sensor 1 parameter is between -38 to $+149^{\circ}\text{C}$ (-36 to $+300^{\circ}\text{F}$).
 - **If not between -38 to $+149^{\circ}\text{C}$ (-36 to $+300^{\circ}\text{F}$)**
Refer to Circuit/System Testing.
 - **Go to next step: If between -38 to $+149^{\circ}\text{C}$ (-36 to $+300^{\circ}\text{F}$)**
3. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the freeze frame/failure records data.

Verify the DTC does not set.

- **If the DTC sets.**
Refer to Circuit/System Testing.
- **Go to next step: If the DTC does not set.**

4. All OK

Circuit/System Testing

1. Ignition Off and all systems Off, it may take up to for 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 $5\ \Omega$ between the low reference circuit terminal 3 and ground.
 - **If $5\ \Omega$ or greater**
 1. Disconnect the harness connector X1 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.
 - **Go to next step: If less than $5\ \Omega$**
3. Ignition On.
4. 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 X1 at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than $2\ \Omega$ in the signal circuit end to end.
 - If $2\ \Omega$ or greater, repair the open/high resistance in the circuit.
 - If less than $2\ \Omega$, replace the K20 Engine Control Module.
 - **Go to next step: If colder than -39°C (-38°F).**
5. Ignition Off, install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 3, ignition On.
6. Verify the scan tool IAT Sensor 1 parameter is warmer than 149°C (300°F).
 - **If colder than 149°C (300°F).**
 1. Ignition Off, remove the jumper wire, disconnect the harness connector X1 at the K20 Engine Control Module.
 2. Ignition On.
 3. 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
4. Ignition Off.
 5. 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.
 - **Go to next step: If warmer than 149°C (300°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.

2. Test the IAT sensor 1 by varying the sensor temperature while monitoring the sensor resistance. Compare the readings with the [Temperature Versus Resistance - Intake Air Temperature Sensor](#) table. The resistance values should be in range of the table values.

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

Replace the B75C Multifunction Intake Air sensor.

- **Go to next step: If within the table values.**

3. All OK

Repair Instructions

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

- Refer to [Mass Airflow Sensor Replacement](#) for B75C Multifunction Intake Air Sensor replacement.
- Refer to [Control Module References](#) for engine control module replacement, programming, and setup.

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

Diagnostic Instructions

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

DTC Descriptors

DTC P0117

Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage

DTC P0118

Engine Coolant Temperature (ECT) Sensor Circuit High Voltage

DTC P0119

Engine Coolant Temperature (ECT) Sensor Circuit Intermittent

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0117, P0119	P0118, P0119	P0118*	P0119, 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 149Â°C (-38 to 300Â°F)			
ECT Sensor	150Â°C (302Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)
Low Reference	-	-40Â°C (-40Â°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 for greater than 10 s.
 - This DTC runs continuously when the above conditions are met.

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 -7Â°C (19Â°F).
 - This DTC runs continuously when the above conditions are met.

P0119

- DTCs P0117, or P0118 are not set.
- The ignition is ON.
- This DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

P0117

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

P0118

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

P0119

The ECM detects that the ECT is intermittent or has abruptly changed for greater than 4 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 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

Engine Controls Wiring Schematics 1.6L(LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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- 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.
 - **Go to next step: 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.
 - **Go to next step: 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 Ω between the low reference 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 low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **Go to next step: If less than 5 Ω**
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 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.
 - **Go to next step: If colder than -39°C (-38°F)**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 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 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.
 - **Go to next step: 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.
 - **Go to next step: 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.

- Go to next step: If infinite resistance

4. All OK.

Repair Instructions

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

- Refer to [Engine Coolant Temperature Sensor Replacement \(FWD\)](#), [Engine Coolant Temperature Sensor Replacement \(AWD\)](#).
- Refer to [Control Module References](#) for ECM replacement, setup, and programming

DTC P0128: ENGINE COOLANT TEMPERATURE (ECT) BELOW THERMOSTAT 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0128

Engine Coolant Temperature (ECT) Below Thermostat Temperature

Diagnostic Fault Information

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

Typical Scan Tool Data

ECT Sensor

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)	-

Circuit/System Description

The engine control module (ECM) uses this diagnostic to determine if the engine coolant temperature (ECT) has reached the minimum calibrated thermostat regulating temperature. The ECM supplies 5 volts to the ECT signal circuit, and a ground for the ECT low reference circuit. The ECM monitors the temperature of the coolant by using the input received from the ECT sensor. The ECM uses a modeled profile of the engine heat up cycle by monitoring the fuel injection quantity, the start-up ECT and the ambient temperature and then uses this profile to determine if the vehicle has been driven within the conditions that would allow the engine coolant to heat up normally to the thermostat regulating temperature. If the coolant temperature does not increase normally, or does not reach the regulating temperature of the thermostat, the engine is considered not warm enough for stable, low emission operation.

Conditions for Running the DTC

- DTC P0102, P0112, P0113, P0117, P0118, P2122, P2123, P2127, P2128, P2138, or P2199 is not set.
- The engine is running.
- The engine run time is less than 24 m.
- The start-up ECT is between -40Â°C and 58Â°C (-40Â°F and 136Â°F).

- The ambient temperature is between -7Â°C and 60Â°C (19Â°F and 140Â°F)
- The vehicle spends at least 50 percent of the time off idle (Throttle Position is greater than 10%, Vehicle Speed is greater than 16 km/ph (10 mph), and Engine Speed is greater than 1, 000 RPM).
- DTC runs once per ignition cycle when above conditions are met.

Conditions for Setting the DTC

The ECM determines that the modeled ECT has met the calibrated target of 88Â°C (190Â°F) and the measured ECT is less than 77Â°C (171Â°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.
- Inspect the ECT sensor terminals and the ECT harness connector for corrosion. This condition 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 Wiring Schematics 1.6L (LH7)

Connector End View Reference

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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, verify that DTC P0101, P0102, P0103, P0112, P0113, P0117, P0118, P2122, P2123, P2127, P2128, P2138, or P2199 is not set.

- If DTC P0101, P0102, P0103, P0112, P0113, P0117, P0118, P2122, P2123, P2127, P2128, P2138, or P2199 is set

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

- **Go to next step: If DTC P0101, P0102, P0103, P0112, P0113, P0117, P0118, P2122, P2123, P2127, P2128, P2138, or P2199 is not set**
2. Verify the cooling system is filled to the correct coolant level. Refer to [Cooling System Draining and Filling \(GE 47716\)](#), [Cooling System Draining and Filling \(Static\)](#), and [Loss of Coolant](#).
 - **If the coolant level is not correct**
Repair as necessary
 - **Go to next step: 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 80°C (176°F).
 - **If less than 80°C (176°F)**
Replace the Engine Coolant Thermostat.
 - **Go to next step: If greater than 80°C (176°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.
 - **Go to next step: 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 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.
 - **Go to next step: If less than 5 Ω**
3. Ignition ON.
4. Verify the scan tool ECT Sensor parameter is colder than -38°C (-36°F).
 - **If warmer than -38°C (-36°F)**
 1. Ignition OFF, disconnect the harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **Go to next step: If colder than -38°C (-36°F)**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2.
6. Verify the scan tool ECT sensor parameter is warmer than 138°C (280°F).
 - **If 138°C (280°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.
 - **Go to next step: If warmer than 138°C (280°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.
 - **Go to next step: 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.
 - **Go to next step: If infinite resistance**
4. Refer to [Thermostat Diagnosis](#).

Repair Instructions

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

- Refer to [Engine Coolant Temperature Sensor Replacement \(FWD\)](#), [Engine Coolant Temperature Sensor Replacement \(AWD\)](#).
- Refer to [Engine Coolant Thermostat Replacement \(LH7\)](#).
- Refer to [Control Module References](#) for ECM replacement, setup, and programming.

DTC P0171 OR P0172: FUEL SYSTEM LEAN/RICH

Diagnostic Instructions

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

DTC Descriptors

DTC P0171

Fuel System Lean

DTC P0172

Fuel System Rich

Circuit/System Description

In order to compensate for variations in the fuel system, the fuel mass observer function adapts a correction quantity using the difference between the measured and modeled oxygen content of the exhaust gas coming from NOx Sensor 1. A DTC will set when the correction quantity reaches the maximum control limit. If the correction quantity is below the calibrated feedback limit for a specified time, the corresponding "Fuel System Lean" fault will be set. If the correction quantity is above the calibrated feedback limit for a specified time, the corresponding "Fuel System Rich" fault will be set.

Conditions for Running the DTC

- DTC P0071-P0074, P0101-P0103, P10B-P10D, P0111-P0114, P0116-P0119, P0128, P0181-P0183, P0201-P0204, P020A-P020D, P0216, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P02EE, P02EF, P02F0, P02F1, P0335, P0336, P0502, P0503, P062B, P062D, P0722, P0723, P111E, P2147, P2148, P1249, P124A-P124C, P2150-P2154, P2156, P2157 P2227-P2230 or P262B is not set.
- Ignition voltage is greater than 11 V.
- Ambient air temperature is warmer than -7°C (19°F).
- Engine coolant temperature is warmer than 65°C (149°F).
- NOx sensor must be active.
- Engine running.
- BARO is above 75 kPa.
- Diesel Particulate Filter (DPF) regeneration is not active.
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM has determined that the Fuel Mass Observer emission correction quantity has exceeded the calibrated limit for greater than 12 s.

Action Taken When the DTC Sets

DTCs P0171 and P0172 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0171 and P0172 are Type B DTCs.

Diagnostic Aids

- This Diagnostic parameter is stored in the ECM over a period of time. Time to set this DTC may take several drive cycles.
- Contaminated or improper fuel quality may cause this DTC to set.
- Worn base engine components or differences in cylinder compression may cause this DTC to set.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

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

DTC Type Reference

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

Scan Tool Reference

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

[Circuit/System Verification](#)

1. Verify DTC P0101, P0102, P0103, P014C, P0201, P0202, P0203, P0204, P0205, P0206, P0207, or P0208 is not set.
 - **If any of the DTCs are set**
 Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.
 - **Go to next step: If none of the DTCs are set .**
2. Verify the scan tool MAF Sensor parameter is between 5 and 40 g/s.
 - **If less than 5 g/s**
 Check for intake system leaks. Refer to [Charge Air Cooler Diagnosis \(Leak Test\)](#). [Charge Air Cooler Diagnosis \(Smoke Test\)](#) .
 If no intake system leaks are found, perform a [Diesel Particulate Filter \(DPF\) Service Regeneration](#) .
 - **If greater than 40 g/s**
 Check for intake system leaks. Refer to [Charge Air Cooler Diagnosis \(Leak Test\)](#). [Charge Air Cooler Diagnosis \(Smoke Test\)](#) .
 - **Go to next step: If between 5 and 40 g/s**
3. Verify there are no exhaust system leaks. Refer to [Exhaust Leakage](#) .
 - **If exhaust system leaks were found**
 Repair as necessary.
 - **Go to next step: If no exhaust system leaks were found**
4. Replace the B195A Nitrogen Oxides Sensor 1.

[Repair Instructions](#)

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

- Refer to [Nitrogen Oxides Sensor Replacement - Position 1](#)
- Perform the scan tool NOx Sensor 1 Reset procedure after replacing NOx sensor 1.
- Refer to [Fuel Injector Replacement](#)
- Perform the [Fuel Injector Flow Rate Programming](#) procedure after replacement of a fuel injector.

DTC P0181, P0182, P0183, OR P0184: FUEL TEMPERATURE SENSOR PERFORMANCE/FUEL TEMPERATURE SENSOR CIRCUIT

[Diagnostic Instructions](#)

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.

- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0181

Fuel Temperature Sensor Performance

DTC P0182

Fuel Temperature Sensor Circuit Low Voltage

DTC P0183

Fuel Temperature Sensor Circuit High Voltage

DTC P0184

Fuel Temperature Sensor Circuit Erratic

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0182	P0183, P0184	P0183, P0184	P0181
Low Reference	-	P0183, P0184	P0184	P0181

Circuit/System Description

The fuel temperature sensor is integrated within the fuel filter assembly. The fuel temperature sensor is a variable resistor that measures the temperature of the fuel. The engine control module (ECM) supplies 5 V to the signal circuit and supplies a ground to the low reference circuit. The following table illustrates the difference between temperature, resistance, and voltage:

Fuel Temperature Sensor	Resistance	Signal Voltage
Cold	High	High
Warm	Low	Low

Conditions for Running the DTC

P0181

- DTC P0116, P0117, P0118, P0182, P0183, P1103, P111E, P16D7-P16D9, or P262B is not set.
- Engine is running.
- Engine Off time is greater than 8 h.
- Engine run time is between 8 and 9 s.
- Fuel Temperature Sensor is within 23Â°C (41Â°F) of the ECT Sensor
- Ignition voltage is greater than 11 V.
- Start-up ECT is greater than -40Â°C (-40Â°F).
- This DTC runs once per ignition cycle when the above conditions are met.

P0182 or P0183

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

P0184

- DTC P0182 or P0183 is not set.

- Ignition voltage is greater than 11 V.
- This DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

P0181

The ECM recognizes the malfunction of the circuit via an internal evaluation logic.

P0182

The ECM detects the fuel temperature sensor is shorted to ground for more than 2 s.

P0183

The ECM detects the fuel temperature sensor is shorted to voltage for more than 2 s.

P0184

The ECM detects that the fuel temperature sensor signal is intermittent or has abruptly changed for at least 1.5 s.

Action Taken When the DTC Sets

DTCs P0181, P0182, P0183 and P0184 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0181, P0182, P0183 and P0184 are Type B DTCs.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

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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 the scan tool Fuel Temperature Sensor parameter is within the operating range of -39 to 149°C (-38 to 300°F), depending on current ambient temperature and the vehicle operating conditions.
 - **If not within the specified range**

Refer to Circuit/System Testing
 - **Go to next step: If within the specified range**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify DTC does not set.
 - **If DTC sets**

Refer to Circuit/System Testing
 - **Go to next step: If DTC does not set**
5. All OK.

Circuit/System Testing

1. Ignition Off and all vehicle systems Off.
2. 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.
3. Disconnect harness connector at the E11A Fuel Heater/Water in Fuel Sensor.
4. Test for less than $10\ \Omega$ between the low reference circuit terminal 1 and ground.
 - **If $10\ \Omega$ or greater**
 1. Ignition Off.
 2. Disconnect harness connector X2 at the K20 Engine Control Module.
 3. 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.
 - **Go to next step: If less than $10\ \Omega$**
5. Ignition On.
6. Verify the scan tool Fuel Temperature Sensor parameter is colder than -39°C (-38°F).
 - **If warmer than -39°C (-38°F)**
 1. Ignition Off.
 2. Disconnect harness connector X2 at the K20 Engine Control Module.
 3. 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, replace the K20 Engine Control Module.
 - **Go to next step: If colder than -39°C (-38°F)**
7. Install a 3 A fused jumper wire between the signal circuit terminal 2 and ground.
8. Verify that the scan tool Fuel Temperature Sensor parameter is warmer than 149°C (300°F).
 - **If colder than 149°C (300°F)**
 1. Ignition Off.
 2. Disconnect harness connector X2 at the K20 Engine Control Module.
 3. Ignition On.
 4. 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
 5. Ignition Off.
 6. Test for less than $2\ \Omega$ in the circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K20 Engine Control Module.
- **Go to next step: If warmer than 149 $^{\circ}$ C (300 $^{\circ}$ F)**

9. Replace the E11A Fuel Heater/Water in Fuel Sensor.

Repair Instructions

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

- For E11A Fuel Heater/Water in Fuel Sensor replacement refer to: [Fuel Filter Assembly Replacement \(AWD\)](#), [Fuel Filter Assembly Replacement \(FWD\)](#).
- For Control Module replacement, programming and setup refer to: [Control Module References](#)

DTC P018B, P018C, OR P018D: FUEL PRESSURE SENSOR PERFORMANCE/FUEL PRESSURE SENSOR CIRCUIT VOLTAGE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC 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	P0097, P00F4, P018C, P0641, P0340, P0405, P0522, P0532, P2199, P227C, P2454	P018C	P018D, P0641, P0523, P0533, P227D, P2455	P018B
Signal	P018C	P018C, P2635	P018D*	P018B
Low Reference	-	P018B	*	P018B

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

Typical Scan Tool Data

Fuel Pressure Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine = Running Parameter Normal Range: 0.2 to 4.8 V			
5 V Reference	0 V	0 V	5 V
Signal	0 V	0 V	5 V
Low Reference	-	5 V	-

Circuit/System Description

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

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

Component	Description
B47 Fuel Pressure Sensor	The sensor measures the pressure in the component: Fuel Line The signal voltage increases when the pressure increases.
K111 Fuel Pump Driver Control Module	The control module K111 supplies the fuel pump with a 3-phase voltage in order to achieve the desired pump speed required for building fuel line pressure.

