DIAGNOSTIC INFORMATION & PROCEDURES

DIAGNOSTIC STARTING POINT - ENGINE CONTROLS

Begin the system diagnosis with the **Diagnostic System Check - Engine Controls** . The Diagnostic System Check will provide the following information:

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the serial data circuit
- The identification of any stored diagnostic trouble codes (DTCs) and their status

The use of the Diagnostic System Check will identify the correct procedure for diagnosing the system and where the procedure is located.

DIAGNOSTIC SYSTEM CHECK - ENGINE CONTROLS

Description

The Diagnostic System Check is an organized approach to identifying a condition created by or affecting the electronic engine control system. The Diagnostic System Check must be the starting point for any driveability concern. The Diagnostic System Check directs the service technician to the next logical step in diagnosing the concern. Understanding the table and using the table correctly reduces diagnostic time and prevents the replacement of good parts.

Diagnostic System Check - Engine Controls

Step	Action	Yes	No
1	Perform the following preliminary inspections: 1. Ensure that the battery is fully charged. Refer to **Battery Inspection/Test (Side Terminal Battery)Battery Inspection/Test (Top Post Terminal Battery)** in Engine Electrical. 2. Ensure that the battery cables are clean and tight. 3. Inspect the easily accessible systems or the visible system components for obvious damage or conditions that could cause the		

	symptom. Refer to **Strategy Based Diagnosis** in General Information. 4. Ensure that the engine and control module grounds are clean, tight, and in the correct location. 5. Inspect for aftermarket devices that could affect the operation of the system. Refer to **Checking Aftermarket Accessories** in Wiring Systems. Did you find and correct the condition?	System OK	Go to **Step 2**
2	1. Install a scan tool. 2. Turn ON the scan tool. Does the scan tool turn ON?	Go to **Step 3**	Go to **Scan Tool Does Not Power Up** in Data Link Communications
3	1. Turn ON the ignition, with the engine OFF. 2. Attempt to establish communication with the listed control modules. If you are using a Tech 2, obtain the information using the Class 2 Message Monitor feature: • Instrument Panel Cluster (IPC) • Engine control module (ECM) • Electronic brake control module (EBCM) • Body control module (BCM) Does the scan tool communicate with all the listed modules?	Go to **Step 4**	Go to **Scan Tool Does Not Communicate with Class 2 Device** in Data Link Communications
4	Attempt to start the engine. Does the engine crank?	Go to **Step 5**	Go to **Symptoms - Engine Electrical** in Engine Electrical
5	Does the engine start and run?	Go to **Step 6**	Go to **Symptoms - Engine Controls**
	IMPORTANT:		

6	**Do NOT clear the DTCs unless instructed by a diagnostic procedure.** 1. Select the DTC display function for the following control modules and record the DTCs: • IP • ECM • EBCM • BCM 2. If there are any powertrain DTCs, select Capture Info to store the powertrain DTC information with a scan tool. 1. Component level DTCs-For example, sensor DTCs, solenoid DTCs, and relay DTCs Begin with the lowest number DTC unless the diagnostic table directs you otherwise. 2. System level DTCs-For example, misfire DTCs, EVAP system DTCs, fuel trim DTCs, and system voltage DTCs Does the scan tool display any DTCs which begin with a "U"?	Go to **Diagnostic Trouble Code (DTC) List** in Data Communications	Go to **Step 7**
7	Does the scan tool display DTC P0601, P0602, P0604, P0606, or P2610?	Go to **DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610**	Go to **Step 8**
8	Does the scan tool display DTC P0562 or P0563?	Go to **DTC P0562** and **DTC P0563** in Engine Electrical	Go to **Step 9**
	IMPORTANT: **DO NOT clear the DTCs unless instructed by a diagnostic procedure.** 1. Review the Captured Info. If multiple powertrain DTCs are stored, diagnose the DTCs in the		

9	following order: 1. Component level DTCs-For example, sensor DTCs, solenoid DTCs, and relay DTCs. Begin with the lowest number DTC unless the diagnostic table directs you otherwise. 2. System level DTCs-For example, misfire DTCs, EVAP system DTCs, fuel trim DTCs, and system voltage DTCs. 2. Search for applicable service bulletins. Does the scan tool display any DTCs?	Go to **Diagnostic Trouble Code (DTC) List** for applicable diagnostic procedure	Go to **Step 10**
10	Is the customers concern with the automatic transmission?	Go to **Diagnostic System Check - Automatic Transmission** in Automatic Transaxle 5AT/VT25-E	Go to **Step 11**
11	Is the customer's concern with Inspection/Maintenance (I/M) testing?	Go to **Inspection/Maintenance (I/M) System Check**	Go to **Step 12**
12	Are there any driveability symptoms observed?	Go to **Symptoms - Engine Controls**	System OK

SCAN TOOL DATA LIST

The Engine Scan Tool Data List contains all engine related parameters that are available on the scan tool. The list is arranged in alphabetical order. A parameter may appear in any one of the data lists, and in some cases may appear more than once, or in more than one data list in order to group certain related parameters together.

Use the Engine Scan Tool Data List only after the following conditions are determined:

- The Diagnostic System Check-Engine Controls is completed.
- There are no diagnostic trouble codes (DTCs).
- The On-Board diagnostics are functioning properly.

Scan tool values from a properly running engine may be used for comparison with the engine you are diagnosing. The Engine Scan Tool Data List represents the values that would be seen on a normal running engine.

IMPORTANT: Do not use a scan tool that displays faulty data. The scan tool concern should be reported to the manufacturer. Use of a faulty scan tool can result in misdiagnosis and in unnecessary parts replacement.

Only the parameters listed below are referenced in this service manual for use in diagnosis. If all values are within the typical range described below, refer to **Symptoms - Engine Controls** for diagnosis.

The column labeled Data List indicates where a parameter is located on the scan tool. Review the scan tool operating manual for the exact locations of the data lists. The following is a description of each term listed:

All

The Parameter is in all data lists indicated below.

Input

General Info-Inputs

Output

General Info-Outputs

FE

Fuel and Emissions

Ign

Ignition

MF

Misfire

Aux

Auxiliary Emissions

Idle

Idle/Speed Control

Eng

Engineering

FF

Freeze Frame Data List

FR

Failure Record Data List

Scan Tool Data List

Scan Tool Parameter	Data List	Parameter Range/Units	Typical Data Values
Engine Idling/Radiator Hose Hot/Park or Neutral/Closed Loop/Accessories Off			
A/C High Side Pressure	Input	0-3,450 kPa / 0-500 psi	Varies
A/C High Side Pressure Sensor	Input, Output	0-5 Volts	Varies
A/C Relay Command	Input, Output, Idle	On/Off	Off
A/C Request	Input, Idle	Yes/No	No
APP at Idle	Idle	Yes/No	Yes
APP Sensor 1	Input, FE, Idle	0.9-4.5 Volts	1 Volt
APP Sensor 2	Input, FE, Idle	0.45-2.25 Volts	0.5 Volt
Battery Voltage	All	0-25.5 Volts	12.8-14.2 Volts
Brake Switch	Input, Idle	Applied/Released	Released
CMP Active Counter	Input, Ign	0-256 Counts	Varies
Cruise Clutch Switch (If Equipped)	Input, Idle	Applied/Released	Released
Cruise Switch	Input, Idle	On/Off	Off
Cruise Brake Switch	Input, Idle	Applied/Released	Released
Cruise Resume/Accel.	Input, idle	On/Off	Off
Cruise Set/Coast	Input, idle	On/Off	Off
Desired Idle Speed	Idle	0-7,000 RPM	650 RPM
ECT	ALL	-39 to +140°C/-38 to +284°F	85-105 °C/185-220°F
Engine Load	ALL	0-99%	2%
Engine Oil Life Left	Input	0-100%	Varies
EGR Duty Cycle	Input, Output, FE, Ign, MF, Aux, Idle	0-100%	0%
EGR Sensor	Input, Aux	0-5 Volts	.82 Volts
Engine Run Time	ALL	0:00:00	Varies
Engine Speed	ALL	RPM	650 RPM
EVAP Purge Solenoid DC	Output, FE, Aux	0-100%	Varies
EVAP Vent Solenoid	Output	On/Off	Off
Fan Speed	Output	Off/Low/High	Varies
Fan Control 1	Output	On/Off	Varies
Fan Control 2	Output	On/Off	Varies
Fuel Level	Input, Ign	Gal/L	Varies
Fuel Level	Input, FE, Ign	0-5 Volts	Varies