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

Conditions for Running the DTC

P018B

- DTC P018C, P018D, P0641, P1029, P102A, P102B, P102C, P1255, P129F, P12A6, P165C = Not set
- Engine = Running - For greater than 5 s
- Fuel Pump Enable = On
- Fuel level = Greater than 10%

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

P018C, P018D

Engine = Running

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

Conditions for Setting the DTC

P018B

Fuel Pressure Sensor = Change is less than 30 kPa (4.4 PSI) - For greater than 5 s

P018C

Fuel Pressure Sensor = Less than 0.2 V - For greater than 5 s

P018D

Fuel Pressure Sensor = Greater than 4.8 V - For greater than 1 s

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

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- **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, P165C is not set.
 - **If any of the DTCs are set**

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

 - **Go to next step: If none of the DTCs are set**
3. Verify there are no DTCs set related to the following system/component:
 - K111 Fuel Pump Driver Control Module
 - 5V Reference
 - **If a related DTC is set**

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

- **Go to next step: If a related DTC is not set**
4. Engine - Running
 5. Verify the scan tool parameter: Fuel Pressure Sensor = 0.2 to 4.8 V
 - **If not between 0.2 and 4.8 V**

Refer to: Circuit/System Testing

 - **Go to next step: If between 0.2 and 4.8 V**
 6. Verify the scan tool parameter: Fuel Pressure Sensor = The value should not spike or drop out.

Perform the action while monitoring the parameter:

- Wiggle the harness and connector: B47 Fuel Pressure Sensor
- Wiggle the harness and connector: K111 Fuel Pump Driver Control Module
- **If the value spikes or drops out**

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

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

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

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

8. All OK.

Circuit/System Testing

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

1. Ignition/Vehicle & All vehicle systems - Off

2. Disconnect the electrical connector: B47 Fuel Pressure Sensor

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

- **If 10 ohms or greater**

1. Disconnect the electrical connector: K111 Fuel Pump Driver Control Module

2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 2 @ Component harness & Terminal 27 @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K111 Fuel Pump Driver Control Module

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

4. Ignition - On/Vehicle - In Service Mode

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

- **If less than 4.8 V**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: K111 Fuel Pump Driver Control Module

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

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

4. Test for less than 2 ohms between the test points: 5 V Reference circuit terminal 1 @ Component harness & Terminal 12 @ Control module harness

- If 2 ohms or greater - Repair the open/high resistance in the circuit.
- If less than 2 ohms - Replace the component: K111 Fuel Pump Driver Control Module

- **If greater than 5.2 V**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: K111 Fuel Pump Driver Control Module

3. Ignition - On/Vehicle - In Service Mode

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

4. Test for less than 1 V between the test points: 5 V Reference circuit terminal 1 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K111 Fuel Pump Driver Control Module
 - **Go to next step: If between 4.8 and 5.2 V**
6. Verify the scan tool parameter: Fuel Pressure Sensor = Less than 0.2 V
 - **If 0.2 V or greater**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K111 Fuel Pump Driver Control Module
 3. Ignition - On/Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 3 @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K111 Fuel Pump Driver Control Module
 - **Go to next step: If less than 0.2 V**
7. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 3 & 5 V Reference circuit terminal 1
8. Verify the scan tool parameter: Fuel Pressure Sensor = Greater than 4.8 V
 - **If 4.8 V or less**
 1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
 2. Disconnect the electrical connector: K111 Fuel Pump Driver Control Module
 3. Test for infinite resistance between the test points: Signal circuit terminal 3 @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance
 4. Test for less than 2 ohms between the test points: Signal circuit terminal 3 @ Component harness & Terminal 26 @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K111 Fuel Pump Driver Control Module
 - **Go to next step: If greater than 4.8 V**
9. Test or replace the component: B47 Fuel Pressure Sensor

Repair Instructions

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

- Refer to [Fuel Pressure Sensor Replacement - Fuel Feed Pipe \(AWD\)](#), [Fuel Pressure Sensor Replacement - Fuel Feed Pipe \(FWD\)](#) - B47 Fuel Pressure Sensor
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P0191, P0192, OR P0193: FUEL RAIL PRESSURE SENSOR PERFORMANCE/FUEL RAIL PRESSURE SENSOR CIRCUIT VOLTAGE

Diagnostic Instructions

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

DTC Descriptors

DTC P0191

Fuel Rail Pressure Sensor Performance

DTC P0192

Fuel Rail Pressure Sensor Circuit Low Voltage

DTC P0193

Fuel Rail Pressure Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference Voltage	P0193, P06A3, P127D	P0193, P127D	P0193, P06A3, P127D	-
Fuel Rail Pressure Sensor Signal 1	P0192	P0193	P0193	P0191
Fuel Rail Pressure Sensor Signal 2	P127C	P127D	P127D	P0191
Low Reference	-	P0193, P127D	P0193, P127D	P0191

Circuit/System Description

The fuel rail pressure sensor measures the fuel pressure within the fuel rail. The engine control module (ECM) monitors the voltage on the fuel rail pressure sensor circuits. The ECM supplies 5 V to the 5 V reference circuit and a ground to the low reference circuit. The fuel rail pressure sensor provides a signal voltage to the ECM, relative to the pressure changes within the fuel rail, on the fuel rail pressure sensor signal circuit.

Conditions for Running the DTC

P0191

- DTC P0116, P0117, P0118, P0119, P0128, P0192, P0193 or P111E is not set.
- Engine Coolant Temperature is warmer than -40°C (-40°F)
- Ignition voltage is greater than 6.0 V.
- The DTC runs continuously when the above conditions are met.

P0192 or P0193

- Ignition On or engine running.
- Ignition voltage is greater than 8.6 V
- The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

P0191

The fuel rail pressure sensor voltage is less than 0.3 V or greater than 0.7 V for 1 s, with the ignition On.

OR

The difference between fuel rail pressure sensor 1 and fuel rail pressure sensor 2 is greater than 21 MPa (3046 PSI) for more than 1 s.

P0192

The ECM detects that the fuel pressure sensor voltage is less than 0.2 V for 1 s.

P0193

The ECM detects that the fuel pressure sensor voltage is greater than 4.8 V for 1 s.

Action Taken When the DTC Sets

DTCs P0191, P0192, and P0193 are Type A DTCs.

Conditions for Clearing the DTC

DTCs P0191, P0192, and P0193 are Type A DTCs.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

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DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

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

Circuit/System Verification

1. With engine running, verify the scan tool Fuel Rail Pressure Sensor is between 0.4 - 4.5 V and changes with engine load conditions.
 - **If not between 0.4 - 4.5 V or does not change**

Refer to Circuit/System Testing.
 - **Go to next step: If between 0.4 - 4.5 V and changes**
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 DTC P0191, P0192, or P0193 is set**

Refer to Circuit/System Testing.
 - **Go to next step: If DTC P0191, P0192, or P0193 is not set**
4. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B47B Fuel Rail 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 3 and ground.
 - **If 10 Ω or greater**
 1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **Go to next step: If less than 10 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 X2 harness connector at the K20 Engine Control Module 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 X2 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.
 - **Go to next step: If between 4.8 - 5.2 V**
5. Verify the scan tool Fuel Rail Pressure Sensor parameter is greater than 4.8 V.
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect the X2 harness connector at the K20 Engine Control Module.
 2. Test for infinite resistance between the signal circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **Go to next step: If 5 V**
6. Connect a 3 A fused jumper wire between the signal circuit terminal 4 and ground.
7. Verify the scan tool Fuel Rail Pressure Sensor parameter is less than 0.4 V.
 - **If parameter is greater than 0.4 V**
 1. Ignition OFF, disconnect the X2 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.
 - **Go to next step: If the parameter is less than 0.4 V**
8. Replace the B47B Fuel Rail Pressure Sensor.

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

- Refer to [Fuel Pressure Sensor Replacement](#) for B47B Fuel Rail Pressure Sensor replacement.
- Refer to [Control Module References](#) for Engine Control Module replacement, programming and setup.

DTC P01CB, P01CC, P01CD, P01CE, P01CF, P01D0, P01D1, OR P01D2: CYLINDER 1-4 INJECTION TIMING RETARDED/ADVANCED

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 P01CB

Cylinder 1 Injection Timing Retarded

DTC P01CC

Cylinder 1 Injection Timing Advanced

DTC P01CD

Cylinder 2 Injection Timing Retarded

DTC P01CE

Cylinder 2 Injection Timing Advanced

DTC P01CF

Cylinder 3 Injection Timing Retarded

DTC P01D0

Cylinder 3 Injection Timing Advanced

DTC P01D1

Cylinder 4 Injection Timing Retarded

DTC P01D2

Cylinder 4 Injection Timing Advanced

Circuit/System Description

To minimize engine vibrations at idle the engine control module can detect even small variations in engine speed and compensates these variations by adjusting the amount of injected fuel for each cylinder individually. This smooth-running control works only inside calibrated limits. The engine control module calculates the injected fuel quantity in two different ways:

- Fuel quantity based on the time the injector was turned on.
- Fuel quantity based on the increase in crankshaft speed when a specific cylinder fires.

Values that differ too much indicate that the injector is not working properly or that something is mechanically wrong with the cylinder.

Conditions for Running the DTC

- DTC Present = No
- Battery Voltage = Greater than 11 V
- Ambient Air Temperature = Warmer than -7°C (19°F)
- Fuel level = Greater than 10%
- BARO Sensor 2 = Greater than 72 kPa (10 PSI)
- Fuel Temperature = 0 to 70°C (32 to 158°F)
- Engine Coolant Temperature = 68 to 126°C (154 to 259°F)
- Transmission Gear = Gear 3, 4, 5, 6
- Diesel Particulate Filter Regeneration Active = No
- Deceleration Fuel Cut-Off = Active - Greater than 20 s
- Engine Speed = 1200 to 2100 RPM
- Accelerator Pedal Position = Less than 0.05%
- Vehicle Speed = Greater than 0 km/h (0 MPH)

DTC runs once per trip when the above conditions are met for greater than 1 s.

Conditions for Setting the DTC

DTC P01CB, P01CC

- Fuel Injection Quantity = Out Of Range - Cylinder 1
- Fuel Injection Timing = Out Of Range - Cylinder 1

DTC P01CD, P01CE

- Fuel Injection Quantity = Out Of Range - Cylinder 2
- Fuel Injection Timing = Out Of Range - Cylinder 2

DTC P01CF, P01D0

- Fuel Injection Quantity = Out Of Range - Cylinder 3
- Fuel Injection Timing = Out Of Range - Cylinder 3

DTC P01D1, P01D2

- Fuel Injection Quantity = Out Of Range - Cylinder 4
- Fuel Injection Timing = Out Of Range - Cylinder 4

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Verify DTC P0087, P00C7, P00E9, P00EA, P00EB, P00EC, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0117, P0118, P0119, P0128, P0181, P0182, P0183, P0201, P0202, P0203, P0204, P020A, P020B, P020C, P020D, P0216, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P02E4, P02E5, P02EE, P02EF, P02F0, P02F1, P0335, P0336, P0403, P0405, P0406, P042E, P042F, P049D, P062B, P062D, P0806, P0807, P0808, P080A, P1089, P111E, P1248, P1249, P124A, P124B, P1402, P1407, P140F, P1424, P163A, P16F3, P2006, P2008, P2009, P200A, P2010, P2015, P2016, P2017, P20F8, P2147, P2148, P2150, P2151, P2227, P2228, P2229, P2230, P228A, P228B, P228C is not set.

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

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

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

2. Verify the condition does not exist:

- Fuel Type Incorrect
- Fuel Contaminated/Poor Quality
- **If a condition exists**

Refer to: [Fuel System Specifications](#) , [Contaminants-in-Fuel Diagnosis](#)

- If no condition exists

3. Inspect for aftermarket devices which may affect the operation of the system.

- If a condition exists - Repair or replace as necessary
- If no condition exists

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

5. Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

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

6. All OK.

Circuit/System Testing

1. Perform a conventional engine compression test. Refer to: [Engine Compression Test](#)

- ***If one or more cylinders indicate low compression***

Repair as necessary

- *Go to next step: If all cylinders indicate normal compression*

2. Replace the component: Q17 Fuel Injector

Repair Instructions

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

- Refer to [Fuel Injector Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P01F0: COOLANT TEMPERATURE DROPPED BELOW DIAGNOSTIC MONITORING 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.
- Refer to [Diagnostic Procedure Instructions](#) to provide an overview of each diagnostic category.

DTC Descriptor

DTC P01F0

Coolant Temperature Dropped Below Diagnostic Monitoring Temperature

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0117	P0118, P0119	P0118*, P0119	P0119, 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 149Â°C (-38 to 300Â°F)			
ECT Sensor	150Â°C (302Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)
Low Reference	-	-40Â°C (-40Â°F)	-

Circuit/System Description

The engine coolant thermostat diagnosis is responsible to detect a delay in warming up of the engine coolant temperature. A stuck open thermostat is detected by monitoring the coolant temperature for a decrease below the diagnostic monitoring threshold during driving after the temperature once increases above the same threshold.

The purpose of this rationality diagnostics is to use the ECT sensor to determine if the engine coolant will heat up at the correct rate, and also meet the calibrated target temperatures under various operating conditions.

Conditions for Running the DTC

- No active DTCs set.
- The Engine Speed is less than 5000 RPM.
- The Engine run time is greater than 30 s.

- The Ambient Air Temperature is greater than -7°C (19°F)
- The Engine Coolant Temperature is less than 70°C (158°F) during the current ignition cycle.
- This DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM determines that the engine coolant temperature is less than 70°C (158°F) for more than 80 s.

Action Taken When the DTC Sets

DTC P01F0 is a Type B DTC.

Conditions for Clearing the DTC

DTC P01F0 is a Type B DTC.

Diagnostic Aids

- Inspect the ECT sensor terminals and the ECT harness connector for corrosion. This condition 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 Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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Cooling System Description and Operation

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- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON, verify that DTC P0117, P0118, P0119, or P0128 is not set.

- If DTC P0117, P0118, P0119, or P0128 is set

Refer to Diagnostic Trouble Code (DTC) List - Vehicle

- Go to next step: If DTC P0117, P0118, P0119, or P0128 is not set

2. Verify the cooling system is filled to the correct coolant level. Refer to **Cooling System Draining and Filling (GE 47716)**, **Cooling System Draining and Filling (Static)**, and **Loss of Coolant**.

- **If the coolant level is not correct**

Repair as necessary

- **Go to next step: 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 80°C (176°F).

- **If less than 80°C (176°F)**

Replace the Engine Coolant Thermostat.

- **Go to next step: If greater than 80°C (176°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.

- **Go to next step: 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 $5\ \Omega$ between the low reference circuit terminal A or 2 and ground.

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

1. Ignition OFF, disconnect the harness connector X2 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.

- **Go to next step: 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 X2 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.

- **Go to next step: 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 150°C (302°F).

- **If 150°C (302°F) or colder**

1. Ignition OFF, remove the jumper wire, disconnect the harness connector X2 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.

• **Go to next step: If warmer than 150°C (302°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.

• **Go to next step: 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.

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

4. Refer to [Thermostat Diagnosis](#).

Repair Instructions

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

- Refer to [Engine Coolant Temperature Sensor Replacement \(FWD\)](#), [Engine Coolant Temperature Sensor Replacement \(AWD\)](#).
- Refer to [Engine Coolant Thermostat Replacement \(LH7\)](#), Engine Coolant Thermostat Replacement.
- Refer to [Control Module References](#) for ECM replacement, setup, and programming.