Fuel Pump Relay Command	Output	On/Off	On
Fuel Shut-off Main	Eng	Yes/No	No
Fuel Shut-off Sec	Eng	Yes/No	No
Fuel Tank Pressure	Input, Aux	in H2O/mm Hg	Varies
Fuel Tank Press	Input, Aux	0-5 Volts	Varies
GEN L-Terminal	Input	High/Low	High
HO2S Bank 1 or Bank 2 Sensor 1	Input, FE, Aux	0-1 Volt	Varies between 0-1 Volt
HO2S Bank 1 or Bank 2 Sensor 2	Input, FE, Aux	0-1000 mV	Varies 400-800 mV
HO2S Bank 1 or Bank 2 Sen. 1 ohms	FE	0-infinity	0
HO2S Bank 1 or Bank 2 Sen. 2 ohms	FE	0-infinity	0
HO2S Bn 1 or Bn 2 Sen. 1 Heater	FE	On/Off	Varies
HO2S Bn 1 or Bn 2 Sen. 1 Heater	FE	On/Off	Varies
IAT	ALL	-39 to +140°C/-38 to +284°F	Varies
Ignition On	Input	Yes/No	Yes
Injector Pulse Width	FE	0-100 ms	3.0-5.4 ms
Intake Plenum Switchover Valve	Output	On/Off	Off
Knock Sensor 1	Ign	Active/Inactive	Inactive
Knock Sensor 2	Ign	Active/Inactive	Inactive
Knock Sensor 1	Input, Ign	0.25-2.67 Volts	1.10 Volts
Knock Sensor 2	Input, Ign	0.25-2.67 Volts	1.10 Volts
Knock Retard Cyl. 1-6	Ign	0-191 Degrees	0 Degrees
Low Oil Pressure	Input	Yes/No	No
LT FT Bn. 1 or Bn. 2 Cruise/Accel.	FE, Aux	-100 to 100%	0%
LT FT Bn. 1 or Bn. 2 Idle/Decel.	FE, Aux	-100 to +100%	0%
Loop Status Bank 1 or Bank 2	FE	Open/Closed	Closed
MAF	ALL	0-655 g/s	3.4-6.3 g/s
MAF Sensor	Input	0-5 Volts	1.2-1.5 Volts
Main Relay Command	Output	On/Off	On
MAP	ALL	kPa/Volts	45
Misfire Current Cyl. 1-6	MF	0-255 Counts	0
Misfire History Cyl. 1-6	MF	0-255 Counts	0

Park/Neutral Switch (If Equipped)	Idle	P-N/R-D-L	P-N
Short Term FT Bank 1 or Bank 2	FE, Aux	-100 to +100%	-3% to +3%
Spark	Ign	-133 to +78 Degrees	2-5 Degrees
TAC Learn Counter	Eng	0-255 Counts	Varies
TAC Limit Authority	Eng	Yes/No	No
TAC Limit Power	Eng	Yes/No	No
Torque Delivered	Input	0-100%	0%
Torque Requested	Input	0-100%	100%
TP Angle	ALL	0-99%	0 percent
TP Sensor 1	Input, FE, Idle	0-5 Volts	0.5-0.8 Volts
TP Sensor 2	Input, FE, Idle	0-5 Volts	4.1-4.5 Volts
Vehicle Speed	ALL	km/mi	Varies

SCAN TOOL DATA DEFINITIONS

The Engine Scan Tool Data Definitions contains a brief description of all engine related parameters available on the scan tool. The list is in alphabetical order.

A/C Refrigerant Pressure-Range 0-5 Volts

The A/C High Side displays the pressure value of the A/C refrigerant pressure sensor. The A/C refrigerant pressure helps diagnose DTC P0530.

A/C Relay Command-Range On/Off

The A/C Relay represents the commanded state of the A/C clutch control relay. The A/C clutch should be engaged when the scan tool displays ON.

A/C Request Signal-Range Yes/No

A/C Request-This displays if engine control module (ECM) has received an A/C request from body control module (BCM) YES or NO.

Air Flow Calculated-Range 0-512 grams/second

The calculated airflow is a calculation based on manifold absolute pressure (MAP). The calculation is used in several diagnostics to determine when a sufficient engine load has been achieved to run the diagnostic.

Air Fuel Ratio-Range 0:1-25.5:1

The air fuel ratio indicates the air to fuel ratio based on the oxygen sensor (O2S 1) inputs. The engine control module (ECM) uses the fuel trim to adjust fueling in order to maintain near an air fuel ratio of

14.7:1.

BARO-Range 11-105 kPa, 0-5.0 Volts

The barometric pressure (BARO) sensor measures the change in the intake manifold pressure which results from altitude changes. This value is updated at ignition ON and also at wide open throttle (WOT).

CMP Resync Counter-Range 0-255 Counts

The camshaft position (CMP) resync counter displays the number of times the engine control module (ECM) had to resync with the CMP sensor. The CMP Resync Counter is helpful in diagnosing DTC P0341.

Calculated Converter Temperature

Represents the calculated temperature of the catalytic converter. Useful for determining if the Catalyst Monitor Test has run.

Cooling Relay Command Relay-Range On/Off

The fan control (FC) relay is commanded by the engine control module (ECM). FC relay 1 displays the command as ON or OFF.

Cooling Fan Relay CMD

Displays ON if the ECM is commanding the cooling fan relay On.

Crank Learned

Displays YES if the ECM has learned the variation between crankshaft reluctor notch spacing. Learning the crankshaft is vital to correct misfire diagnostics.

Cruise Clutch Command

Displays YES if the ECM is commanding the cruise control module clutch On.

Cruise Delta

Displays the difference between the cruise set speed and the actual vehicle speed.

Cruise Direction Command

Displays YES if the ECM is commanding cruise direction.

Cruise In Released State

Displays YES if the ECM has disengaged cruise.

Cruise Resume/Accel

Displays ON if the RES/ACCEL switch is depressed.

Cruise Set Speed

Indicates the set vehicle cruise speed.

Cruise Set/Coast

Displays ON if the SET/COAST switch is depressed.

Cruise Switch

Displays ON if the CRUISE ON/OFF switch is On.

Cruise Switch-ON/OFF

The Stepper Cruise display indicates if the engine control module (ECM) is allowing the cruise operation. The ECM has the ability to disable the cruise control under certain conditions.

Cruise Switch Voltage

Indicates the value of the cruise control signal voltage at the ECM.

Desired Idle Speed- 0-3,187 RPM

The engine control module (ECM) commands the idle speed. The ECM compensates for various engine loads in order to maintain the desired idle speed. The actual engine RPM speed should remain close to the desired idle under the various engine loads with the engine idling.

Dist. Since Code Clear

Indicates the number of miles the vehicle has traveled since the last time the ECM DTCs were cleared.

ECT-Range -40 to +151°C (-40 to +304°F)

The engine coolant temperature (ECT) sensor sends engine temperature information to the engine control module (ECM). The ECM supplies 5 volts to the ECT sensor circuit. The sensor is a thermistor which changes internal resistance as temperature changes. When the sensor is cold, internal resistance high, the ECM monitors a high voltage which is interpreted as a cold engine. As the sensor warms, internal resistance decreases, the voltage signal will decrease and the ECM will interpret the lower voltage as a warm engine.