DTC P0201, P0202, P0203, OR P0204: CYLINDER 1-4 INJECTOR CONTROL CIRCUIT

Diagnostic Instructions

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

DTC Descriptors

DTC P0201

Cylinder 1 Injector Control Circuit

DTC P0202

Cylinder 2 Injector Control Circuit

DTC P0203

Cylinder 3 Injector Control Circuit

DTC P0204

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Cylinder 1 Fuel Injector High Voltage Supply	P2147	P0201	P2148	P1248*
Cylinder 2 Fuel Injector High Voltage Supply	P2150	P0202	P2151	P1249*
Cylinder 3 Fuel Injector High Voltage Supply	P2150	P0203	P2151	P124A*
Cylinder 4 Fuel Injector High Voltage Supply	P2147	P0204	P2148	P124B*
Cylinder 1 Fuel Injector High Voltage Control	P0261	P0201	P0262, P2148	P1248*
Cylinder 2 Fuel Injector High Voltage Control	P0264	P0202	P0265, P2151	P1249*
Cylinder 3 Fuel Injector High Voltage Control	P0267	P0203	P0268, P2151	P124A*
Cylinder 4 Fuel Injector High Voltage Control	P0270	P0204	P0271, P2148	P124B*
* Short from Supply Circuit to Control Circuit				

Circuit/System Description

The engine control module (ECM) supplies voltage to each fuel injector on the injector positive voltage control circuits. The ECM energizes each fuel injector by grounding the control circuit of that fuel injector. The ECM monitors the status of the injector positive voltage control circuits and the fuel injector control circuits. The injectors are separated into the following two groups:

- Group 1 - Injectors 1 and 4
- Group 2 - Injectors 2 and 3

When a fuel injector circuit condition is detected by the ECM, the affected fuel injector will be disabled and may disable the affected group of fuel injectors.

Conditions for Running the DTC

- The engine is running.
- The ECM monitors for a condition once per camshaft revolution.

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 500 ms.

Action Taken When the DTC Sets

DTCs P0201, P0202, P0203 and P0204 are Type A DTCs.

Conditions for Clearing the DTC

DTCs P0201, P0202, P0203 and P0204 are Type A DTCs.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

Component View Reference

Powertrain Component Views

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- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

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

Circuit/System Verification

1. Engine running.
2. Verify that DTCs P062D, P2147, P2148, P2150 or P2151 is not set.
 - **If DTCs P062D, P2147, P2148, P2150 or P2151 is set**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **Go to next step: If DTCs P062D, P2147, P2148, P2150 or P2151 is not set**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify that DTCs P0201, P0202, P0203 and P0204 does not set.
 - **If DTC P0201, P0202, P0203, or P0204 is set**
Refer to Circuit/System Testing
 - **Go to next step: If DTC P0201, P0202, P0203, or P0204 is not set**
5. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems off.
2. It may take up to 2 min for all vehicle systems to power down.
3. Disconnect the harness connector at the appropriate Q17 Fuel Injector.
4. Ignition ON.
5. Test for 4.5 - 6.5 V between the high voltage supply circuit terminal 1 and ground.
 - **If less than 4.5 V**
 1. Ignition OFF.
 2. Disconnect the X2 harness connector at the K20 Engine Control Module.
 3. Test for infinite resistance between the supply circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 4. Test for less than 2 Ω in the supply 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 6.5 V**
 1. Ignition OFF.
 2. Disconnect the harness connector X2 at the K20 Engine Control Module, Ignition ON.
 3. Test for less than 1 V between the high voltage supply circuit terminal 1 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **Go to next step: If between 4.5 - 6.5 V**
- 6. Test for 0.60 - 0.80 V between the high voltage control circuit terminal 2 and ground.
 - **If less than 0.60 V**
 1. Ignition OFF.
 2. Disconnect the harness connector X2 at the K20 Engine Control Module.
 3. 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
 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 greater than 0.80 V**
 1. Ignition OFF.
 2. Disconnect the harness connector X2 at the K20 Engine Control Module, Ignition ON.
 3. Test for less than 1 V between the control circuit terminal 2 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **Go to next step: If between 0.60 - 0.80 V**
- 7. Test or replace the appropriate Q17 Fuel Injector.

Component Testing

Static Test

1. Ignition OFF.
2. Disconnect the harness connector at the appropriate Q17 Fuel Injector.

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

3. Test for 0.2 - 1.5 Ω between the supply terminal 1 and the control terminal 2.
 - **If not between 0.2 - 1.5 Ω**
Replace the appropriate Q17 Fuel Injector.
 - **Go to next step: If between 0.2 - 1.5 Ω**
4. Test for infinite resistance between each terminal and the injector housing/case.
 - **If less than infinite resistance**
Replace the appropriate Q17 Fuel Injector.
 - **Go to next step: If infinite resistance**
5. All OK

Repair Instructions

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

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

DTC P020A, P020B, P020C, OR P020D: CYLINDER 1-4 INJECTION TIMING

Diagnostic Instructions

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

DTC Descriptors

DTC P020A

Cylinder 1 Injection Timing

DTC P020B

Cylinder 2 Injection Timing

DTC P020C

Cylinder 3 Injection Timing

DTC P020D

Cylinder 4 Injection Timing

Circuit/System Description

The engine control module (ECM) supplies voltage to each fuel injector on the injector positive voltage control circuits. The ECM energizes each fuel injector by grounding the control circuit of that fuel injector. The ECM monitors the status of the injector positive voltage control circuits and the fuel injector control circuits. The injectors are separated into the following two groups:

- Group 1 - Injectors 1 and 4
- Group 2 - Injectors 2 and 3

When a fuel injector circuit condition is detected by the ECM, the affected fuel injector will be disabled and may disable the affected group of fuel injectors.

Conditions for Running the DTC

- The engine is running.
- No other injector faults are present
- The ECM monitors for a condition once per camshaft revolution.

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

DTCs P020A, P020B, P020C and P020D are Type C DTCs.

Conditions for Clearing the DTC

DTCs P020A, P020B, P020C and P020D are Type C DTCs.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

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DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

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

Circuit/System Verification

1. Engine running.
2. Verify that DTCs P062D, P2147, P2148, P2150 or P2151 is not set.
 - **If DTCs P062D, P2147, P2148, P2150 or P2151 is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **Go to next step: If DTCs P062D, P2147, P2148, P2150 or P2151 is not set**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify that DTCs P020A-P020D do not set.
 - **If DTC P020A-P020D is set**

Refer to Circuit/System Testing
 - **Go to next step: If DTC P020A-P020D is not set**
5. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems off.
2. It may take up to 2 min for all vehicle systems to power down.
3. Disconnect the harness connector at the appropriate Q17 Fuel Injector.
4. Ignition ON.
5. Test for 4.5 - 6.5 V between the high voltage supply circuit terminal 1 and ground.
 - **If less than 4.5 V**

1. Ignition OFF.
2. Disconnect the X2 harness connector at the K20 Engine Control Module.
3. Test for infinite resistance between the supply circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
4. Test for less than 2 Ω in the supply 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 6.5 V**
 1. Ignition OFF.
 2. Disconnect the harness connector X2 at the K20 Engine Control Module, Ignition ON.
 3. Test for less than 1 V between the high voltage supply circuit terminal 1 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
- **Go to next step: If between 4.5 - 6.5 V**
6. Test for 0.60 - 0.80 V between the high voltage control circuit terminal 2 and ground.
 - **If less than 0.60 V**
 1. Ignition OFF.
 2. Disconnect the harness connector X2 at the K20 Engine Control Module.
 3. 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
 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 greater than 0.80 V**
 1. Ignition OFF.
 2. Disconnect the harness connector X2 at the K20 Engine Control Module, Ignition ON.
 3. Test for less than 1 V between the control circuit terminal 2 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **Go to next step: If between 0.60 - 0.80 V**
7. Test or replace the appropriate Q17 Fuel Injector.

Component Testing

Static Test

1. Ignition OFF.
2. Disconnect the harness connector at the appropriate Q17 Fuel Injector.

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

3. Test for 0.2 - 1.5 Ω between the supply terminal 1 and the control terminal 2.
 - **If not between 0.2 - 1.5 Ω**

Replace the appropriate Q17 Fuel Injector.
 - **Go to next step: If between 0.2 - 1.5 Ω**
4. Test for infinite resistance between each terminal and the injector housing/case.
 - **If less than infinite resistance**

Replace the appropriate Q17 Fuel Injector.

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

5. All OK

Repair Instructions

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

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

DTC P0216: INJECTOR TIMING CONTROL CIRCUITRY

Diagnostic Instructions

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

DTC Descriptors

DTC P0216

Injector Timing Control Circuitry

Circuit/System Description

The engine control module (ECM) supplies voltage to each fuel injector on the injector positive voltage control circuits. The ECM energizes each fuel injector by grounding the control circuit of that fuel injector. The ECM monitors the status of the injector positive voltage control circuits and the fuel injector control circuits.

Conditions for Running the DTC

- The engine is running.
- The ECM monitors for a Energizing time - Signal plausibility failure.

Conditions for Setting the DTC

The ECM detects that the energizing time exceeds limit of overrun monitoring for more than 140 events every 20 ms.

Action Taken When the DTC Sets

DTC P0216 is a Type B DTC.

Conditions for Clearing the DTC

DTC P0216 is a Type B DTC.

Reference Information

Schematic Reference

[Engine Controls Wiring Schematics 1.6L \(LH7\)](#)

Connector End View Reference

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- [Wiring Repairs](#)

DTC Type Reference

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

Scan Tool Reference

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

Circuit/System Verification

1. Ignition ON.
2. Verify with scan tool that no other DTCs are set.
 - **If DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)
 - **Go to next step: If DTCs are not set**
3. Operate the vehicle within the Conditions for Running the DTC.
4. Verify that DTC P0216 does not set.
 - **If DTC P0216 is set**

Replace the K20 Engine Control Module.
 - **Go to next step: If the DTC does not set**
5. All OK

Repair Instructions

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

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

DTC P0234, P0299, OR P2263: ENGINE OVERBOOST/ENGINE UNDERBOOST/TURBOCHARGER BOOST SYSTEM PERFORMANCE

Diagnostic Instructions

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

DTC Descriptors

DTC P0234

Engine Overboost

DTC P0299

Engine Underboost

DTC P2263

Turbocharger Boost System Performance

The Manifold Absolute Pressure (MAP) sensor measures the pressure inside the intake manifold. Pressure in the intake manifold is affected by turbocharger output, engine speed, accelerator pedal input, ambient air temperature, and Barometric Pressure (BARO). A diaphragm within the MAP pressure sensor is displaced by the pressure changes that occur from the varying load and operating conditions of the engine. The sensor translates these changes into electrical resistance. The Engine Control Module (ECM) supplies a regulated 5 volts on the 5 volt reference circuit and a ground on a low reference circuit. The MAP sensor provides a signal voltage to the ECM, relative to intake manifold pressures, on the MAP sensor signal circuit. The ECM converts the signal voltage input to a pressure value. Under normal operation, the lowest pressure that can exist in the intake manifold is equal to the BARO. This occurs when the throttle is not being used, and while the vehicle is operated at idle or when the ignition is On, and the engine is Off. The highest manifold pressures occur when the turbocharger output is high. Manifold pressure can range from 58 kPa (8 psi) when pressures are low to greater than 276 kPa (40 psi) when pressures are high, depending on the BARO. The MAP pressure sensor has a range of 0 - 365 kPa (0 - 46.8 psi). The ECM monitors boost deviation by comparing a calculated value at a predetermined engine load and speed, to the actual sensor input.

Conditions for Running the DTC**P0234**

- The ignition voltage is greater than 11 V.
- The engine is operating in Closed Loop.
- The engine speed is between 1, 600 and 1, 700 RPM
- The barometric pressure is between 70 and 110 kPa (10 and 16 PSI)
- The ambient air temperature is between -7 and 55°C (19 and 131°F).
- The engine coolant temperature is between 70 and 130°C (158 and 266°F).
- Air flow/throttle valve position is at least 85% when active or at least 75% if not active.
- The ECM is commanding a steady desired boost pressure.
- The DTCs run continuously when the above conditions are met for at least 1 s.

P0299

- The ignition voltage is greater than 11 V.
- The engine is operating in Closed Loop.
- The engine speed is between 900 and 1, 600 RPM
- The barometric pressure is between 70 and 110 kPa (10 and 16 PSI)
- The ambient air temperature is between -7 and 55°C (19 and 131°F).
- The engine coolant temperature is between 70 and 130°C (158 and 266°F).
- Air flow/throttle valve position is at least 85% when active or at least 75% if not active.
- The ECM is commanding a steady desired boost pressure.
- The DTCs run continuously when the above conditions are met for at least 1 s.

P2263

- The ignition voltage is greater than 11 V.
- The engine is operating in Closed Loop.
- The engine speed is between 560 and 3, 100 RPM
- The barometric pressure is between 70 and 110 kPa (10 and 16 PSI)
- The ambient air temperature is between -7 and 55°C (19 and 131°F).
- The engine coolant temperature is between 70 and 130°C (158 and 266°F).
- Air flow/throttle valve position is at least 85% when active or at least 75% if not active.
- The desired boost pressure is between 70 and 320 kPa (10 and 46 PSI).
- The ECM is commanding a steady desired boost pressure.
- The DTCs run continuously when the above conditions are met for at least 1 s.

Conditions for Setting the DTC

P0234

The actual turbocharger boost pressure is greater than the desired range for greater than 10 s.

P0299

The actual turbocharger boost pressure is less than the desired range for greater than 10 s.

P2263

The actual boost pressure is greater or less than expected, during steady state boost control, for a cumulative time of greater than 10 s.

Action Taken When the DTC Sets

- DTCs P0234 and P0299 are Type B DTCs.
- DTC P2263 is Type A DTC
- Engine power is reduced

Conditions for Clearing the DTC

- DTCs P0234 and P0299 are Type B DTCs.
- DTC P2263 is Type A DTC

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

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

Special Tools

EN-23738-A Mityvac

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

Circuit/System Verification

1. Ignition ON
2. Verify that DTC P003A, P0045, P0047, P0048, P00C7, P007B, P007C, P007D, P007E, P0106, P0107, P0108, P02E0, P02E2, P02E3, P02E4, P02E5, P026A, P0502, P0503, P0722, P0723,

P0111, P0112, P0113, P0114, P0101, P0102, P0103, P010B, P010C, P010D, P0116, P0117, P0118, P0119, P0128, P111E, P02E8, P02E9, P122D, P16A0, P16A1, P16A2, P2227, P2228, P2229, or P2230 is not set.

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

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

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

3. Verify the scan tool MAP Sensor parameter is within the range listed in the following table:

[Altitude Versus Barometric Pressure](#)

- **If not within the specified range**

Refer to [DTC P0107 or P0108](#) Circuit/System Testing.

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

4. Engine running, increase the engine speed to 2,000 RPM.

5. Verify the scan tool MAP Sensor pressure parameter increases and decreases with the engine speed.

- **If the MAP Sensor parameter does not increase and decrease**

Refer to Circuit/System Testing.

- **Go to next step: If the MAP Sensor parameter does increase and decrease**

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

Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

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

7. All OK

[Circuit/System Testing](#)

1. Verify the conditions listed below do not exist:

- Loose clamps, cracks or other damage in the air intake system.
- Collapsed or restricted intake duct system.
- Air flow restrictions, including the air filter.
- Air leaks between the turbocharger and the intake air flow valve, including the charge air cooler assembly, refer to [Charge Air Cooler Diagnosis \(Leak Test\)](#), [Charge Air Cooler Diagnosis \(Smoke Test\)](#).
- Leaks at the positive crankcase ventilation (PCV) heater to air cleaner outlet duct interface.
- Missing, restricted or leaking exhaust components including the EGR valve, refer to [Symptoms - Engine Exhaust](#).
- Loose or incorrect installation of any components.
- Aftermarket components.
- Incorrect fuel content or contamination, refer to [Contaminants-in-Fuel Diagnosis](#).
- **If any condition is found**

Repair the condition or replace the component as necessary.

- **Go to next step: If no condition is found**

2. Verify the conditions listed below do not exist:

- Damaged turbocharger.
- Debris in the turbocharger.

- Sticking or obstructed turbocharger vanes.
- Damaged or restricted turbocharger vane control actuator.
- **If any condition is found**

Repair the condition or replace the component as necessary.

- **Go to next step: If no condition is found**

3. Disconnect the vacuum source from the Q41 Turbocharger Vane Position Control Solenoid Valve.
4. Connect the **EN-23738-A** Mityvac to the Q41 Turbocharger Vane Position Control Solenoid Valve vacuum supply hose. Engine running, verify the vacuum is greater than -50 kPa (-7.25 PSI).

- **If -50 kPa (-7.25 PSI) or less**

Inspect the vacuum supply hose and filter for a leak or restriction. If the supply hose is normal, replace the vacuum pump.

- **Go to next step: If greater than -50 kPa (-7.25 PSI)**

5. Connect the vacuum source to the Q41 Turbocharger Vane Position Control Solenoid Valve. Connect the **EN-23738-A** Mityvac to the Q41 Turbocharger Vane Position Control Solenoid Valve vacuum port on the Q41 Turbocharger Vane Position Control Solenoid Valve.
6. Engine running, command the Turbocharger Vane Position to 5% with a scan tool. Verify the vacuum is between 0 to -40 kPa (0 to - 5.8 PSI).

- **If greater than -40 kPa (-5.8 PSI)**

Replace the Q41 Turbocharger Vane Position Control Solenoid Valve.

- **Go to next step: If between 0 to -40 kPa (-5.8 PSI)**

7. Command the Turbocharger Vane Position ON with a scan tool. Verify the vacuum is greater than -50 kPa (-7.25 PSI).

- **If -50 kPa (-7.25 PSI) or less**

Replace the Q41 Turbocharger Vane Position Control Solenoid Valve.

- **Go to next step: If greater than -50 kPa (-7.25 PSI)**

8. Inspect the turbocharger oil supply lines for a restriction.

- **If any restrictions are present**

Repair or replace as necessary.

- **Go to next step: If no restrictions are present**

9. Replace the turbocharger.

Repair Instructions

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

- Refer to [Turbocharger Wastegate Actuator Vacuum Control Solenoid Valve Replacement](#) - Q41 Turbocharger Vane Position Control Solenoid Valve
- Refer to [Turbocharger Replacement](#)
- Refer to [Control Module References](#) for Engine Control Module replacement, programming and setup.

DTC P0261, P0262, P0264, P0265, P0267, P0268, P0270, OR P0271: CYLINDER 1-4 INJECTOR CONTROL CIRCUIT LOW/HIGH VOLTAGE

Diagnostic Instructions

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

DTC Descriptors

DTC 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
Cylinder 1 Fuel Injector High Voltage Supply	P2147	P0201	P2148	P1248*
Cylinder 2 Fuel Injector High Voltage Supply	P2150	P0202	P2151	P1249*
Cylinder 3 Fuel Injector High Voltage Supply	P2150	P0203	P2151	P124A*
Cylinder 4 Fuel Injector High Voltage Supply	P2147	P0204	P2148	P124B*
Cylinder 1 Fuel Injector High Voltage Control	P0261	P0201	P0262, P2148	P1248*
Cylinder 2 Fuel Injector High Voltage Control	P0264	P0202	P0265, P2151	P1249*
Cylinder 3 Fuel Injector High Voltage Control	P0267	P0203	P0268, P2151	P124A*
Cylinder 4 Fuel Injector High Voltage Control	P0270	P0204	P0271, P2148	P124B*
* Short from Supply Circuit to Control Circuit				

Circuit/System Description

The engine control module (ECM) supplies voltage to each fuel injector on the injector positive voltage control circuits. The ECM energizes each fuel injector by grounding the control circuit of that fuel injector. The ECM monitors the status of the injector positive voltage control circuits and the fuel injector control circuits. The injectors are separated into the following two groups:

- Group 1 - Injectors 1 and 4
- Group 2 - Injectors 2 and 3

When a fuel injector circuit condition is detected by the ECM, the affected fuel injectors will be disabled and may disable the affected group of fuel injectors.

Conditions for Running the DTC

- The engine is running.
- The ECM monitors for a condition once per camshaft revolution.

Conditions for Setting the DTC

DTC P0261

The ECM detects that the Injector 1 low control circuit has a short to ground for greater than 500 ms

DTC P0262

The ECM detects that the Injector 1 low control circuit has a short to voltage for greater than 500 ms

DTC P0264

The ECM detects that the Injector 2 low control circuit has a short to ground for greater than 500 ms

DTC P0265

The ECM detects that the Injector 2 low control circuit has a short to voltage for greater than 500 ms

DTC P0267

The ECM detects that the Injector 3 low control circuit has a short to ground for greater than 500 ms

DTC P0268

The ECM detects that the Injector 3 low control circuit has a short to voltage for greater than 500 ms

DTC P0270

The ECM detects that the Injector 4 low control circuit has a short to ground for greater than 500 ms

DTC P0271

The ECM detects that the Injector 4 low control circuit has a short to voltage for greater than 500 ms

Action Taken When the DTC Sets

DTCs P0261, P0262, P0264, P0265, P0267, P0268, P0270 and P0271 are Type C DTCs.

Conditions for Clearing the DTC

DTCs P0261, P0262, P0264, P0265, P0267, P0268, P0270 and P0271 are Type C DTCs.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

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- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

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

Circuit/System Verification

1. Ignition ON.
2. Verify DTC P2147, P2148, P2150, or P2151 is not set.
 - **If DTC P2147, P2148, P2150, or P2151 is set**
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **Go to next step: If DTC P2147, P2148, P2150, or P2151 is not set**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC P0261, P0262, P0264, P0265, P0267, P0268, P0270 or P0271 does not set.
 - **If DTC P0261, P0262, P0264, P0265, P0267, P0268, P0270 or P0271 is set**
Refer to Circuit/System Testing
 - **Go to next step: If DTC P0261, P0262, P0264, P0265, P0267, P0268, P0270 or P0271 is not set**
5. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems off.
2. It may take up to 2 min for all vehicle systems to power down.
3. Disconnect the harness connector at the appropriate Q17 Fuel Injector.
4. Ignition ON.
5. Test for 4.5 - 6.5 V between the high voltage supply circuit terminal 1 and ground.
 - **Go to next step: If less than 4.5 V**
 1. Ignition OFF.
 2. Disconnect the X2 harness connector at the K20 Engine Control Module.
 3. Test for infinite resistance between the supply circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 4. Test for less than 2 Ω in the supply 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 6.5 V**
 1. Ignition OFF.
 2. Disconnect the harness connector X2 at the K20 Engine Control Module, Ignition ON.
 3. Test for less than 1 V between the high voltage supply circuit terminal 1 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **Go to next step: If between 4.5 - 6.5 V**
- 6. Test for 0.60 - 0.80 V between the high voltage control circuit terminal 2 and ground.
 - **If less than 0.60 V**
 1. Ignition OFF.
 2. Disconnect the harness connector X2 at the K20 Engine Control Module.
 3. 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
 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 greater than 0.80 V**
 1. Ignition OFF.
 2. Disconnect the harness connector X2 at the K20 Engine Control Module, Ignition ON.
 3. Test for less than 1 V between the control circuit terminal 2 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **Go to next step: If between 0.60 - 0.80 V**
- 7. Test or replace the appropriate Q17 Fuel Injector.

Component Testing

Static Test

1. Ignition OFF.
2. Disconnect the harness connector at the appropriate Q17 Fuel Injector.

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

3. Test for 0.2 - 1.5 Ω between the supply terminal 1 and the control terminal 2.
 - **If not between 0.2 - 1.5 Ω**

Replace the appropriate Q17 Fuel Injector.
 - **Go to next step: If between 0.2 - 1.5 Ω**
4. Test for infinite resistance between each terminal and the injector housing/case.
 - **If less than infinite resistance**

Replace the appropriate Q17 Fuel Injector.
 - **Go to next step: If infinite resistance**
5. All OK

Repair Instructions

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

- Refer to [Fuel Injector Replacement](#)

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

DTC P0263, P0266, P0269, OR P0272: CYLINDER 1-4 BALANCE SYSTEM

Diagnostic Instructions

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

DTC Descriptors

DTC P0263

Cylinder 1 Balance System

DTC P0266

Cylinder 2 Balance System

DTC P0269

Cylinder 3 Balance System

DTC P0272

Cylinder 4 Balance System

Circuit/System Description

The control functions for the fuel injection system are integrated in the Engine Control Module (ECM). The ECM monitors changes in crankshaft speed using input from the crankshaft position sensor. The ECM adjusts the fuel delivery to each fuel injector in order to maintain correct fuel balance and minimize crankshaft speed changes.

Conditions for Running the DTC

- Engine running
- The ECM monitors for a condition once per camshaft revolution.

Conditions for Setting the DTC

DTC P0263

The ECM detects unstable crankshaft acceleration for cylinder 1.

DTC P0266

The ECM detects unstable crankshaft acceleration for cylinder 2.

DTC P0269

The ECM detects unstable crankshaft acceleration for cylinder 3.

DTC P0272

The ECM detects unstable crankshaft acceleration for cylinder 4.

Action Taken When the DTC Sets

DTCs P0263, P0266, P0269 and P0272 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0263, P0266, P0269 and P0272 are Type B DTCs.

Diagnostic Aids

During cold ambient temperatures, condensation can occur causing water/ice to collect inside the charge air cooler tube resulting in poor combustion and possible engine stall. As a result of poor combustion, this DTC may set. Check CAC inlet tubes for water/ice blockage.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC P0263, P0266, P0269 or P0272 is not set.
 - **If DTC P0263, P0266, P0269, or P0272 is set**
Refer to Circuit/System Testing.
 - **Go to next step: If DTC P0263, P0266, P0269, or P0272 is not set**
2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 - **If DTC P0263, P0266, P0269, or P0272 is set**
Refer to Circuit/System Testing.
 - **Go to next step: If DTC P0263, P0266, P0269, or P0272 is not set**
3. All OK.

Circuit/System Testing

1. Perform a scan tool Compression Test. Refer to **Fuel Injector Balance Test with Scan Tool** .
 - **If cylinder compression is not within specification**

Refer to the appropriate engine mechanical repair.

- **Go to next step: If cylinder compression is within specification**

2. Replace the appropriate Q17 Fuel Injector.

Repair Instructions

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

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

DTC P026A: CHARGE AIR COOLER (CAC) LOW EFFICIENCY

Diagnostic Instructions

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

DTC Descriptor

DTC P026A

Charge Air Cooler (CAC) Low Efficiency

Diagnostic Fault Information

CAC Inlet Temperature Sensor

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P007C	P007D	P007D*	P007B, P026A
Low Reference	-	P007D	P007D*	P007B, P026A
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.				

CAC Outlet Temperature Sensor

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P10D6	P10D7	P10D7*	P026A, P10D5
Low Reference	-	P10D7	P10D7*	P026A, P10D5
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.				

Typical Scan Tool Data

Charge Air Cooler Temperature

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON or Engine Running			
Parameter Normal Range: -39 to +198.8°C (-38 to +388°F)			
Signal	215.0°C (419.0°F)	-40.0°C (-40.0°F)	-40.0°C (-40.0°F)*
Low Reference	-	-40.0°C (-40.0°F)	-40.0°C (-40.0°F)*
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.			

Charge Air Cooler Outlet Temperature

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON or Engine Running			
Parameter Normal Range: -39 to +198.8°C (-38 to +388°F)			
Signal	215.0°C (419.0°F)	-40.0°C (-40.0°F)	-40.0°C (-40.0°F)*
Low Reference	-	-40.0°C (-40.0°F)	-40.0°C (-40.0°F)*
* Internal ECM or sensor damage may occur if the circuit is shorted to B+.			

Circuit/System Description

The engine control module (ECM) monitors the ambient air temperature, and the charge air temperature before and after the charge air cooler to calculate the efficiency of the charge air cooler (CAC). The charge air cooler systems' function is to reduce the temperature of the induction air charge that is heated by the turbocharger to improve the efficiency and performance of the engine.

The charge air cooler inlet temperature sensor, located at the outlet of the turbocharger, the charge air cooler outlet temperature sensor, located near the intake air flow valve are variable resistors. The ECM supplies 5 V to the signal circuit, and a ground for the sensors' low reference circuits.

Conditions for Running the DTC

- DTC P00C7, P0071, P0072, P0073, P0074, P007B, P007C, P007D, P007E, P0101, P0102, P0103, P00E9, P00EA, P00EB, P00EC, P0106, P0107, P0108, P0116, P0117, P0118, P0119, P02E8, P02E9, P0502, P0503, P0722, P0723, P10D5, P10D6, P10D7, P10D8, P111E, P122D, P16A0, P16A1, P16A2, P2227, P2228, P2229, or P2230 is not set.
- Vehicle speed is greater than 64 kph (39 MPH).
- The intake airflow valve position is greater than 85%.
- The engine coolant temperature (ECT) is warmer than 70°C (+158°F).
- The mass air flow is between 20 and 50 gm/s.
- The absolute difference between the CAC inlet air temperature and the ambient air temperature is greater than 36°C (65°F).
- Ambient temperature is greater than -7°C (19°F).
- The barometric pressure is greater than 69.6 kPa (10.09 PSI).
- This DTC runs continuously when the above conditions exist for greater than 9 s.

Conditions for Setting the DTC

The CAC efficiency is computed as a ratio between CAC inlet temperature - CAC outlet temperature and CAC inlet temperature - ambient air temperature.

The ECM detects that the average temperature reduction ratio of the CAC is less than 25% for greater than 20 s.

Action Taken When the DTC Sets

DTC P026A is a Type B DTC.

Conditions for Clearing the DTC

DTC P026A is a Type B DTC.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

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Powertrain Component Views

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- [Wiring Repairs](#)

DTC Type Reference

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

Scan Tool Reference

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

Special Tools

EL-38522-A Variable Signal Generator

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

[Circuit/System Verification](#)

1. Ignition ON.
2. Verify that DTC P00C7, P0071, P0072, P0073, P0074, P007B, P007C, P007D, P007E, P0101, P0102, P0103, P0106, P0107, P0108, P0119, P02E8, P02E9, P0502, P0503, P0722, P0723, P105D, P10D6, P10D7, P10D8, P122D, P16A0, P16A1, P16A2, P2227, P2228, P2229, or P2230 is not set.

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

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

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

NOTE:

- **To minimize the effects of residual engine heat and sensor internal heating elements, perform Step 3 of this verification procedure only if the ignition has been OFF for 8 hours or more.**
- **The vehicle sitting in direct sun light or having the block heater ON will skew the results.**

3. Verify the following scan tool parameters are within 10Â°C (18Â°F) of each other.

- Charge Air Cooler Temperature
- Charge Air Cooler Outlet Temperature
- Ambient Air Temperature
- **If not within 10Â°C (18Â°F)**

Refer to [DTC P007C-P007E](#); for further diagnosis of the Charge Air Cooler Inlet Temperature Sensor.

Refer to [DTC P10D6-P10D8](#) ; for further diagnosis of the Charge Air Cooler Outlet Temperature Sensor.

Refer to [DTC P0071-P0074](#) ; for further diagnosis of the Ambient Air Temperature Sensor.

- **Go to next step: If within 10Â°C (18Â°F)**

WARNING: Refer to [Road Test Warning](#) .

4. Road test the vehicle under various operating conditions.
5. Verify the following scan tool parameters change temperature.
 - Charge Air Cooler Temperature
 - Charge Air Cooler Outlet Temperature
 - **If the temperature does not change**

Refer to [DTC P007C-P007E](#); for further diagnosis of the Charge Air Cooler Inlet Temperature Sensor.

Refer to [DTC P10D6-P10D8](#); for further diagnosis of the Charge Air Cooler Outlet Temperature Sensor.

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

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

7. Verify the scan tool parameter Charge Air Cooler Outlet Temperature is cooler than the scan tool parameter Charge Air Cooler Temperature.

- **If not cooler**

Refer to Circuit/System Testing.

- **Go to next step: If cooler**

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

Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

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

9. All OK.

Circuit/System Testing

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

1. Check the engine cooling system and front of the vehicle to verify that none of the conditions listed below exist:

- Obstruction of the grille
- Debris in the radiator, condenser, or CAC fins

Refer to [Radiator Cleaning](#).

- Bent radiator, condenser, or CAC fins
- Engine overheating

Refer to [Engine Overheating](#).

- **If a condition exists**

Repair or replace as appropriate.

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

2. Replace the Charge Air Cooler.

Repair Instructions

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

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

DTC P02CC, P02CD, P02CE, P02CF, P02D0, P02D1, P02D2, OR P02D3: CYLINDER 1-4 INJECTOR EXCEEDED MINIMUM/MAXIMUM LEARNING LIMIT

Diagnostic Instructions

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

DTC Descriptors

DTC P02CC

Cylinder 1 Injector Exceeded Minimum Learning Limit

DTC P02CD

Cylinder 1 Injector Exceeded Maximum Learning Limit

DTC P02CE

Cylinder 2 Injector Exceeded Minimum Learning Limit

DTC P02CF

Cylinder 2 Injector Exceeded Maximum Learning Limit

DTC P02D0

Cylinder 3 Injector Exceeded Minimum Learning Limit

DTC P02D1

Cylinder 3 Injector Exceeded Maximum Learning Limit

DTC P02D2

Cylinder 4 Injector Exceeded Minimum Learning Limit

DTC P02D3

Cylinder 4 Injector Exceeded Maximum Learning Limit

Circuit/System Description

The control functions for the fuel injection system are integrated in the ECM. The ECM during normal running conditions performs a check on the difference between injected quantities and expected quantities. This check is done on each injector. If the difference is too big a DTC set indicating the injector to be investigated.