Engine LOAD-Range 0-100 Percent

Indicates engine load based on MAP. The higher the percentage, the more load the engine is under.

Engine Oil Life Remaining-Range 0-100 Percent

This display represents the engine oil life index that is calculated and maintained by the engine control module (ECM).

Engine Oil Life Reset

Displays YES when the oil life reset switch in the UHFB is being depressed (switch closed).

Engine Run Time-Range 0:00:00-18:12:15 hours:minutes:seconds

The engine run time is a measure of how long the engine has been running. When the engine stops running the timer resets to zero.

Engine Speed-Range 0-16,384 RPM

Engine Speed is computed by the engine control module (ECM) from the fuel control reference input. The engine speed should remain close to desired idle under the various engine loads with the engine idling.

EVAP Large Leak

Indicates the PASS or FAIL result of the EVAP large leak diagnostic during the EVAP diagnostic system test. NOT RAN means the test has not run this ignition and INV means the test results were invalid. A FAIL indicates a large leak is present.

EVAP Purge Solenoid

Displays ON if the ECM is commanding a duty cycle to the EVAP purge solenoid.

EVAP Purge Solenoid DC

Indicates the EVAP purge solenoid On-time percentage the ECM is commanding.

EVAP Purge Solenoid Command-Range 0-100 Percent

Indicates the engine control module (ECM) command of the evaporative emission (EVAP) purge valve solenoid in order to control the EVAP canister purge function. At 0 percent the valve is commanded fully closed. 100 percent implies that the valve is fully open.

EVAP Purge Valve Leak

Indicates the PASS or FAIL result of the EVAP purge solenoid diagnostic test during the EVAP diagnostic system test. NOT RAN means the test has not run this ignition and INV means the test results were invalid. A FAIL most likely indicates the EVAP purge solenoid is stuck open.

EVAP Small Leak

Indicates the PASS or FAIL result of the EVAP small leak diagnostic during the EVAP diagnostic system test. NOT RAN means the test has not run this ignition and INV means the test results were invalid. A FAIL indicates a small leak is present.

EVAP Tank Vac. Slope

Indicates the rate at which the vacuum in the fuel tank during the EVAP system small and large leak diagnostic test is decreasing (losing vacuum). Units are in millimeters of mercury per second.

EVAP Vent Blockage

Indicates the PASS or FAIL result of the EVAP vent solenoid diagnostic test during the EVAP diagnostic system test. NOT RAN means the test has not run this ignition and INV means the test results were invalid. A FAIL most likely indicates the EVAP vent solenoid is stuck closed or an EVAP line from the vent to the fuel tank is kinked.

EVAP Vent Solenoid

Displays ON if the ECM is commanding the EVAP vent solenoid On.

EVAP Vent Solenoid Command-Range Venting/Non-venting

Indicates the engine control module (ECM) command of the evaporative emission (EVAP) vent solenoid allowing fresh outside air to the EVAP canister during the purge mode. The EVAP vent solenoid allows the diagnostic to pull a vacuum on the fuel tank by closing the vent solenoid.

Fuel Level Sensor- Range 0-100 Percent

The fuel level sensor monitors the fuel level in the tank. Several of the enhanced EVAP system diagnostics are dependent upon the correct fuel level.

Fuel Level Sensor

Indicates the value of the fuel level sensor voltage at the ECM based on fuel tank level.

Fuel Pump Relay Command- Range ON/OFF

Indicates the engine control module (ECM) command of the fuel pump relay.

Fuel Tank Pressure Sensor- Range -25.89 to +32.45 mm Hg

The fuel tank pressure (FTP) sensor measures the difference between the pressure or vacuum in the fuel tank and the outside air pressure.

Fuel Tank Pressure Sensor-Range - 0.0 to +5.0 Volts

The fuel tank pressure (FTP) sensor measures the difference between the pressure or the vacuum in the fuel tank and the outside air pressure. When the air pressure in the fuel tank equals the outside air pressure, the output voltage of the sensor is 1.3-1.7 volts.

Fuel Trim Cell-Range 0-22

A fuel trim cell depends upon the engine speed and the manifold absolute pressure (MAP) sensor readings. RPM vs. MAP is broken down into 22 fuel trim cells. The fuel trim cell indicates which cell is currently active.

Generator L Terminal Signal-Range Inactive/Active

The generator L terminal indicates whether the engine control module (ECM) is allowing the generator to operate. The ECM can disable the generator under certain conditions to ease starting. Inactive indicates that the ECM is allowing generator operation, while active indicates that the ECM is not allowing generator operation.

Generator F Terminal Signal-Range 0-100 Percent

Indicates the amount of ON time the engine control module (ECM) is commanding the generator. The higher the percentage the longer the generator is being commanded ON.

High Spark Modifier

LOW, MID and HIGH SPARK MODIFIERS are adaptive spark retard values used to control engine spark knock. The HIGH SPARK MODIFIER should display 0 degrees if no spark retard is needed. The high spark modifier is used for high engine speeds. The adaptives are based on ECT and will reset to 0 degrees during cold temperatures. If a hot restart occurs, a percentage of the learned adaptive will be used. The ECM will always work back to zero compensation or no spark retard.

HO2S 1-Range 0-1132 mV

The front heated oxygen sensor (HO2S) 1 reading represents the exhaust oxygen sensor output voltage. This voltage will fluctuate constantly between 100 mV, lean exhaust to 900 mV, rich exhaust, when operating in a Closed Loop.

HO2S 2- Range 0-1132 mV

The rear heated oxygen sensor (HO2S) 2 represents the exhaust oxygen output voltage past the catalytic converter. This voltage remains inactive, or the voltage will appear lazy within a range of 100 mV, lean exhaust and 900 mV, rich exhaust, when the system is operating in a Closed Loop.

HO2S 1 Heater Command-Range On/Off

Indicates the engine control module (ECM) command of the heated oxygen sensor (HO2S) 1 heater.

HO2S 2 Heater Command- Range On/Off

Indicates the engine control module (ECM) command of the heated oxygen sensor (HO2S) 2 heater.

HO2S 1 Heater Current-Amps

The parameter displays the current through the control module when the HO2S sensor 1 heater is commanded ON by the control module. HO2S 1 Heater is a range of values indicating a low current when the heater circuit resistance is high to a high current when the heater circuit resistance is low.

HO2S 2 Heater Current-Amps

The parameter displays the current through the control module when the HO2S sensor 2 heater is commanded ON by the control module. HO2S 2 Heater is a range of values indicating a low current when the heater circuit resistance is high to a high current when the heater circuit resistance is low.

IAC Position-Range 0-255 Counts

The idle air control (IAC) pintle position command from the engine control module (ECM) is displayed in counts. The higher the counts read, the more the commanded idle speed is. The IAC responds fairly quickly to changes in the engine load in order to maintain the desired idle RPM.

IAC Position W/O A/C

Indicates the learned idle air control position with the A/C Off.

IAC Position With A/C

Indicates the learned idle air control position with the A/C On.

IAT Sensor-Range -40 to +151°C (-40 to +304°F)

The engine control module (ECM) converts the resistance of the intake air temperature (IAT) sensor to degrees in the same manner as the engine coolant temperature (ECT) sensor. Intake air temperature is used by the ECM to adjust fuel delivery and spark timing according to incoming air density.

Ignition 1 Signal-Range 0-25.5 Volts

The ignition volts represents the system voltage measured by the engine control module (ECM) at the ignition feed circuit.

Injector PWM - Range 0-999.9 mS

Indicates the base pulse width modulation (PWM) or ON time of the fuel injectors in milliseconds. When the engine load is increased, the injector pulse width will increase.