Conditions for Running the DTC

- The engine is running.
- The ECM monitors for a condition once per camshaft revolution.

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

DTC P02CC, P02CD, P02CE, P02CF, P02D0, P02D1, P02D2 and P02D3 are Type B DTCs.

Conditions for Clearing the DTC

DTC P02CC, P02CD, P02CE, P02CF, P02D0, P02D1, P02D2 and P02D3 are Type B DTCs.

[Reference Information](#)

Schematic Reference

[Engine Controls Wiring Schematics 1.6L \(LH7\)](#)

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Component View Reference

[Powertrain Component Views](#)

Description and Operation

[Fuel System Description](#)

Electrical Information Reference

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

DTC Type Reference

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

Scan Tool Reference

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

[Circuit/System Verification](#)

1. Engine running, verify that DTC P2147, P2148, P2150, or P2151 is not set.
 - If DTC P2147, P2148, P2150, or P2151 is set
Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for further diagnosis.
 - Go to next step: If DTC P2147, P2148, P2150, or P2151 is set
2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
 - If DTC P02CC, P02CD, P02CE, P02CF, P02D0, P02D1, P02D2, or P02D3 is set
Replace the appropriate Q17 Fuel Injector.
 - Go to next step: If DTC P02CC, P02CD, P02CE, P02CF, P02D0, P02D1, P02D2, or P02D3 is not set
3. All OK.

[Repair Instructions](#)

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

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

DTC P02E0, P02E2, P02E3, P02EB, P122B, P122C, OR P1425: INTAKE AIR FLOW VALVE CONTROL CIRCUIT/INTAKE AIR FLOW VALVE CONTROL MOTOR

[Diagnostic Instructions](#)

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

DTC Descriptor

DTC P02E0

Intake Air Flow Valve Control Circuit

DTC P02E2

Intake Air Flow Valve Control Circuit Low Voltage

DTC P02E3

Intake Air Flow Valve Control Circuit High Voltage

DTC P02EB

Intake Air Flow Valve Control Motor Current Performance

DTC P122B

Intake Air Flow Valve Control Supply Voltage Circuit

DTC P122C

Intake Air Flow Valve Control Circuit Shorted

DTC P1425

Intake Air Flow Valve Control Motor High Temperature

Circuit/System Description

An intake airflow valve actuator is used to achieve high exhaust gas recirculation rates. It increases the pressure difference between exhaust and intake so that the appropriate exhaust quantity can be mixed with the intake air. The ECM transmits the desired angle as a PWM signal to the airflow valve actuator. The airflow valve actuator operates a DC motor to control the valve based on the PWM signal from the ECM. The airflow valve position is monitored by an internal position sensor.

In the event that the engine control module (ECM) detects the engine speed increases beyond desired control limits. Upon detection, the engine will be shutdown by closing the intake air flow valve and disabling the fuel injectors.

Conditions for Running the DTC

- Battery voltage is greater than 11 V.
- Engine is running.
- Intake air flow valve motor control circuit is active.
- The DTCs run continuously whenever the above conditions are met.

Conditions for Setting the DTC

P02E0

The ECM detects an open circuit condition of the intake air flow valve control circuit.

P02E2

The ECM detects that the intake air flow valve control circuit voltage is less than a calibrated threshold.

P02E3

The ECM detects that the intake air flow valve control circuit voltage is greater than a calibrated threshold.

P02EB

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

P122B

The ECM detects an open circuit on the intake air flow valve control circuit.

P122C

The ECM detects a short circuit on the intake air flow valve control circuit voltage for greater than 0.5 s.

P1425

The ECM detects that the intake air flow valve control circuit internal temperature is greater than a calibrated threshold.

Action Taken When the DTC Sets

- DTC P02E0, P02E2, P02E3, P02EB, P122B, P122C, and P1425 are Type A DTCs, with LH7
- DTC P02E0, P02E2, P02E3, P02EB, P122B, P122C, and P1425 are Type B DTCs, with NE4, NCP, or NCV

Conditions for Clearing the DTC

- DTC P02E0, P02E2, P02E3, P02EB, P122B, P122C, and P1425 are Type A DTCs, with LH7
- DTC P02E0, P02E2, P02E3, P02EB, P122B, P122C, and P1425 are Type B DTCs, with NE4, NCP, or NCV

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Engine running, verify the scan tool parameters listed below display OK or Not Run.
 - Intake Air Flow Valve Control Circuit Open Test Status
 - Intake Air Flow Valve Control Circuit Low Voltage Test Status

- Intake Air Flow Valve Control Circuit High Voltage Test Status
- Intake Air Flow Valve Control Circuit Shorted Test Status
- **If Malfunction**

Refer to Circuit/System Testing.

- **Go to next step: If OK or Not Run**

2. Clear the DTCs with a scan tool, ignition Off for 1 min.
3. Ignition On, verify DTC P02E0, P02E2, P02E3, P02EB, P122B, P122C, or P1425 is not set.

- **If the DTC is set**

Refer to Circuit/System Testing.

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

4. Operate the vehicle within the Conditions for Running the DTCs. 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

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

2. Verify the conditions listed below do not exist:

- Intake air flow valve blade that is not in the rest position.
- Intake air flow valve blade that is binding open or closed.
- Intake air flow valve blade that opens or closes without spring pressure.
- Dirt, debris or coking in the intake air flow valve.
- Damaged intake air flow valve blade or shaft.
- **If a condition exists**

Repair or replace the component as necessary.

- **Go to next step: If none of the conditions exist**

3. Disconnect the harness connector at the Q20 Intake Air Flow Valve.

4. Ignition On, test for 1.5 - 2.5 V between the throttle control open circuit terminal 1 and ground.

- **If less than 1.5 V**

1. Ignition Off, disconnect the X2 harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between control circuit terminal 1 and ground.

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

3. Test for infinite resistance between the motor control circuit terminals 1 and 2.

- If less than infinite resistance, repair the short between the control circuits.
- If infinite resistance.

4. Test for less than 2 Ω in the control circuit terminal 1, end to end.

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

- **If greater than 2.5 V**

1. Ignition Off, disconnect the X2 harness connector at the K20 Engine Control Module.

2. Ignition On.
 3. Test for less than 1 V between the control circuit terminal 1 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **Go to next step: If 1.5 - 2.5 V**
5. Connect a test lamp between the control circuit terminal 2 and B+.
6. Ignition On, verify the test lamp does not illuminate.
 - **If the test lamp illuminates**
 1. Ignition Off, remove the test lamp.
 2. Disconnect the X2 harness connector at the K20 Engine Control Module.
 3. Test for infinite resistance between control circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground in the control circuit.
 - If infinite resistance, replace the K20 Engine Control Module.
 - **Go to next step: If the test lamp does not illuminate**
7. Connect a test lamp between the control circuit terminal 2 and ground.
8. Ignition On, verify the test lamp does not illuminate.
 - **If the test lamp illuminates**
 1. Ignition Off, remove the test lamp.
 2. Disconnect the X2 harness connector at the K20 Engine Control Module, ignition On.
 3. Test for less than 1 V between the control circuit terminal and ground.
 - If 1 V or greater, repair the short to voltage in the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **Go to next step: If the test lamp does not illuminate**
9. Remove the test lamp.
10. Test for 1.5 - 2.5 V between the control circuit terminal 1 and the control circuit terminal 2.
 - **If not within the specified range**
 1. Ignition Off, disconnect the X2 harness connector at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the control circuit terminal 2, end to end.
 - If 2 Ω or greater, repair open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **Go to next step: If within the specified range**
11. Test or replace the component: Q20 Intake Air Flow Valve

Repair Instructions

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

- Refer to [Throttle Body Assembly Replacement](#) - Q20 Intake Air Flow Valve
- Refer to [Control Module References](#) for ECM replacement, programming and setup.

DTC P02E1, P02E4, OR P02E5: INTAKE AIR FLOW VALVE CONTROL PERFORMANCE/INTAKE AIR FLOW VALVE STUCK

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 P02E1

DTC P02E4

Intake Air Flow Valve Stuck Open

DTC P02E5

Intake Air Flow Valve Stuck Closed

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - Terminal 1	P122C	P02E0	P122C, P122D	P1425
Control - Terminal 2	P122C	P02E0	P122C, P122D	P1425

Circuit/System Description

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

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

Component	Description
K20 Engine Control Module	The control module 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.
Q20 Intake Air Flow Valve	The intake air flow valve of diesel engines reduces the intake air flow rate in part load operation so that a higher exhaust gas recirculation rate can be achieved.

Conditions for Running the DTC

- DTC P02E8, P02E9, P0651, P16A0-P16A2 = Not set
- Ignition = On or Engine = Running
- Ignition Voltage = Greater than 5 V

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

Conditions for Setting the DTC**P02E1**

Control Circuit = Commanded state does not match the actual state - For greater than 1 s

P02E4

Actual & Desired Intake Air Flow Valve Position Not within 16% of each other - Commanded duty cycle = Less than 34%

P02E5

Actual & Desired Intake Air Flow Valve Position Not within 16% of each other - Commanded duty cycle = Greater than 34%

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type A DTC

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

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC

Diagnostic Aids

- A high resistance condition on the component circuits may cause a DTC to set.
- A weak battery may cause this DTC to set.
- If the throttle blade becomes stuck, a DTC will set. Depending on the position of the throttle blade, the ECM may enter Engine Shutdown Mode. The ECM will disable fuel and de-energize the throttle actuator. If the condition remains present during the next ignition cycle, the ECM may disable engine cranking. Inspect the throttle body assembly for a stuck throttle blade if a throttle actuator DTC is current and the engine won't crank.
- Inspect for a condition in which the throttle blade may have been held open. For example, ice may have formed in the throttle bore causing the throttle blade not to close.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Powertrain Component Views

Powertrain Component Views

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC P02E8, P02E9, P16A0-P16A2 is not set.

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

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

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

3. Engine at Idle Verify the scan tool parameter:

- Intake Air Flow Valve Control Circuit Open Test Status = OK or Not Run
- Intake Air Flow Valve Control Circuit Low Voltage Test Status = OK or Not Run
- Intake Air Flow Valve Control Circuit High Voltage Test Status = OK or Not Run
- Intake Air Flow Valve Control Circuit Shorted Test Status = OK or Not Run

- **If not the specified state**

Refer to: Circuit/System Testing

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

4. Clear the DTCs.

5. Ignition Off - For greater than 1 min

6. Ignition - On/Vehicle - In Service Mode

7. Verify DTC P02E1, P02E4, P02E5 is not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

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

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

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

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

9. All OK.

Circuit/System Testing

1. Ignition/Vehicle - Off

2. Verify the following conditions do not exist:

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

- Intake air flow valve blade that opens or closes without spring pressure.
- Intake air flow valve blade that is binding open or closed.
- Dirt, debris, or coking in the intake air flow valve.
- Damaged intake air flow valve blade or shaft.
- **If a condition exists**

Replace the component: Q20 Intake Air Flow Valve

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

NOTE: Disconnecting the component electrical connector causes additional DTCs to set.

3. Disconnect the electrical connector: Q20 Intake Air Flow Valve

4. Ignition - On/Vehicle - In Service Mode

5. Test for 1.5 to 2.5 V between the test points: Control circuit terminal 1 & Ground

- **If less than 1.5 V**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: X2 @ K20 Engine Control Module

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

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

4. Test for infinite resistance between the test points: Control circuit terminal 1 & Control circuit terminal 2

- If less than infinite resistance - Repair the short between the circuits.
- If infinite resistance

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

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

- **If greater than 2.5 V**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: X2 @ K20 Engine Control Module

3. Ignition - On/Vehicle - In Service Mode

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

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

- **Go to next step: If between 1.5 and 2.5 V**

6. Verify a test lamp does not turn On between the test points: Control circuit terminal 2 & B+

- **If the test lamp turns On**

1. Ignition/Vehicle - Off Remove - Test Lamp

2. Disconnect the electrical connector: X2 @ K20 Engine Control Module

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

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

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

7. Verify a test lamp does not turn On between the test points: Control circuit terminal 1 & Ground

- **If the test lamp turns On**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: X2 @ K20 Engine Control Module

3. Ignition - On/Vehicle - In Service Mode

4. Test for less than 1 V between the test points: Control circuit terminal 2 @ Component harness & Ground

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

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

8. Test for 1.5 to 2.5 V between the test points: Control circuit terminal 1 & Control circuit terminal 2

- **If not between 1.5 and 2.5 V**

1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: X2 @ K20 Engine Control Module
3. Test for less than 2 ohms between the test points: Control circuit terminal 2 @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
- **Go to next step: If between 1.5 and 2.5 V**
9. Test or replace the component: Q20 Intake Air Flow Valve

Repair Instructions

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

- Refer to [Throttle Body Assembly Replacement](#) - Q20 Intake Air Flow Valve
- For the system learn/reset procedure refer to: [Control Module References](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P0300: ENGINE MISFIRE DETECTED

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0300

Engine Misfire Detected

Circuit/System Description

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

The crankshaft position sensor variation or reluctor ring learn is used to calculate reference period errors caused by slight tolerance variations in the crankshaft and the crankshaft position sensor. The calculated error allows the ECM to accurately compensate for reference period variations. This enhances the ability of the ECM to detect misfire events over a wider range of engine speed and load. The compensation values are stored in ECM memory after a learn procedure has been performed.

Conditions for Running the DTC

- DTC P0016, P00C7, P0101, P0102, P0103, P0106, P0107, P0108, P0111, P0112, P0113, P0114, P0117, P0118, P0119, P0128, P0191, P0192, P0193, P0335, P0336, P0340, P0341, P0601, P0604, P0606, P0641, P0651, P0697, P06A3, P122B, P122C, P122D, P16A0, P16A1, P16A2, P16F3, P2122, P2123, P2127, P2128, P2138, P2227, P2228, P2229, P2230, P227B, P227C, P227D, P227E = Not set
- Crankshaft Position Sensor & Camshaft Position Sensor = Synchronized
- Engine Coolant Temperature = -7 to 125°C (19.4 to 257°F)
- Engine Speed = 1,000 to 3,200 RPM
- Rough Road Signal = Not Detected
- System Voltage = 9 to 32 V

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

Conditions for Setting the DTC

The control module K20 detects a crankshaft rotation speed variation indicating a single cylinder misfire rate sufficient to cause emissions levels to exceed mandated standards.

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Engine - Idling
2. Verify there is no abnormal noise from the component: Engine
 - **If an abnormal noise is present**

Refer to: [Symptoms - Engine Mechanical](#)

 - **Go to next step: If no abnormal noise is present**
3. Perform the scan tool learn/reset function: [Crankshaft Position Variation Learn](#)
4. Verify there are no DTCs set related to the following system/component:
 - B23 Camshaft Position Sensor
 - B26 Crankshaft Position Sensor
 - Q17 Fuel Injector
 - Fuel System
 - Mechanical Condition
 - **If a related DTC is set**

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

- **Go to next step: If a related DTC is not set**
5. Perform the scan tool control function: Cylinder Power Balance - Enable

Verify the sound of the engine changes the same way when turning off each individual injector.

- **If the engine sound does not change the same way for one or more cylinders**

Refer to: Circuit/System Testing

- **Go to next step: If the engine sound changes the same way for all cylinders**

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

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

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

7. All OK.

Circuit/System Testing

1. Verify the following conditions do not exist:

- Accessory drive bracket - Defective/Loose/Visible Damage
- Belt Driven Device - Defective/Loose/Visible Damage
- Brake Rotor - Excessive runout
- Component Malfunction - Transmission
- Drive Belt - Defective/Loose/Visible Damage
- Drive Shaft - Excessive runout
- During certain road conditions: Rough
- Fuel - Contaminated/Dirty/Fill Level = Low - Refer to: [Contaminants-in-Fuel Diagnosis](#)
- Fuel Pressure - Low - Refer to: [Fuel System Diagnosis](#)
- High resistance in the circuits of the component may set DTC P0300 without setting the DTC for the component: Q17 Fuel Injector
- If the condition is intermittent, wiggle the related wiring harnesses and connectors, with the ignition/vehicle on or engine running, while monitoring the scan tool circuit status parameters for the component. The parameters will display if there is a condition with the circuit or a connection.
- Tire and wheel assemblies which exhibit excessive runout can produce vibrations even if the assemblies are balanced.
- **If a condition exists**

Repair or replace as necessary.

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

2. Perform the following procedure/test: Fuel Injector Balance - Refer to: [Fuel Injector Balance Test with Scan Tool](#)

Verify the procedure/test passes.

- **If the procedure/test does not pass**

Replace the component that failed the test: Q17 Fuel Injector

- **Go to next step: If the procedure/test passes**

3. Verify the condition does not exist: An engine mechanical condition. - Refer to: [Symptoms - Engine Mechanical](#)

- **If a condition exists**

Repair or replace as necessary.

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

4. All OK.

Repair Instructions

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

Perform [Crankshaft Position Variation Learn](#)

DTC P0315: CRANKSHAFT POSITION SYSTEM VARIATION NOT LEARNED

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

Crankshaft Position System Variation Not Learned

Circuit/System Description

The crankshaft position sensor variation or reluctor ring learn is used to calculate reference period errors caused by slight tolerance variations in the crankshaft and the crankshaft position sensor. The calculated error allows the ECM to accurately compensate for reference period variations. This enhances the ability of the ECM to detect misfire events over a wider range of engine speed and load. The compensation values are stored in ECM memory after a learn procedure has been performed.

Conditions for Running the DTC

Engine = Running

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

Conditions for Setting the DTC

Crankshaft Position Reluctor Ring Learn = Not Learned

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type A DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC

Diagnostic Aids

This test procedure requires that the vehicle battery has passed a load test and is completely charged. Refer to: [Battery Inspection/Test](#)

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Perform the scan tool learn/reset function: [Crankshaft Position Variation Learn](#)
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**

Replace the component: K20 Engine Control Module

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

4. All OK.

Repair Instructions

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

DTC P0335 OR P0336: CRANKSHAFT POSITION SENSOR CIRCUIT/PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0335

Crankshaft Position Sensor Circuit

DTC P0336

Crankshaft Position Sensor Performance

Diagnostic Fault Information

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

Circuit/System Description

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

Component	Description
B26 Crankshaft Position Sensor	The sensor contains a hall-effect sensor and additional electronics that processes the signal. It detects the change of strength of the magnetic field caused by the reluctor ring. When the strength changes, the sensor changes the amount of current it consumes. This results in a square wave signal of the current, while the voltage stays constant. The control module detects the frequency in which the current changes, which is proportional to the rotational speed.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.
Reluctor Ring	There are 58 teeth or invisible magnetic segments on the edge of the crankshaft position reluctor ring mounted on the crankshaft. Each tooth or magnetic segment on the ring is spaced at a 60 segment spacing with 2 missing segments for a reference gap.

Conditions for Running the DTC

P0335 Condition 1

- DTC P0016, P0102, P01CB, P01CC, P01CD, P01CE, P01CF, P01D0, P01D1, P01D2, P0315, P0506, P0507 = Not set
- Camshaft Position Sensor = Signal received
- MAF Sensor = Greater than 2 g/s
- Starter = Active

Condition 2

- Crankshaft and camshaft position sensors have been learned.
- Engine Speed = Greater than 550 RPM
- Starter = Inactive

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

P0336 Condition 1

- DTC P0016, P0102, P01CB, P01CC, P01CD, P01CE, P01CF, P01D0, P01D1, P01D2, P0315, P0506, P0507 = Not set
- Engine Speed = Greater than 450 RPM
- Crankshaft Position Sensor = Not Detected

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

Conditions for Setting the DTC

P0335

Crankshaft Position Sensor = No Signal - During 6 engine revolutions.

P0336

Crankshaft Position Sensor = Sync gap not detected. - Greater than 3 pulses

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type A DTC

- Camshaft Position Sensor = Used for engine position

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type A DTC

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component Views

Electrical Information Reference

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

- [Wiring Repairs](#)

DTC Type Reference

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

Scan Tool Reference

[Control Module References](#)

[Circuit/System Verification](#)

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

- **If the DTC is set**

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

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

3. Engine - Running
4. Verify DTC P0336 is not set.

- **If the DTC is set**

Refer to: Circuit/System Testing

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

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

Verify the DTC does not set.

- **If the DTC sets**

Refer to: Circuit/System Testing

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

6. All OK.

[Circuit/System Testing](#)

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

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: B26 Crankshaft Position Sensor
3. Test for less than 10 ohms between the test points: Low Reference circuit terminal 2/B & Ground

- **If 10 ohms or greater**

1. Disconnect the electrical connector: K20 Engine Control Module
2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 2/B @ Component harness & The other end of the circuit @ Control module harness

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

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

4. Ignition - On/Vehicle - In Service Mode
5. Test for 4.8 to 5.2 V between the test points: 5 V Reference circuit terminal 1/A & Ground

- **If less than 4.8 V**

1. Ignition/Vehicle - Off

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

Verify the scan tool parameter: Crankshaft Position Active Counter = Increments

- **If the parameter value does not increment**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K20 Engine Control Module
 3. Ignition - On/Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 3/C @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V
- 1. Ignition/Vehicle - Off
- 2. Test for infinite resistance between the test points: Signal circuit terminal 3/C @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance
- 3. Test for less than 2 ohms between the test points: Signal circuit terminal 3/C @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
- **Go to next step: If the parameter value increments**
- 7. Verify DTC P0336 is not set.
- **If the DTC is set**

Verify the following conditions do not exist:

- B26 Crankshaft Position Sensor & Reluctor Ring - Excessive play/Foreign material passing between the components/Incorrect air gap/Incorrect installation/Loose/Visible Damage
- Camshaft Sprocket - Visible Damage/Worn
- Crankshaft Sprocket - Visible Damage/Worn
- Engine Oil - Contaminated/Dirty
- Timing Chain or Timing Belt - Visible Damage/Worn
- Timing Chain Tensioner or Timing Belt Tensioner - Visible Damage/Worn

- If a condition exists - Repair or replace as necessary
- If no condition exists - Test or replace the component: B26 Crankshaft Position Sensor

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

8. Test or replace the component: B26 Crankshaft Position Sensor

Repair Instructions

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

- Refer to [Crankshaft Position Sensor Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P0340 OR P0341: CAMSHAFT POSITION SENSOR CIRCUIT/PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)
- An overview of each diagnostic category can be found here: [Diagnostic Procedure Instructions](#)

DTC Descriptor

DTC P0340

Camshaft Position Sensor Circuit

DTC P0341

Camshaft Position Sensor Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0651*	P0340	P0651*	-
Signal	P0340	P0340	P0340	P0341
Low Reference	-	P0340	P0340	-
* Additional DTCs may set.				

Circuit/System Description

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

Component	Description
B23 Camshaft Position Sensor	The sensor contains a hall-effect sensor and additional electronics that processes the signal. It detects the change of strength of the magnetic field caused by the reluctor ring. When the strength changes, the sensor changes the amount of current it consumes. This results in a square wave signal of the current, while the voltage stays constant. The control module detects the frequency in which the current changes, which is proportional to the rotational speed.

Component	Description
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.
Reluctor Ring	There are 4 equally spaced teeth on the edge of the camshaft position reluctor ring mounted on the camshaft.

Conditions for Running the DTC

- DTC P0016, P0315 = Not set
- Camshaft Position Sensor = Signal received
- Crankshaft and camshaft position sensors have been learned.
- Crankshaft Position Sensor = Signal received
- Engine Speed = Greater than 600 RPM

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

Conditions for Setting the DTC

P0340

Camshaft Position Sensor = No Signal - During 3 engine revolutions.

P0341

Camshaft Position Sensor = Sync gap not detected. - Greater than 6 pulses

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC

Control module command = Reduced Engine Power

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Diagnostic Aids

The cranking period may take longer.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Powertrain Component Views

Electrical Information Reference

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

- [Wiring Repairs](#)

DTC Type Reference

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

Scan Tool Reference

[Control Module References](#)

[Circuit/System Verification](#)

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC P0641, P0651 is not set.
 - **If the DTC is set**
Refer to: [DTC P0641, P0651, P0697, or P06A3](#)
 - **Go to next step: If the DTC is not set**
3. Engine - Running
4. Verify DTC P0341 is not set.
 - **If the DTC is set**
Refer to: Circuit/System Testing
 - **Go to next step: If the DTC is not set**
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

Verify the DTC does not set.

- **If the DTC sets**
Refer to: Circuit/System Testing
 - **Go to next step: If the DTC is not set**
6. All OK.

[Circuit/System Testing](#)

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

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: B23 Camshaft Position Sensor
3. Test for less than 10 ohms between the test points: Low Reference circuit terminal 2/B & Ground
 - **If 10 ohms or greater**
 1. Disconnect the electrical connector: K20 Engine Control Module
 2. Test for less than 2 ohms between the test points: Low Reference circuit terminal 2/B @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **Go to next step: If less than 10 ohms**
4. Ignition - On/Vehicle - In Service Mode
5. Test for 4.8 to 5.2 V between the test points: 5 V Reference circuit terminal 1/A & Ground
 - **If less than 4.8 V**
 1. Ignition/Vehicle - Off

2. Disconnect the electrical connector: K20 Engine Control Module
3. Test for infinite resistance between the test points: 5 V Reference circuit terminal 1/A @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance
4. Test for less than 2 ohms between the test points: 5 V Reference circuit terminal 1/A @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
- **If greater than 5.2 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K20 Engine Control Module
 3. Ignition - On/Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: 5 V Reference circuit terminal 1/A @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module
- **Go to next step: If between 4.8 and 5.2 V**
6. Test for 4.8 and 5.2 V between the test points: Signal circuit terminal 3/C & Ground
 - **If less than 4.8 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K20 Engine Control Module
 3. Test for infinite resistance between the test points: Signal circuit terminal 3/C @ Component harness & Ground
 - If less than infinite resistance - Repair the short to ground on the circuit.
 - If infinite resistance
 4. Test for less than 2 ohms between the test points: Signal circuit terminal 3/C @ Component harness & The other end of the circuit @ Control module harness
 - If 2 ohms or greater - Repair the open/high resistance in the circuit.
 - If less than 2 ohms - Replace the component: K20 Engine Control Module
 - **If greater than 5.2 V**
 1. Ignition/Vehicle - Off
 2. Disconnect the electrical connector: K20 Engine Control Module
 3. Ignition - On/Vehicle - In Service Mode
 4. Test for less than 1 V between the test points: Signal circuit terminal 3/C @ Component harness & Ground
 - If 1 V or greater - Repair the short to voltage on the circuit.
 - If less than 1 V - Replace the component: K20 Engine Control Module
 - **Go to next step: If between 4.8 and 5.2 V**
7. Verify DTC P0341 is not set.
 - **If the DTC is set**

Verify the following conditions do not exist:

- B23 Camshaft Position Sensor & Reluctor Ring - Excessive play/Foreign material passing between the components/Incorrect air gap/Incorrect installation/Loose/Visible Damage
- Engine Oil - Contaminated/Dirty
- Timing Chain or Timing Belt - Visible Damage/Worn
- Timing Chain Tensioner or Timing Belt Tensioner - Visible Damage/Worn
 - If a condition exists - Repair or replace as necessary
 - If no condition exists - Test or replace the component: B23 Camshaft Position Sensor

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

8. Test or replace the component: B23 Camshaft Position Sensor

Repair Instructions

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

- Refer to [Camshaft Position Sensor Replacement](#)
- For control module replacement, programming, and setup refer to: [Control Module References](#)

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

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 P034A

Crankshaft Position Sensor - Engine Start Position Incorrect

DTC P034B

Crankshaft Position Sensor - Crankshaft Direction Incorrect

Circuit/System Description

The engine control module monitors the speed and the direction of rotation of the crankshaft during an autostop event and memorizes the crankshaft angle at which the engine stopped to be able to start the engine quicker.

Conditions for Running the DTC

P034A

- DTC P0335, P0336, P0651 = Not set
- Engine = Running - After an autostop event.
- Crankshaft position is being verified.

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

P034B

- DTC P0335, P0336, P0651 = Not set
- Engine Speed = 400 to 2,000 RPM
- MAF Sensor = Greater than 2 g/s
- Crankshaft Position Sensor = Signal received

Frequency the DTC runs = Continuously - After the running conditions are met - For greater than 4 s

Conditions for Setting the DTC

P034A Condition 1

The difference between the memorized and actual crankshaft position was greater than 1 reluctor ring teeth during 3 autostart events in one ignition cycle.

Condition 2

The difference between the memorized and actual crankshaft position was greater than 1 reluctor ring teeth during 5 autostart events in one ignition cycle.

P034B

The direction of rotation of the crankshaft has changed more than 3 times within 10 s.

Actions Taken When the DTC Sets

DTCs listed in the DTC Descriptor Category = Type B DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type B DTC

Diagnostic Aids

A DTC may set depending on certain driving conditions and would not require a component replacement. The Circuit/System Verification must be performed.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC P0335, P0336, P0651 is not set.
 - **If any of the DTCs are set**

Refer to: [**Diagnostic Trouble Code \(DTC\) List - Vehicle**](#)
 - **Go to next step: If none of the DTCs are set**
3. 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**

Test or replace the component: B26 Crankshaft Position Sensor
 - **Go to next step: If the DTC is not set**
4. All OK.

Repair Instructions

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

Refer to [**Crankshaft Position Sensor Replacement**](#)

DTC P037A, P037B, OR P0381: WAIT TO START INDICATOR CONTROL CIRCUIT

Diagnostic Instructions

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

DTC Descriptor

DTC P037A

Wait to Start Indicator Control Circuit Low Voltage

DTC P037B

Wait to Start Indicator Control Circuit High Voltage

DTC P0381

Wait to Start Indicator Control Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Wait To Start Indicator Control	P037A	P0381	P037B	-

Typical Scan Tool Data

Wait To Start Indicator Control Circuit Low Voltage Test Status

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON Parameter Normal Range: OK/Not Run			
Wait To Start Indicator Control	Malfunction	OK/Not Run	OK/Not Run

Wait To Start Indicator Control Circuit Open Test Status

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON Parameter Normal Range: OK/Not Run			
Wait To Start Indicator Control	OK/Not Run	Malfunction	OK/Not Run

Wait To Start Indicator Control Circuit High Voltage Test Status

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Ignition ON Parameter Normal Range: OK/Not Run			
Wait To Start Indicator Control	OK/Not Run	OK/Not Run	Malfunction

Circuit/System Description

The engine control module (ECM) provides a ground to the Wait To Start Indicator Control circuit when conditions require the Wait To Start Indicator to be turned on. The ECM monitors the Wait To Start Indicator Control circuit for proper operation.

Conditions for Running the DTC

P037A

- Wait to Start Indicator is illuminated.
- Battery voltage is greater than 11 V.
- Engine Speed is greater than 650 RPM.
- DTC P037A runs continuously when the above conditions are met.

P037B

- Wait to Start Indicator is not illuminated
- Battery voltage is greater than 11 V.
- Engine Speed is greater than 650 RPM.

- DTC P037B runs continuously when the above conditions are met.

P0381

- Battery voltage is greater than 11 V.
- Engine Speed is greater than 650 RPM.
- DTC P0381 runs continuously when the above conditions are met.

Conditions for Setting the DTC

P037A

- The ECM detects a short to ground on the Wait To Start Indicator Control circuit for greater than 3 s.

P037B

- The ECM detects a short to voltage on the Wait To Start Indicator Control circuit for greater than 1 s.

P0381

- The ECM detects an open circuit on the Wait To Start Indicator Control circuit for greater than 0.2 s.

Action Taken When the DTC Sets

DTCs P037A, P037B and P0381 are Type B DTC.

Conditions for Clearing the DTC

DTCs P037A, P037B and P0381 are Type B DTC.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

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Component View Reference

Powertrain Component Views

Description and Operation

- **Glow Plug System Description**
- **Fuel System Description**

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Circuit/System Verification

1. Ignition ON.
2. Command the Wait to Start Indicator ON and OFF with a scan tool. Verify that the Wait to Start Indicator turns ON and OFF with each command.
 - **If Wait to Start Indicator does not turn on and off**

Refer to Circuit/System Testing.
 - **Go to next step: If Wait to Start Indicator turns on and off**
3. Command the Wait to Start Indicator ON and OFF with a scan tool while observing the following control circuit status parameters:
 - Wait To Start Indicator Control Circuit Low Voltage Test Status
 - Wait To Start Indicator Control Circuit Open Test Status
 - Wait To Start Indicator Control Circuit High Voltage Test Status

Each parameter should display OK or Not Run.

 - **If parameter displays Malfunction**

Refer to Circuit/System Testing.
 - **Go to next step: If parameter does not display Malfunction**
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.
 - **Go to next step: If the DTC does not set**
6. All OK.