Injector 1-4 Command-On/Off

Indicates the engine control module (ECM) command on the fuel injectors.

KS Noise

Indicates the level of normal noise as seen by the knock sensor at idle. The higher the count value, the higher the amplitude of the noise. Normal noise levels will vary with the SOHC and DOHC engines.

Knock Retard-Range 0-90 Degrees

The Adaptive Knock Retard indicates the long term amount of the spark advance the engine control module (ECM) removes from the ignition control (IC). The ECM responds to the knock sensor (KS) signal.

Lean/Rich Avg. Time

Indicates the average time for the O2S-1 to transition from under 300 mV to over 600 mV during the last test sample.

Lean/Rich Transitions

Indicates the number of times the O2S-1 transitioned from under 300 mV to over 600 mV during the last test sample.

Long Term FT-Range 0-255 (-100 to +100 Percent)

The long term FT is derived from the short term FT value. The long term FT is used for the long term correction of the fuel delivery. A value of the 128 counts, 0 percent, indicates that the fuel delivery requires no compensation in order to maintain a 14.7:1 air to fuel ratio. A value below 128 counts means that the fuel system is too rich and the fuel delivery is being reduced. The engine control module (ECM) is decreasing the injector pulse width. A value above 128 counts indicates that a lean condition exists for which the ECM is compensating.

Loop Status-Range Open/Closed

A Closed Loop displayed indicates that the engine control module (ECM) is controlling the fuel delivery according to the oxygen sensor (O2S) 1 voltage. The ECM controls the fuel delivery air to fuel ratio as close to 14.7:1 as possible.

Low Coolant Level

Displays YES if the coolant in the coolant surge tank is low (switch open).

Low Spark Modifier

LOW, MID and HIGH SPARK MODIFIERS are adaptive spark retard values used to control engine spark knock. The LOW SPARK MODIFIER should display 0 degrees if no spark retard is needed. The low spark modifier is used for low engine speeds. The adaptives are based on ECT and will reset to 0 degrees during cold temperatures. If a hot restart occurs, a percentage of the learned adaptive will be used. The ECM always works back to zero compensation or no spark retard.

M/T Clutch Disengaged

Displays YES if the ECM has detected engine flare as a result of the clutch pedal being depressed. There is NO clutch pedal input to the ECM.

MAP Sensor-Range 11-105 kPa, 0-5.0 Volts

The manifold absolute pressure (MAP) sensor measures the change in the intake manifold pressure which results from engine load and speed changes. As the intake manifold pressure increases, the air density in the intake also increases and additional fuel is required.

MIL Command-Range ON/OFF

Indicates whether the engine control module (ECM) is commanding the malfunction indicator lamp (MIL) ON or OFF.

Mid Spark Modifier

LOW, MID and HIGH SPARK modifiers are adaptive spark retard values used to control engine spark knock. The MID SPARK MODIFIER should display 0 degrees if no spark retard is needed. The mid spark modifier is used for mid engine speeds. The adaptives are based on ECT and will reset to 0 degrees during cold temperatures. If a hot restart occurs, a percentage of the learned adaptive will be used. The ECM always works back to zero compensation or no spark retard.

Mileage Since DTC Cleared

The scan tool displays km or miles. This parameter indicates the mileage accumulated since an emission DTC cleared. The powertrain control module (PCM) stores this mileage in the Freeze Frame and Failure Records memory.

Mileage Since First Fail

The scan tool displays km or miles. This parameter indicates the mileage accumulated since an emission DTC first failed. The powertrain control module (PCM) stores this mileage in the Freeze Frame and Failure Records memory.

Mileage Since Last Fail

The scan tool displays km or miles. This parameter indicates the mileage accumulated since an emission

DTC last failed. The powertrain control module (PCM) stores this mileage in the Failure Records memory.

Mileage Since MIL Request

The scan tool displays km or miles. This parameter displays the mileage accumulated since the powertrain control module (PCM) requested the malfunction indicator lamp (MIL) to illuminate. The PCM stores the mileage in the Failure Records memory.

Misfire Current #1-4-Range 0-255 Counts

Indicates the number of current misfires that are present in the indicated cylinder. Increments only when misfire is current.

Misfire Enabled

Displays YES when the ECM has detected that all of the misfire enable criteria have been met. Parameters can be found under P0300 DTC PARAMETERS.

Misfire History #1-4-Range 0-255 Counts

Indicates the number of misfires that have occurred after 195 current misfires have been counted. The current misfire counter will add the misfires to the history misfire counter after 195 total misfires have taken place. If 1 cylinder is misfiring, the misfiring current counter will have 195 misfires counted before adding to its history counter. If 2 cylinders are misfiring, the misfiring current counters will add to their history counters after 97 misfires. Increments only after a misfire diagnostic trouble code (DTC) has been set.

Park/Neutral Switch

Displays P-N or R-D-L as indicated from the transaxle range switch.

Rich/Lean Avg. Time

Indicates the average time for the O2S-1 to transition from over 600 mV to under 300 mV during the last test sample.

Rich/Lean Transitions

Indicates the number of times for the O2S-1 to transition from over 600 mV to under 300 mV during the last test sample.

Short Term FT-Range 0-255 (-100 to +100 Percent)

Short term FT represents a short term correction to fuel delivery by the engine control module (ECM) in response to the amount of time the oxygen sensor (O2S) voltage spends above or below the 450 mV threshold. If the oxygen sensor has mainly been below 450 mV, indicating a lean air/fuel mixture, short term FT will increase to tell the ECM to add fuel. If the oxygen sensor voltage stays mainly above the threshold, the ECM will reduce fuel delivery to compensate for the indicated rich condition.

Spark-Range 64 to -64 Degrees

This is a display of the spark advance ignition control (IC) calculation which the engine control module (ECM) is programming in the ignition system. The desired spark advance is computed using data such as engine temperature, RPM, engine load, vehicle speed and operating mode.

Start Up ECT

Indicates the engine coolant temperature (ECT) at engine start up.

Steering Assist Sol. DC

Indicates the steering assist solenoid On-time percentage the ECM is commanding. Under 16 km/h (10 mph), the duty cycle will be 0% or full assist. Over 113 km/h (70 mph) the duty cycle will be 100% or no assist. In between speeds will vary.

TP Sensor-Range 0-100 Percent

The engine control module (ECM) computes the throttle position (TP) from the TP sensor voltage input. The TP angle will auto zero to 0 percent at idle when the TP voltage is below 0.90 volt. The TP angle will read 100 percent at wide open throttle (WOT).

TP Sensor-Range 0.0-0.5 Volts

The engine control module (ECM) uses the TP sensor to determine the amount of the throttle demanded by the operator of the vehicle. The throttle position (TP) sensor reads between 0.36-0.96 volt at idle to above 4 volts at wide open throttle (WOT).

TR Switch-Range High or Low

A transaxle mounted switch is used as an input to let the engine control module (ECM) know what position the gear select lever is in. The scan tool status will switch from High to Low as different combinations are met. In Park, PRNDL P and A will be Low and B and C will be High.

Vehicle Speed Sensor-Range 0-255 km/h, 0-255 mph

The vehicle speed sensor (VSS) signal is converted into km/h (mph) for display. The vehicle speed output from the engine control module (ECM) is 4,000 pulses per mile. The scan tool uses the Class 2 serial data from the ECM to obtain vehicle speed, while the instrument panel cluster, cruise control module and multi-function alarm module use the 4,000 ppm output.

VTD Fuel Cutoff-Range No/Yes

Indicates if the vehicle theft deterrent (VTD) module has received proper information to enable or disable fuel.

SCAN TOOL OUTPUT CONTROLS

Scan Tool Output Controls

Scan Tool Output Control	Additional Menu Selection(s)	Description
Engine Speed Control	Special Functions/TAC System	This function activates the idle speed override in 20 RPM, 100 RPM, and 500 RPM increments, from 600 RPM to 1700 RPM. The engine speed will remain in the commanded state until cancelled by the tool.
EGR Solenoid	Special Functions/EGR System	This function activates the exhaust gas recirculation (EGR) solenoid in 10 percent increments from 0 to 100 percent or a maximum of 30 seconds at 100%
EVAP Purge Solenoid (PWM)	Special Functions/EVAP System	This function activates the EVAP purge solenoid valve. The normal commanded state is NONE. The system will INCREASE or DECREASE the amount of purge by changing the duty cycle of the purge valve in 10 percent increments within a range of 0 percent-100 percent. The system remains in the commanded state until cancelled by the tool or the fuel tank pressure (FTP) exceeds -24 mm Hg (-12 in H20).
EVAP Purge/Seal	Special Functions/EVAP System	This function activates two functions. One function increases or decreases the amount of purge by changing the duty cycle of the purge valve and commanding the vent ON, non-venting. The normal commanded state of both valves is NONE. The system will INCREASE or DECREASE the amount of EVAP purge valve opening by 10 percent increments within a range of 0 percent-100 percent. The second function seals the system after using the purge function to obtain a specific amount of fuel tank pressure (FTP). When activated, the purge valve is commanded to 0 percent and the vent valve is commanded ON, non-venting. Both functions remain in the commanded state until cancelled by the tool or the FTP exceeds -24 mm Hg (-12 in H20).
EVAP System Seal	Special Functions/EVAP System	When activated, the purge valve is commanded to 0 percent and the vent valve is commanded ON, non-venting. This functions remain in the commanded state until cancelled by the tool or the FTP exceeds -24 mm Hg (-12 in H20).
EVAP Service Bay Test	Special Functions/EVAP System	This function activates the Service Bay Test to verify the integrity of the EVAP System. The scan tool initiates the test when the following conditions are met: • All the instructions on the scan tool have been completed • The engine coolant temperature is less then a specified value • No DTCs are set
		This function activates the EVAP vent solenoid. The normal

EVAP Vent Solenoid	Special Functions/EVAP System	commanded state is NONE. When commanded ON, the vent valve switches to non-venting. The system remains in the commanded state unless one of the following conditions occurs: • Cancelled by the tool • Purge is greater than 0 percent, and the fuel tank pressure (FTP) exceeds -24 mm Hg (-12 in H20)
Fuel Pump	Special Functions/Engine Output Controls	This function activates the fuel pump relay. The normal commanded state is NONE. When commanded ON/OFF, the ECM turns the fuel pump relay ON/OFF. If the engine is running and the fuel pump relay is commanded OFF, the engine will stall. The system remains in the commanded state until cancelled by the scan tool.
Fuel Economy Test	Special Functions/Fuel System	When the Test is ENABLED the ECM calculates fuel economy based on throttle position, injector pulse width, vehicle speed and engine load.
Ignition System	Special Functions/Engine Output Controls	**IMPORTANT:** **The spark tester must be connected to the ignition coil and a good ground before using this function.** This function activates the ignition control (IC) circuit for the selected ignition coil for 30 seconds. The scan tool initiates the test when the following conditions are met: • The ignition is on with the engine off • The vehicle speed is 0 km/h mph Control is not allowed again on the same coil until that ignition coil is allowed to cool for 60 seconds.
Intake Plenum Switchover Valve	Special Functions/Engine Output Controls	This function activates the solenoid that supplies vacuum to the IMRC valve located in the intake manifold. The commanded states include NONE, ON and OFF. When commanded ON or OFF, the system remains in the commanded state until cancelled by the scan tool.
Throttle Valve Position	Special Functions/TAC System	This function opens the throttle plate in 25 percent increments. The Scan tool initiates the test when the following conditions are met: • The ignition is on with the engine off • The vehicle speed is 0 km/h mph The system remains in the commanded state until cancelled by the scan tool.

DIAGNOSTIC TROUBLE CODE (DTC) LIST

Diagnostic Trouble Code (DTC) List

DTC	Diagnostic Procedure	Module (s)
P0068	**DTC P0068**	ECM
P0106	**DTC P0106**	ECM
P0107	**DTC P0107**	ECM
P0108	**DTC P0108**	ECM
P0112	**DTC P0112**	ECM
P0113	**DTC P0113**	ECM
P0117	**DTC P0117**	ECM
P0118	**DTC P0118**	ECM
P0120	**DTC P0120**	ECM
P0122	**DTC P0122**	ECM
P0123	**DTC P0123**	ECM
P0125	**DTC P0125**	ECM
P0128	**DTC P0128**	ECM
P0130	**DTC P0130**	ECM
P0131	**DTC P0131**	ECM
P0132	**DTC P0132**	ECM
P0133	**DTC P0133**	ECM
P0134	**DTC P0134**	ECM
P0135	**DTC P0135 or P0141**	ECM
P0136	**DTC P0136**	ECM
P0137	**DTC P0137**	ECM
P0138	**DTC P0138**	ECM
P0140	**DTC P0140**	ECM
P0141	**DTC P0135 or P0141**	ECM
P0171	**DTC P0171**	ECM
P0172	**DTC P0172**	ECM
P0201	**DTC P0201-P0204**	ECM
P0202	**DTC P0201-P0204**	ECM
P0203	**DTC P0201-P0204**	ECM
P0204	**DTC P0201-P0204**	ECM
P0217	**DTC P0217** in Engine Cooling	ECM
P0220	**DTC P0220**	ECM
P0222	**DTC P0222**	ECM
P0223	**DTC P0223**	ECM
P0300	**DTC P0300**	ECM
P0301	**DTC P0301-P0304**	ECM
P0302	**DTC P0301-P0304**	ECM
P0303	**DTC P0301-P0304**	ECM
P0304	**DTC P0301-P0304**	ECM

P0315	**DTC P0315**	ECM
P0326	**DTC P0326**	ECM
P0327	**DTC P0327**	ECM
P0336	**DTC P0336**	ECM
P0340	**DTC P0340**	ECM
P0341	**DTC P0341**	ECM
P0420	**DTC P0420**	ECM
P0442	**DTC P0442**	ECM
P0446	**DTC P0446**	ECM
P0452	**DTC P0452**	ECM
P0453	**DTC P0453**	ECM
P0455	**DTC P0455**	ECM
P0461	**DTC P0461** in Instrument, Panel, Gages and Console	ECM
P0462	**DTC P0462** in Instrument, Panel, Gages and Console	ECM
P0463	**DTC P0463** in Instrument, Panel, Gages and Console	ECM
P0480	**DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L61)DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L66)** in Engine Cooling	ECM
P0481	**DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L61)DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L66)** in Engine Cooling	ECM
P0496	**DTC P0496**	ECM
P0506	**DTC P0506**	ECM
P0507	**DTC P0507**	ECM
P0562	**DTC P0562** in Engine Electrical	ECM
P0563	**DTC P0563** in Engine Electrical	ECM
P0601	**DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610**	ECM
P0602	**DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610**	ECM
P0604	**DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610**	ECM
P0606	**DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610**	ECM
P0607	**DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610**	ECM
P0621	**DTC P0621** in Engine Electrical	ECM
P0622	**DTC P0622** in Engine Electrical	ECM
P0641	**DTC P0641**	ECM
P0651	**DTC P0651**	ECM
P0700	**DTC P0700**	ECM
P1133	**DTC P1133**	ECM
P1134	**DTC P1134**	ECM
P1137	**DTC P1137**	ECM
P1138	**DTC P1138**	ECM
P1171	**DTC P1171**	ECM
P1516	**DTC P1516**	ECM
P1599	**DTC P1599**	ECM