Circuit/System Testing

1. Ignition ON.
2. Verify that the (IPC) Instrument Panel Cluster warning indicators are illuminated.
 - **If IPC warning indicators do not illuminate**
 1. Test the IPC Cluster fuse for an open.
 - If the fuse is open, repair the short to ground or high resistance in the circuit.
 - If the fuse is not open
 2. Test for battery voltage between the IPC Cluster fuse and ground.
 - If battery voltage is not present, repair the open in the circuit.
 - If battery voltage is present, replace the P16 Instrument Cluster.
 - **Go to next step: If IPC warning indicators illuminate**
3. Ignition OFF.
4. Disconnect the harness connector X1 at the K20 Engine Control Module
5. Ignition ON.
6. Verify that the Wait to Start indicator does not illuminate.
 - **If Wait to Start indicator illuminates**
 1. Test for infinite resistance between the wait to start indicator lamp control circuit ECM connector X1 terminal 19 and ground.
 - If less than infinite resistance, repair the short to ground in the circuit.
 - If infinite resistance, replace the P16 Instrument Cluster.

- **Go to next step: If Wait to Start indicator does not illuminate**

7. Test for less than 1 V between the wait to start indicator lamp control circuit ECM connector X1 terminal 19 and ground.

- **If greater than 1 V**

Repair the short to voltage in the circuit.

- **If less than 1 V**

8. Connect a 3A fused jumper wire between the Wait To Start Indicator Control circuit ECM connector X1 terminal 19 and ground. The Wait to Start indicator should illuminate.

- **If Wait to Start indicator does not illuminate**

1. Test for an open or high resistance in the wait to start indicator lamp control circuit.

- If an open or high resistance is found, repair the open or high resistance in the circuit.
- If an open or high resistance is not found, replace the P16 Instrument Cluster.

- **Go to next step: If Wait to Start indicator illuminates**

9. Replace the K20 Engine Control Module.

Repair Instructions

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

- Refer to [Instrument Cluster Replacement \(Equinox\)](#), [Instrument Cluster Replacement \(Terrain\)](#).
- Refer to [Control Module References](#) for ECM replacement, setup, and programming

DTC P037E OR P037F: GLOW PLUG FEEDBACK CIRCUIT LOW/HIGH VOLTAGE

Diagnostic Instructions

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

DTC Descriptors

DTC P037E

Glow Plug Feedback Circuit Low Voltage

DTC P037F

Glow Plug Feedback Circuit High Voltage

Circuit/System Description

The glow plug control module is integrated in the engine control module (ECM) and is a solid state device which operates the glow plugs. The temperature and the power consumption is controlled within a wide range to suit the engine pre-heating requirements. The glow plug initial ON time will vary based on the system voltage and temperature. Lower temperatures cause longer ON times.

Conditions for Running the DTC

- The ignition is ON.
- The ignition voltage is between 9 - 16 V.
- Engine running (cranking excluded).
- No fault on supply system.
- Glow plug system ON.
- No electrical fault on glow plugs.

Conditions for Setting the DTC

The ECM detects an internal fault in the integrated glow plug module.

Action Taken When the DTC Sets

DTC P037E and P037F are Type C DTCs.

Conditions for Clearing the DTC

DTC P037E and P037F are Type C DTCs.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

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

Circuit/System Verification

1. Ignition ON.
2. Verify with a scan tool that no other DTCs are set.
 - **If DTCs are set**

Refer to refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **Go to next step: If DTCs are not set**
3. Clear all DTCs with a scan tool
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**

Replace the K20 Engine Control Module
 - **Go to next step: If the DTC does not set**
6. All OK.

Repair Instructions

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

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

DTC P0401 OR P0402: EXHAUST GAS RECIRCULATION (EGR) FLOW INSUFFICIENT/EXCESSIVE

Diagnostic Instructions

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

DTC Descriptors

DTC P0401

Exhaust Gas Recirculation (EGR) Flow Insufficient

DTC P0402

Exhaust Gas Recirculation (EGR) Flow Excessive

Circuit/System Description

The Exhaust Gas Recirculation (EGR) valve is controlled by the Engine Control Module (ECM). The ECM controls the EGR valve by supplying a 12-volt pulse width modulated signal to the EGR Valve low control circuit and 12 volts to the high control circuit. The ECM monitors the EGR flow performance when the EGR is active by comparing the desired Mass Air Flow (MAF) to the actual MAF. If the actual MAF is less than or greater than a calibrated threshold level the amount of detected EGR flow is out of range.

Conditions for Running the DTC

P0401

- DTC P0071, P0072, P0073, P0074, P00E9, P00EA, P00EB, P00EC, P0101, P0102, P0103, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0502, P0503, P0722, P0723, P111E, or P262B is not active.
- Engine speed is between 750-2, 000 RPM.
- Calculated fuel rate is between 5-60 mm³
- Ambient air temperature is warmer than -7Â°C (19.4Â°F).
- Engine coolant temperature is warmer than 70Â°C (158Â°F).
- Barometric Pressure is greater than 69.6 kPa (10.9 psi).
- Ignition voltage is greater than 11 V.
- EGR valve position is greater than 0%.

The DTC runs continuously when the above conditions are met for greater than 1 s.

P0402

- DTC P0071, P0072, P0073, P0074, P00E9, P00EA, P00EB, P00EC, P0101, P0102, P0103, P0111, P0112, P0113, P0114, P0116, P0117, P0118, P0119, P0502, P0503, P0722, P0723, P111E, or P262B is not active.
- Engine speed is between 1, 250-1, 900 RPM.
- Calculated fuel rate is between 21-36 mm³
- Ambient air temperature is warmer than -7Â°C (19.4Â°F).
- Engine coolant temperature is warmer than 70Â°C (158Â°F).
- Barometric Pressure is greater than 69.6 kPa (10.9 psi).
- Ignition voltage is greater than 11 V.
- EGR valve position is greater than 0%.

The DTC runs continuously when the above conditions are met for greater than 1 s.

Conditions for Setting the DTC

P0401

The ECM detects that the difference between the actual mass air flow and the desired mass air flow is less than a calibrated value for greater than 10 s.

P0402

The ECM detects that the difference between the actual mass air flow and the desired mass air flow is greater than a calibrated value for greater than 10 s.

Action Taken When the DTC Sets

DTC P0401 and P0402 are Type B DTCs.

Conditions for Clearing the DTC

DTC P0401 and P0402 are Type B DTCs.

Diagnostic Aids

Inspect for the following conditions that may cause this DTC to set:

- Contamination on the MAF sensor element
- Restriction before or after the MAF sensor
- Skewed MAF sensor
- Aftermarket air filter

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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 P0403, P0405, P0406, P0489, P0490, P1407, P140D, P140E, or P140F is not set.
 - If any of the DTCs are set
Refer to Diagnostic Trouble Code (DTC) List - Vehicle .
 - Go to next step: If none of the DTCs are set

NOTE: When using scan tool functions, Engine Reduced Power and Clean Exhaust Filter messages may occur after a short delay when commanding large EGR positions. The messages are a result of ECM protecting hardware during device control mode. No DTCs will be stored and the Diesel Particulate Filter does not need to be service cleaned. Exiting device control will restore normal function.

3. Verify the scan tool Desired EGR Position and the EGR Position Sensor parameters remain within 3% when commanding the EGR Valve between 0 - 60% with a scan tool.

- **If not within 3%**

Refer to Circuit/System Testing.

- **Go to next step: If within 3%**

4. Engine running.

NOTE: The MAF parameter is not valid if the Reduced Engine Power message is active.

5. Command the EGR Valve to 0% with a scan tool and record the MAF Sensor g/s parameter.

6. Command the EGR Valve to 60% with a scan tool and record the MAF Sensor g/s parameter.

7. Verify the MAF Sensor parameter is between 2 - 12 g/s and changes when the commanding the EGR Valve 60% with the scan tool.

- **If not between 2 - 12 g/s or does not change**

Refer to Circuit/System Testing.

- **Go to next step: If between 2 - 12 g/s and changes**

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

9. Verify a DTC does not set.

- **If a DTC sets**

Refer to Circuit/System Testing.

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

10. All OK.

Circuit/System Testing

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

1. Verify the conditions listed below do not exist:

- Restrictions in the EGR cooler, EGR cooler bypass valve and passages.
- Wet or restricted air filter.
- Loose or improperly connected hoses.
- Damaged or missing components.
- Induction/charge air cooler system restrictions.
- Exhaust system restrictions.
- Binding, damaged or restricted intake air flow valve.
- Binding, damaged or restricted EGR valve.
- Induction/charge air cooler system leaks. Refer to [Charge Air Cooler Diagnosis \(Leak Test\)](#), [Charge Air Cooler Diagnosis \(Smoke Test\)](#) - Induction System Smoke Test and Full System Air Leak Test.
- Exhaust system/turbo charger leaks.
- Restrictions or damage to the turbocharger.
- **If a condition exists**

Repair or replace the component as necessary.

- **Go to next step: If none of the conditions exist**

2. Test or replace the Q14 Exhaust Gas Recirculation Valve.

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

1. Ignition Off.
2. Remove the Q14 Exhaust Gas Recirculation Valve. Refer to [Exhaust Gas Recirculation Valve Replacement](#).
3. Verify the conditions listed below do not exist:
 - Sticking, binding, or frozen EGR valve
 - Leaks or restrictions in the EGR valve body and EGR ports and passages
 - Coking, soot build up, debris or damage that can cause the EGR valve to stick partially open or closed
 - **If a condition is found**

Repair or replace the component as necessary.
 - **Go to next step: If none of the conditions exist**
4. All OK.

Repair Instructions

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

Refer to [Exhaust Gas Recirculation Valve Replacement](#)

DTC P0403, P0490, P1402, P1407, OR P140F: EXHAUST GAS RECIRCULATION (EGR) CIRCUITS/EXHAUST GAS RECIRCULATION (EGR) CURRENT PERFORMANCE

Diagnostic Instructions

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

DTC Descriptors

DTC P0403

Exhaust Gas Recirculation (EGR) Control Circuit

DTC P0490

Exhaust Gas Recirculation (EGR) Motor Control Circuit - High Voltage

DTC P1402

Exhaust Gas Recirculation (EGR) Supply Circuit

DTC P1407

Exhaust Gas Recirculation (EGR) Control Circuit Shorted

DTC P140F

Exhaust Gas Recirculation (EGR) Current Performance

Circuit/System Description

The engine control module (ECM) supplies the Exhaust Gas Recirculation (EGR) valve with a 5 V reference circuit, a low reference circuit, an H-bridge motor directional control circuit, and a signal circuit. The EGR position sensor provides a signal voltage that changes relative to EGR position. The

EGR position sensor information is transmitted between the EGR valve and the ECM on the signal circuit. The Mass Air Flow (MAF) sensor signal is used by the ECM to detect the proper amount of EGR flow. The ECM will close the EGR valve, then open the EGR valve to 100%. The ECM will then calculate the MAF difference and determine if the proper EGR flow has been detected.

Conditions for Running the DTC

- The engine is running.
- The ignition voltage is greater than 11 V.

The DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

P0403

The ECM detects an open on the control circuit for greater than 2.5 s.

P0490

The ECM detects a short to voltage on the control circuit for greater than 2.5 s.

P1402

The ECM detects a low voltage on the EGR motor supply for greater than 2.5 s.

P1407

The ECM detects a short circuit between the open and close terminals of the EGR motor for greater than 2.5 s.

P140F

The ECM detects excessive current flow to the EGR motor for greater than 2.5 s.

Action Taken When the DTC Sets

DTCs P0403, P0490, P1402, P1407 and P140F are Type B DTCs.

Conditions for Clearing the DTC

DTCs P0403, P0490, P1402, P1407 and P140F are Type B DTCs.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON

NOTE: When using an Scan tool Control Functions, Engine Reduced Power and Clean Exhaust Filter messages may occur after a short delay when commanding large EGR positions. The messages are a result of ECM protecting hardware during device control mode. No DTCs will be stored and the Diesel Particulate Filter does not need to be service cleaned. Exiting device control will restore normal function.

2. Verify the EGR Position Sensor percentage parameter remains within 5% of the EGR Valve Commanded State when commanding the EGR valve between 0 - 100% with a scan tool.

- **If not within 5%**

Refer to Circuit/System Testing.

- **Go to next step: If within 5%**

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

4. Verify a DTC does not set.

- **If a DTC sets**

Refer to Circuit/System Testing

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

5. All OK.

Circuit/System Testing

1. Ignition Off, disconnect the harness connector at the Q14 Exhaust Gas Recirculation Valve, ignition On.

2. Test for 0.1 - 0.5 V between the EGR motor control circuit terminal 2 and ground.

- **If greater than 0.5 V**

1. Ignition Off, 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, replace the K20 Engine Control Module.

- **Go to next step: If less than 0.1 V**

1. Ignition Off, disconnect the X2 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

3. 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 between 0.1 - 0.5 V**

3. Test for 1 - 3 V between the EGR motor control circuit terminal 6 and ground.

- **If greater than 3 V**

1. Ignition Off, 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, replace the K20 Engine Control Module.
- **Go to next step: If less than 1 V**
 1. Ignition Off, disconnect the X2 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
 3. 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 between 1 - 3 V**
 4. Replace the Q14 Exhaust Gas Recirculation Valve.

Repair Instructions

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

- Refer to [Exhaust Gas Recirculation Valve Replacement](#)
- Refer to [Control Module References](#) for engine control module replacement, programming and setup.

DTC P0404, P0405, OR P0406: EXHAUST GAS RECIRCULATION (EGR) OPEN POSITION PERFORMANCE/EXHAUST GAS RECIRCULATION (EGR) POSITION SENSOR CIRCUIT VOLTAGE

Diagnostic Instructions

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

DTC Descriptors

DTC P0404

Exhaust Gas Recirculation (EGR) Open Position Performance

DTC P0405

Exhaust Gas Recirculation (EGR) Position Sensor Circuit Low Voltage

DTC P0406

Exhaust Gas Recirculation (EGR) Position Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
5 V Reference	P0097, P00F4, P018C, P0340, P0405, P0522, P0532, P0641, P2199, P227C, P2454, P2495	P0405	P018D, P0406, P0523, P0533, P0641, P227D, P2455, P2495

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
EGR Valve Position Sensor Signal	P0405	P018D, P0406, P0523, P0533, P0641, P227D, P2455	P0406
Low Reference	-	P0406	-

Typical Scan Tool Data

EGR Position Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine Running Parameter Normal Range: 0.25 - 4.8 V			
5 V Reference Voltage	0 V	0 V	5.0 V
EGR Sensor Signal	0 V	5.0 V	5.0 V
Low Reference	-	5.0 V	-

Circuit/System Description

The Engine Control Module (ECM) uses the Exhaust Gas Recirculation (EGR) position sensor to determine the position of the EGR valve. The ECM sends a reference voltage through the 5 V reference circuit to the EGR position sensor. The ECM provides a voltage return path for the sensor through the low reference circuit. A variable voltage signal, based on the EGR valve position, is sent from the sensor to the ECM through the EGR position sensor signal circuit.

Conditions for Running the DTC

The DTCs run continuously when the ignition voltage is greater than 11 V.

Conditions for Setting the DTC

P0404

The ECM detects a stuck valve.

P0405

The ECM detects that the EGR position sensor voltage is less than 0.25 V for greater than 5 s.

P0406

The ECM detects that the EGR position sensor voltage is greater than 4.8 V for greater than 5 s.

Action Taken When the DTC Sets

- DTCs P0404, P0405 and P0406 are Type B DTCs.
- The driver information center may display Service Emissions System message.

Conditions for Clearing the DTC

DTCs P0404, P0405 and P0406 are Type B DTCs.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

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- [Wiring Repairs](#)

DTC Type Reference

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

Scan Tool Reference

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

[Circuit/System Verification](#)

1. Ignition On.
2. Verify DTC P0641 is not set

- **If the DTC is set**

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

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

NOTE: When using an EGR device control, Engine Reduced Power and Clean Exhaust Filter messages may occur after a short delay when commanding large EGR positions. The messages are a result of ECM protecting hardware during device control mode. No DTCs will be stored and the Diesel Particulate Filter does not need to be service cleaned. Exiting device control will restore normal function.

3. Verify the scan tool Desired EGR Position and the EGR Position Sensor parameters are within 5% when commanding EGR between 0-100% with a scan tool.

- **If not within 5%**

Refer to Circuit/System Testing.

- **Go to next step: If within 5%**

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

5. Verify a DTC does not set.

- **If a DTC sets**

Refer to Circuit/System Testing

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

6. All OK.

[Circuit/System Testing](#)

1. Ignition Off and all vehicle systems Off, disconnect the harness connector at the Q14 Exhaust Gas Recirculation Valve. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.