P1621	**DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610**	ECM
P1640	**DTC P1640**	ECM
P1670	**DTC P1670**	ECM
P1680	**DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610**	ECM
P1681	**DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610**	ECM
P1682	**DTC P1682**	ECM
P2101	**DTC P2101**	ECM
P2119	**DTC P2119**	ECM
P2120	**DTC P2120**	ECM
P2122	**DTC P2122**	ECM
P2123	**DTC P2123**	ECM
P2125	**DTC P2125**	ECM
P2127	**DTC P2127**	ECM
P2128	**DTC P2128**	ECM
P2135	**DTC P2135**	ECM
P2138	**DTC P2138**	ECM
P2176	**DTC P2176**	ECM

DIAGNOSIS

DTC P0068

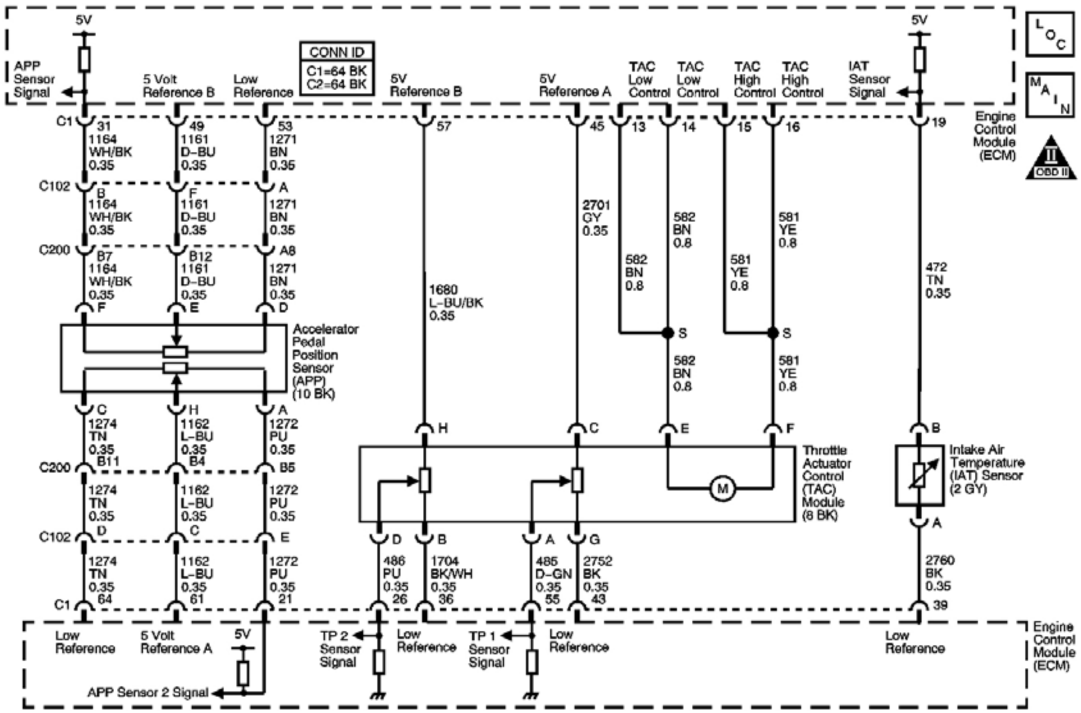


Fig. 1: DTC P0068 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The engine control module (ECM) uses the following information in order to calculate an expected airflow rate:

- The throttle position (TP)
- The barometric pressure (BARO)
- The intake air temperature (IAT)
- The engine RPM

If the ECM detects the airflow rate is more than expected, DTC P0068 will set.

Conditions for Running the DTC

- DTCs P0120, P0122, P0123, P0220, P0222, P0223, P0641, P0651 are not set.
- The engine is running and the engine speed is more than 600 RPM.

Conditions for Setting the DTC

The ECM detects that the calculated airflow rate is more than expected.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The PCM will turn OFF the malfunction indicator lamp (MIL) during the third consecutive trip in which the diagnostic has run and passed.
- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- The DTC can be cleared by using a scan tool.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

5: This step will determine if the manifold absolute pressure (MAP) sensor voltage is within the proper range at idle.

6: This step will determine if the MAP sensor responds properly to the change in manifold pressure.

7: A throttle blade that sticks or binds may set this code. Opening the throttle will indicate problems such as these.

9: When the ECM detects a condition within the ETC system, other DTCs may set due to the many redundant tests run continuously on this system. Locating and repairing one individual condition may correct more than one DTC. Keep this in mind when reviewing captured DTC info.

DTC P0068 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**

2	Are DTCs P0641 or P0651 also set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition. **IMPORTANT:** **If the engine cranks but does not start, go to Step 5.** 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	Inspect for the following conditions: • Vacuum hoses for splits, kinks, and proper connections as shown on Vehicle Emission Control Information label-Inspect thoroughly for any type of leak or restriction. • Air leaks at throttle body mounting area and intake manifold sealing surfaces Did you find and correct the condition?	-	Go to **Step 8**	Go to **Step 5**
5	Observe the MAP sensor voltage parameter with a scan tool. Is the MAP sensor voltage within the specified range?	0.8-4 V	Go to **Step 6**	Go to **DTC P0106**
6	1. Idle the engine. 2. Observe the MAP sensor kPa parameter with a scan tool. 3. Increase the engine speed slowly, and then back to idle. Does the MAP sensor kPa change smoothly and gradually as the engine speed is increased and returned to idle?	-	Go to **Step 7**	Go to **DTC P0106**

7	**CAUTION:** **Turn OFF the ignition before inserting fingers into the throttle bore. Unexpected movement of the throttle blade could cause personal injury.** 1. Inspect the throttle body for the following conditions while modulating the throttle using the scan tool: • Loose or damaged throttle blade • Broken throttle shaft • Drive mechanism damage 2. If any of these conditions exist, replace the throttle body assembly. Refer to **Throttle Body Assembly Replacement** . Did you find and correct the condition?	-	Go to **Step 8**	Go to Diagnostic Aids
8	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 7**
9	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0106

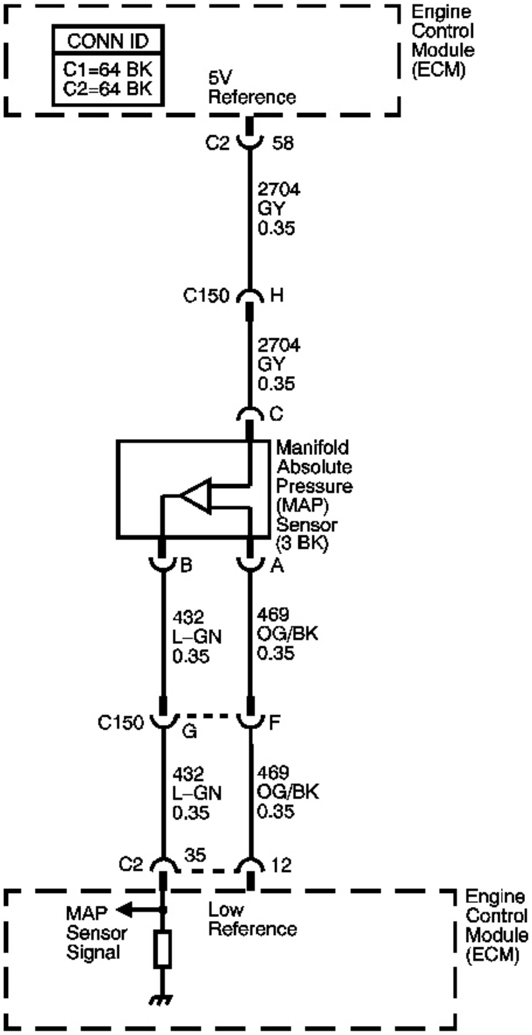


Fig. 2: DTC P0106 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The manifold absolute pressure (MAP) sensor responds to pressure changes in the intake manifold. The pressure changes occur based on the engine load. The MAP sensor has the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A MAP sensor signal circuit

The engine control module (ECM) supplies 5 volts to the MAP sensor on the 5-volt reference circuit. The ECM, also, provides a ground on the low reference circuit. The MAP sensor provides a signal to the ECM on the MAP sensor signal circuit which is relative to the pressure changes in the manifold. The ECM should detect a low signal voltage at a low MAP, such as during an idle or a deceleration. The ECM should detect a high signal voltage at a high MAP, such as the ignition is ON, with the engine OFF, or at a wide-open throttle (WOT). The MAP sensor is also used in order to determine the barometric pressure (BARO). This occurs when the ignition switch is turned ON, with the engine OFF. The BARO reading may also be updated whenever the engine is operated at WOT. The ECM monitors the MAP sensor signal for voltage outside of the normal range.

The ECM calculates a predicted value for the MAP sensor based on throttle position (TP) and engine speed. The ECM then compares the predicted value to the actual MAP sensor signal. If the ECM detects that the MAP sensor signal is not within the predicted range, DTC P0106 sets.

Conditions for Running the DTC

- DTC P0068, P0107, P0108, P0117, P0118, P0120, P0122, P0123, P0125, P0128, P0130, P0131, P0132, P0133, P0134, P0135, P0171, P0172, P0201, P0202, P0203, P0204, P0220, P0222, P0223, P0300, P0301, P0302, P0303, P0304, P0336, P0340, P0341, P0442, P0446, P0452, P0453, P0455, P0496, P0502, P0506, P0507, P1133, P1134, P1516, P1680, P1681, P1682, P2101, P2119, P2120, P2122, P2123, P2125, P2127, P2128, P2135, P2138, or P2176 are not set.
- The engine run time is more than 60 seconds.
- The change in engine speed is less than 50 RPM.
- The engine speed is between 600-6,200 RPM.
- The change in throttle angle is less than 2 percent.
- The torque converter clutch (TCC) is stable to within 1.3 percent.

Conditions for Setting the DTC

The ECM detects that the MAP sensor voltage is outside of the predicted range for more than 12 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other

emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

4: This step tests the ability of the MAP sensor to correctly indicate BARO.

13: The measurement noted in this step will be used in subsequent steps if the measurement does not exceed the specified value.

16: This step calculates the resistance in the 5-volt reference circuit.

17: This step calculates the resistance in the low reference circuit.

DTC P0106 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Inspect for the following conditions: • Disconnected, damaged, or incorrectly routed vacuum hoses • Missing or damaged manifold absolute pressure (MAP) sensor seal • Restrictions in the MAP sensor vacuum source • Intake manifold vacuum leaks Did you find and correct the condition?	-	Go to **Step 29**	Go to **Step 3**
3	**IMPORTANT:** **The vehicle used for the comparison is not limited to the same type of vehicle as is being serviced. A vehicle known to provide an accurate reading is acceptable.** Do you have access to another vehicle in which the MAP sensor pressure can be observed with a scan tool?	-	Go to **Step 4**	Go to **Step 5**
	1. In both vehicles, turn ON the ignition, with the engine OFF.			

4	2. Observe the MAP sensor pressure with a scan tool. 3. Observe the MAP sensor pressure in the known good vehicle with a scan tool. 4. Compare the values. Is the difference between the values less than the specified value?	3 kPa	Go to **Step 6**	Go to **Step 11**
5	**IMPORTANT:** **The Altitude vs. Barometric Pressure table indicates a pressure range for a given altitude under normal weather conditions. Weather conditions consisting of very low or very high pressure and/or very low or very high temperature may cause a reading to be slightly out of range.** 1. Turn ON the ignition, with the engine OFF. 2. Observe the MAP sensor pressure with a scan tool. Refer to **Altitude vs Barometric Pressure** . 3. The MAP sensor pressure should be within the range specified for your altitude. Does the MAP sensor indicate the correct barometric pressure?	-	Go to **Step 6**	Go to **Step 11**
6	1. Observe the MAP sensor pressure with a scan tool. 2. Start the engine. Does the MAP sensor pressure change?	-	Go to **Step 7**	Go to **Step 11**
7	1. Turn OFF the ignition. 2. Remove the MAP sensor from the engine vacuum source. Leave the MAP sensor connected to the engine harness. 3. Connect a **J 23738-A** Mityvac to the MAP sensor. 4. Turn ON the ignition, with the engine OFF. 5. Observe the MAP sensor pressure with the scan tool. 6. Apply vacuum to the MAP sensor with the **J 23738-A** in 1 in Hg increments until 15 in Hg is reached. Each 1 in Hg should decrease MAP sensor pressure by 3-4 kPa. Is the decrease in MAP sensor pressure consistent?	-	Go to **Step 8**	Go to **Step 11**
8	Apply vacuum with the **J 23738-A** until 20 in Hg is reached.	34 kPa		

	Is the MAP sensor pressure less than the specified value?		Go to **Step 9**	Go to **Step 11**
9	Disconnect the **J 23738-A** from the MAP sensor. Does the MAP sensor pressure return to the value observed in step 4 or 5?	-	Go to **Step 10**	Go to **Step 27**
10	Inspect for the following conditions: • Incorrect cam timing-Refer to **Timing Chain, Sprockets, and/or Tensioner Replacement** in Engine Mechanical for the correct timing. • Restricted exhaust flow- Refer to **Restricted Exhaust** in Engine Exhaust. • Worn piston rings-Refer to **Engine Compression Test** in Engine Mechanical.	-	Go to **Step 29**	Go to **Intermittent Conditions**
11	Test for an intermittent and for a poor connection at the MAP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 29**	Go to **Step 12**
12	1. Disconnect the MAP sensor electrical connector. 2. Observe the MAP sensor parameter with the scan tool. Is the voltage less than the specified value?	0.1 V	Go to **Step 13**	Go to **Step 19**
13	Measure the voltage from the 5-volt reference circuit of the MAP sensor to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Note the measurement as Supply voltage. Is the voltage more than the specified value?	5.2 V	Go to **Step 20**	Go to **Step 14**
14	Is the voltage more than the specified value?	4.8 V	Go to **Step 15**	Go to **Step 21**
15	1. Connect a test lamp and a DMM in series between the 5-volt reference circuit and the low reference circuit of the MAP sensor, at the harness connector. 2. Measure the amperage, with the DMM. Note the measurement as Amperage. Is the amperage equal to the specified value?	0 mA	Go to **Step 24**	Go to **Step 16**
	1. Remove the DMM from the circuit. 2. Connect the test lamp between the 5-volt reference circuit and the low reference circuit of the MAP sensor, at the harness connector. 3. Measure the voltage from the 5-volt reference circuit at the test lamp to a good ground, with the			

16	DMM. Note the measurement as Load voltage drop. **IMPORTANT:** **Before any calculations are performed, ensure that all measurements are converted into like units, for example volts/amps or millivolts/milliamps.** 4. Subtract the Load voltage drop from the Supply voltage. Note the result as Supply voltage drop. 5. Divide the Supply voltage drop by the Amperage. Is the result more than the specified value?	5 ohm	Go to **Step 22**	Go to **Step 17**
17	1. Measure the voltage from the low reference circuit of the MAP sensor at the test lamp to a good ground, with the DMM. Note the result as Low reference voltage drop. **IMPORTANT:** **Before any calculations are performed, ensure that all measurements are converted into like units, for example volts/amps or millivolts/milliamps.** 2. Divide the Low reference voltage drop by the Amperage. Is the result more than the specified value?	5 ohm	Go to **Step 25**	Go to **Step 18**
18	1. Remove the test lamp. 2. Connect a 3-amp fused jumper wire between the 5-volt reference circuit and the signal circuit of the MAP sensor, at the harness connector. 3. Observe the MAP sensor parameter with the scan tool. Is the voltage more than the specified value?	4.9 V	Go to **Step 27**	Go to **Step 23**
19	Test the MAP sensor signal circuit between the ECM and the MAP sensor for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 29**	Go to **Step 26**
20	Test all branches of the 5-volt reference circuit that is shared with the MAP sensor for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.	-		