- **If 10 Ω or greater**

1. Ignition Off, disconnect the X2 harness connector at the K20 Engine Control Module.

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

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

- **Go to next step: If less than 10 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 X2 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 X2 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.

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

5. Verify the scan tool EGR Position Sensor parameter is between 4.8-5.2 V.

- **If less than 4.8 V**

1. Ignition Off, disconnect the X2 harness connector at the K20 Engine Control Module.

2. Test for infinite resistance between the signal circuit terminal 5 and ground.

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

- **Go to next step: If greater than 5.2 V**

1. Ignition Off, disconnect the X2 harness connector at the K20 Engine Control Module.

2. Test for less than 1 V between the signal circuit terminal 5 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.

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

6. Install a 3 A fused jumper wire between the signal circuit terminal 5 and the low reference circuit terminal 3.

7. Verify the scan tool EGR Position Sensor parameter is less than 0.2 V.

- **If 0.2 V or greater**

1. Ignition Off, remove the jumper wire, disconnect the X2 harness connector at the K20 Engine Control Module, ignition On.

2. 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.

- **Go to next step: If less than 0.2 V**

8. Test or replace the Q14 Exhaust Gas Recirculation Valve.

Repair Instructions

- Refer to [Exhaust Gas Recirculation Valve Replacement](#)
- Refer to [Control Module References](#) for ECM replacement, setup and programming.

Repair Verification

1. Perform the [Diagnostic Repair Verification](#) after completing the repair.
2. Perform the [Reductant System Tamper Service Bay Test](#) with a scan tool to clear the Service Emission System message, if illuminated.

- If the Service Emission System message does not turn Off

A condition with the system still exists.

- Go to next step: If the Service Emission System message turns Off

3. All OK.

DTC P0407, P0408, P046E, OR P046F: EXHAUST GAS RECIRCULATION COOLER COOLANT INLET TEMPERATURE SENSOR

Diagnostic Instructions

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

DTC Descriptors

DTC P0407

Exhaust Gas Recirculation Cooler Coolant Inlet Temperature Sensor Circuit Low Voltage

DTC P0408

Exhaust Gas Recirculation Cooler Coolant Inlet Temperature Sensor Circuit High Voltage

DTC P046E

Exhaust Gas Recirculation Cooler Coolant Inlet Temperature Sensor Performance

DTC P046F

Exhaust Gas Recirculation Cooler Coolant Inlet Temperature Sensor Circuit Erratic

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0407	P0408	P0408*	P046E, P046F
Low Reference	-	P0408	-	P046E, P046F
* ECM or sensor damage may occur if the circuit is shorted to B+.				

Typical Scan Tool Data

EGR Cooler Coolant Inlet Temperature

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine Running Parameter Normal Range: -39 to 149Â°C (-38 to 300Â°F)			
EGR Cooler Coolant Inlet Temperature Signal	150Â°C (302Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)
Low Reference	-	-40Â°C (-40Â°F)	-

Circuit/System Description

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

Conditions for Running the DTC

P0407 and P0408

- Ignition On

- Ignition voltage greater than 11 V
- Engine not cranking

This DTC runs continuously when the above conditions are met.

P046E

- DTCs P007B-P007E, P0407, P0408, P046F, P10D5-P10D8 or P2610 are not set.
- Ignition voltage is greater than 11 V
- The vehicle has been off for at least 8 hours
- The engine is running for greater than 5 s.
- The absolute value of the difference between the Charge Air Cooler upstream air temperature and Charge Air Cooler downstream air temperature is less than or equal to 10Â°C
- This DTC runs continuously when the above conditions are met.

P046F

- DTCs P0407 or P0408 are not set.
- Ignition is on and engine is not cranking
- Ignition voltage is greater than 11 V
- This DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

P0407

The ECM detects that the EGR cooler inlet coolant temperature resistance value is less than 55 Ω for greater than 2.4 s.

P0408

The ECM detects that the EGR cooler inlet coolant temperature resistance value is greater than 134 kΩ for greater than 2.4 s.

P046E

There is greater than 10Â°C (50Â°F) difference between the EGR cooler inlet coolant temperature and the average value between the Charge Air Cooler Inlet Temperature Sensor and Charge Air Cooler Outlet Temperature Sensor.

P046F

The ECM detects that the EGR cooler inlet coolant temperature is colder than -39Â°C (-38Â°F) or warmer than 149Â°C (300Â°F) for greater than 5 s.

Action Taken When the DTC Sets

DTC P0407, P0408, P046E, or P046F are Type B DTCs.

Conditions for Clearing the DTC

DTC P0407, P0408, P046E, or P046F are a Type B DTCs.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Exhaust Aftertreatment System Description

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool EGR Cooler Coolant Inlet Temperature 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.
 - **Go to next step: 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.
 - **Go to next step: If the DTC does not set**
5. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the B318A Exhaust Gas Recirculation 1 Cooler Temperature Sensor-Coolant Inlet 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 X2 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.
 - **Go to next step: If less than $5\ \Omega$**
3. Ignition ON.
4. Verify the scan tool EGR Cooler Coolant Inlet Temperature parameter is colder than -39°C (-38°F).
 - **If warmer than -39°C (-38°F)**
 1. Ignition OFF, disconnect X2 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.
 - **Go to next step: 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 EGR Cooler Coolant Inlet Temperature 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 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.
 - **Go to next step: If warmer than 149°C (300°F)**
 7. Test or replace the B318A Exhaust Gas Recirculation 1 Cooler Temperature Sensor - Coolant.

Component Testing

1. Ignition OFF, disconnect the harness connector at the B318A Exhaust Gas Recirculation 1 Cooler Temperature Sensor - Coolant.
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 B318A Exhaust Gas Recirculation 1 Cooler Temperature Sensor - Coolant.

 - **Go to next step: If within the specified range**
3. Test for infinite resistance between each terminal and the sensor housing.
 - **If less than infinite resistance**

Replace the B318A Exhaust Gas Recirculation 1 Cooler Temperature Sensor - Coolant.

 - **Go to next step: If infinite resistance**
4. All OK.

Repair Instructions

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

- Refer to [Engine Coolant Temperature Sensor Replacement \(FWD\)](#) [Engine Coolant Temperature Sensor Replacement \(AWD\)](#).
- Refer to [Control Module References](#) for ECM replacement, setup, and programming

DTC P0421: CATALYST 1 LOW EFFICIENCY

Diagnostic Instructions

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

DTC Descriptors

DTC P0421

Catalyst 1 Low Efficiency

Circuit Description

The main function of the close coupled diesel oxidation catalyst (CCDOC) is to control emissions of non methane hydrocarbons and carbon monoxide (CO). Its secondary function is to assist with the diesel particulate filter (DPF) regeneration, by obtaining and sustaining the temperature necessary for regeneration. In order to generate the high exhaust temperatures needed for regeneration, the aftertreatment system increases exhaust temperatures by injecting diesel fuel into the exhaust system via post-injection. The injected fuel is converted into heat by the DOC to incinerate soot accumulated in the DPF. The engine control module (ECM) monitors the exhaust gas temperature sensor 1 and 2 to determine if catalyst downstream temperatures are achieved during a DPF regeneration.

Conditions for Running the DTC

- Ambient Air Temperature = -7 to 42Â°C (19 to 108Â°F)
- BARO Sensor = Greater than 70 kPa (10.2 PSI)
- Calculated Catalyst Temperature = Colder than 55Â°C (131Â°F)
- Coolant Temperature = Colder than 55Â°C (131Â°F)
- Engine - Running

DTC P0421 runs when the above conditions are met for greater than 150 s

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

DTCs P0421 is a Type B DTC.

Conditions for Clearing the DTC

DTCs P0421 is a Type B DTC.

Diagnostic Aids

The continuing use of non ultra low sulfur fuel may be a contributor to diesel oxidation catalyst failure.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Control Module References for scan tool information.

Circuit/System Verification

1. Verify that DTCs P0100, P010B, P010C, P010D, P014C, P014D, P0201, P0202, P0203, P0204, P0205, P0206, P0207, P0208, P020A, P020B, P020C, P020D, P020E, P020F, P021A, P021B, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0279, P0280, P0282, P0283, P02EE, P02EF, P02F0, P02F1, P02F2, P02F3, P02F4, P02F5, P113D, P113F, P115E, P115F, P1160, P116A, P116B, P116C, P116D, P116E, P116F, P118E, P118F, P1192, P1193, P1194, P1196, P1198, P119A, P119B, P119C, P11C5, P11C6, P11DB, P1248, P1249, P124A, P124B, P124C, P124D, P124E, P124F, P12AF, P12B0, P12B1, P12B2, P2004, P2205, P2006, P2008, P2009, P200A, P2010, P2015, P2016, P2017, P201B, P201D, P20F8, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P2205, P2206, P2207, P2208, P220A, P2210, P2211, P2227, P2228, P2229, P2230, P2297, P242B, P242C, P242D, P242E, P2452, P2453, P2454, P2455, P2456, P2481, P2482, P2483, P2484, P2627, P2628, P2A00, U029D are not set.

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

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

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

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

- **If the DTC sets**

Refer to Circuit/System Testing.

- **Go to next step: If no DTCs set**

4. All OK.

Circuit/System Testing

1. Verify the following conditions do not exist with the air induction system and exhaust system:

- Induction system leaks.
- Exhaust leaks before or after the diesel oxidation catalyst. Refer to **Exhaust Leakage** for further diagnosis.
- Physical damage.
- Loose or missing hardware.
- **If a condition is found**

Repair or replace the affected exhaust system components as necessary.

- **Go to next step: If no condition is found**

2. Verify the following conditions do not exist with the diesel oxidation catalyst:

- Physical damage or alterations.
- Internal rattles caused by a damaged catalyst substrate.
- Restrictions.
- **If a condition is found**

Replace the diesel oxidation catalyst.

- **Go to next step: If no condition is found**

3. Verify the following conditions do not exist:

- Off road fuel or red dye fuel.
- Low quality B20 fuel.

- Fuel containing high sulfur content.
- Engine oil or coolant consumption.
- **If a condition is found**

Repair as necessary.

- **Go to next step: If no condition is found**

4. Replace the component: B131B Exhaust Temperature Sensor 2 & diesel oxidation catalyst

Repair Instructions

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

- Refer to [Oxidation Catalytic Converter Replacement \(LH7\)](#).
- Refer to [Exhaust Temperature Sensor Replacement - Position 2](#).
- For control module replacement, programming, and setup refer to: [Control Module References](#)

DTC P042E OR P042F: EXHAUST GAS RECIRCULATION (EGR) OPEN/CLOSED POSITION PERFORMANCE

Diagnostic Instructions

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

DTC Descriptors

DTC P042E

Exhaust Gas Recirculation (EGR) Open Position Performance

DTC P042F

Exhaust Gas Recirculation (EGR) Closed Position Performance

Circuit/System Description

The engine control module (ECM) uses the exhaust gas recirculation (EGR) position sensor to determine the position of the EGR valve. The ECM sends a reference voltage through the 5 V reference circuit to the EGR position sensor. The ECM provides a voltage return path for the sensor through the low reference circuit. A signal based on the EGR valve position, is sent from the EGR sensor to the ECM.

Conditions for Running the DTC

- DTCs P0403, P0405, P0406, P0489, P0490, P049D, P1402, P1407, P140F, or P1424 are not set
- The engine is running

These DTCs run continuously when the above conditions are met.

Conditions for Setting the DTC

P042E

The ECM detects the position of the EGR valve more open than desired for greater than 10 s.

P042F

The ECM detects the position of the EGR valve more closed than desired for greater than 10 s.

Action Taken When the DTC Sets

DTCs P042E and P042F are Type A DTCs.

Conditions for Clearing the DTC

DTCs P042E and P042F are Type A DTCs.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exhaust Gas Recirculation (EGR) 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, verify that the EGR Position Sensor parameter reading is between 0.25 - 4.75 V.
 - **If not within the specified range**
Refer to [DTC P0404-P0406](#).
 - **Go to next step: If within the specified range**
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 that DTC P042E or P042F does not set.
 - **If the DTC sets**
Refer to Circuit/System Testing.
 - **Go to next step: If the DTC does not set**
4. All OK.

Circuit/System Testing

1. Verify that the conditions listed below are not present at the Q14 Exhaust Gas Recirculation Valve:
 - Stuck Q14 Exhaust Gas Recirculation Valve
 - Any coking, soot build up, debris or damage that can cause the EGR valve to stick partially open or closed
 - **If a condition is present**
Repair as necessary

- **Go to next step: If no condition is present**
- 2. Ignition Off, disconnect the harness connector at the Q14 Exhaust Gas Recirculation Valve, ignition On.
- 3. Verify a test lamp does illuminate between the EGR motor control circuit terminal 6 and ground.
 - **If the test lamp does not illuminate**
 1. Ignition Off, remove the test lamp and disconnect the X2 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
 3. 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
 - **Go to next step: If the test lamp illuminates**
- 4. Ignition ON, verify a test lamp does not illuminate between the EGR motor control circuit terminal 5 and B+.
 - **If the test lamp illuminates**
 1. Ignition Off, remove the test lamp and 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
 - **Go to next step: If the test lamp does not illuminate**
- 5. Ignition On, verify a test lamp illuminates between the EGR motor control circuit terminal 2 and B+ when commanding the EGR Motor to 10% with a scan tool.
 - **If the test lamp does not illuminate**
 1. Ignition Off, remove the test lamp and disconnect the X2 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
 3. Ignition ON, 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.
 - **Go to next step: If the test lamp illuminates**
- 6. Replace the Q14 Exhaust Gas Recirculation Valve.

Repair Instructions

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

- Refer to [Exhaust Gas Recirculation Valve Replacement](#)
- Refer to [Control Module References](#) for engine control module replacement, programming, and setup.

DTC P049D: EXHAUST GAS RECIRCULATION (EGR) POSITION NOT LEARNED

Diagnostic Instructions

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

DTC Descriptors

DTC P049D

Exhaust Gas Recirculation (EGR) Position Not Learned

Circuit/System Description

The offset of the EGR valve is checked after the offset learning has been completed in after-run/post drive. The difference between the maximum and minimum EGR valve offset values is calculated by the engine control module (ECM). If the difference is above a calibrated threshold or the offset learned value is not within a calibrated range, a fault is recognized. While the offset learning is active, the EGR valve is checked for a stuck valve. If the valve is stuck during opening or closing for a calibrated time, a fault is reported. If either of these conditions occur, the DTC will be set.

Conditions for Running the DTC

- DTC P0117, P0118, P0403, P0405, P0406, P042E, P042F, P0490, P1402, P1407, P140F or P1424 is not set.
- Ignition is OFF and the engine is in after-run/post drive.
- Battery voltage is greater than 5 V.

The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM detects that the offset learned value for the EGR valve is not within a calibrated range.

Action Taken When the DTC Sets

DTC P049D is a Type B DTC.

Conditions for Clearing the DTC

DTC P049D is a Type B DTC.

Reference Information

Schematic Reference

Engine Controls Wiring Schematics 1.6L (LH7)

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition On.
2. Verify P0403, P0490, P1407, or P140F is not set.

- If any of the DTCs are set

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

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

NOTE: When using scan tool functions, Engine Reduced Power and Clean Exhaust Filter messages may occur after a short delay when commanding large EGR positions. The messages are a result of ECM protecting hardware during scan tool functions. No DTCs will be stored and the Diesel Particulate Filter does not need to be service cleaned. Exiting device control will restore normal function.

3. Verify the scan tool Desired EGR Position and the EGR Position Sensor parameters remain within 3% when commanding the EGR Valve between 0 - 40% with a scan tool.

- If not within 3%

Refer to Circuit/System Testing.

- Go to next step: If within 3%

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 a DTC does not set.

- If a DTC sets

Refer to Circuit/System Testing.

- Go to next step: If a DTC does not set

6. All OK.

Circuit/System Testing

1. Ignition Off, remove the Q14 EGR valve. Refer to [Exhaust Gas Recirculation Valve Replacement](#) .

2. Verify the conditions listed below do not exist:

- Sticking, binding or frozen EGR valve.
- Coking, soot build up, debris or damage that can cause the EGR valve to stick partially open or closed.

- If a condition exists

Repair or replace the component as necessary.

- Go to next step: If none of the conditions exist

- Test or replace the Q14 Exhaust Gas Recirculation Valve.

Repair Instructions

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

- Refer to [Exhaust Gas Recirculation Valve Replacement](#)
- Refer to [Control Module References](#) for ECM replacement, programming and setup