	Did you find and correct the condition?		Go to **Step 29**	Go to **Step 26**
21	Test the 5-volt reference circuit between the ECM and the MAP sensor for an open or for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 29**	Go to **Step 26**
22	Test the 5-volt reference circuit between the ECM and the MAP sensor for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 29**	Go to **Step 26**
23	Test the MAP sensor signal circuit between the ECM and the MAP sensor for the following: • An open • A short to ground • High resistance Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 29**	Go to **Step 26**
24	Test the low reference circuit between the ECM and the MAP sensor for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 29**	Go to **Step 26**
25	Test the low reference circuit between the ECM and the MAP sensor for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 29**	Go to **Step 26**
26	Test for shorted terminals and for poor connections at the ECM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 29**	Go to **Step 28**
27	Replace the MAP sensor. Refer to **Manifold Absolute Pressure (MAP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 29**	-
28	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 29**	-
	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine.			

29	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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 30**
30	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0107

Circuit Description

The manifold absolute pressure (MAP) sensor responds to pressure changes in the intake manifold. The pressure changes occur based on the engine load. The MAP sensor has the following circuits:

- 5-volt reference circuit
- Low reference circuit
- MAP sensor signal circuit

The engine control module (ECM) supplies 5 volts to the MAP sensor on the 5-volt reference circuit. The ECM also provides a ground on the low reference circuit. The MAP sensor provides a signal to the ECM on the MAP sensor signal circuit which is relative to the pressure changes in the manifold. The ECM should detect a low signal voltage at a low MAP, such as during an idle or a deceleration. The ECM should detect a high signal voltage at a high MAP, such as the ignition is ON, with the engine OFF, or at a wide open throttle (WOT). The MAP sensor is also used in order to determine the barometric pressure (BARO). This occurs when the ignition switch is turned ON, with the engine OFF. The BARO reading may also be updated whenever the engine is operated at WOT. The ECM monitors the MAP sensor signal for voltage outside of the normal range.

If the ECM detects a MAP sensor signal voltage that is excessively low, diagnostic trouble code (DTC) P0107 sets.

Conditions for Running the DTC

- The engine is running.
- DTC P0068, P0120, P0122, P0123, P0220, P0222, P0223, P1516, P2101, P2119, P2120, P2122, P2123, P2125, P2127, P2128, P2135, P2138, P2176 are not set.
- The throttle angle is more than 0 percent when the engine speed is less than 1,000 RPM.

  OR

- The throttle ange is more than 15 percent when The engine speed is more than 1,000 RPM.

Conditions for Setting the DTC

The ECM detects that the MAP sensor voltage is less than 0.1 volts for more than 6 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0107 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Monitor the DTC Information with the scan tool. Is DTC P0651 also set?	-	Go to **DTC P0651**	Go to **Step 3**
3	Observe the manifold absolute pressure (MAP) sensor parameter with the scan tool. Is the voltage is less than the specified value?	0.1 V	Go to **Step 5**	Go to **Step 4**
4	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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.	-		

	Does the DTC fail this ignition?		Go to **Step 5**	Go to **Intermittent Conditions**
5	Test for an intermittent and for a poor connection at the MAP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 6**
6	1. Turn OFF the ignition. 2. Disconnect the MAP sensor electrical connector. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the 5-volt reference circuit of the MAP sensor to a good ground, with a DMM. Is the voltage more than the specified value?	4.8 V	Go to **Step 7**	Go to **Step 8**
7	1. Connect a 3-amp fused jumper wire between the 5-volt reference circuit of the MAP sensor and the signal circuit of the MAP sensor. 2. Observe the MAP sensor parameter with the scan tool. Is the voltage more than the specified value?	4.9 V	Go to **Step 11**	Go to **Step 9**
8	Test the 5-volt reference circuit between the engine control module (ECM) and the MAP sensor for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 10**
9	Test the MAP sensor signal circuit between the ECM and the MAP sensor for a short to ground or an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 10**
10	Test for an intermittent and for a poor connection at the ECM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
11	Replace the MAP sensor. Refer to **Manifold Absolute Pressure (MAP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
12	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** .	-		

	Did you complete the replacement?		Go to **Step 13**	-
13	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 14**
14	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0108

Circuit Description

The manifold absolute pressure (MAP) sensor responds to pressure changes in the intake manifold. The pressure changes occur based on the engine load. The MAP sensor has the following circuits:

- 5-volt reference circuit
- Low reference circuit
- MAP sensor signal circuit

The engine control module (ECM) supplies 5 volts to the MAP sensor on the 5-volt reference circuit. The ECM also provides a ground on the low reference circuit. The MAP sensor provides a signal to the ECM on the MAP sensor signal circuit which is relative to the pressure changes in the manifold. The ECM should detect a low signal voltage at a low MAP, such as during an idle or a deceleration. The ECM should detect a high signal voltage at a high MAP, such as the ignition is ON, with the engine OFF, or at a wide open throttle (WOT). The MAP sensor is also used in order to determine the barometric pressure (BARO). This occurs when the ignition switch is turned ON, with the engine OFF. The BARO reading may also be updated whenever the engine is operated at WOT. The ECM monitors the MAP sensor signal for voltage outside of the normal range.

If the ECM detects a MAP sensor signal voltage that is excessively high, DTC P0108 sets.

Conditions for Running the DTC

- DTC P0068, P0120, P0122, P0123, P0220, P0222, P0223, P1516, P2101, P2119, P2120, P2122, P2123, P2125, P2127, P2128, P2135, P2138, P2176 are not set.
- The throttle position (TP) is less than 12 percent.
- The vehicle speed is 0 km/h (0 mph).
- The engine run time is more than 40 seconds.

Conditions for Setting the DTC

The ECM detects that the MAP sensor voltage is more than 3.8 volts for more than 10 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0108 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Observe the manifold absolute pressure (MAP) sensor parameter with the scan tool. Is the voltage more than the specified value?	3.8 V	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**

4	Inspect the MAP sensor vacuum source for the following conditions: • A leak • A restriction • A faulty connection Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 5**
5	Monitor the DTC Information with the scan tool. Is DTC P0651 also set?	-	Go to **Step 9**	Go to **Step 6**
6	Test for an intermittent and for a poor connection at the MAP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 7**
7	1. Turn OFF the ignition. 2. Disconnect the MAP sensor electrical connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the MAP sensor parameter with the scan tool. Is the voltage less than the specified value?	0.1 V	Go to **Step 8**	Go to **Step 10**
8	1. Turn OFF the ignition. 2. Connect a jumper wire between each of the terminals in the MAP sensor harness connector and the corresponding terminal at the MAP sensor. Refer to **Using Connector Test Adapters** in Wiring Systems. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the low reference circuit of the MAP sensor at the jumper wire terminal to a good ground with the DMM. Refer to **Measuring Voltage Drop** in Wiring Systems. Is the voltage more than the specified value?	0.2 V	Go to **Step 11**	Go to **Step 13**
9	1. Turn OFF the ignition. 2. Disconnect the MAP sensor electrical connector. 3. Turn ON the ignition, with the engine OFF.	0.1 V		

	4. Observe the MAP sensor parameter with the scan tool. Is the voltage less than the specified value?		Go to **DTC P0651**	Go to **Step 10**
10	Test the MAP sensor signal circuit between the engine control module (ECM) and the MAP sensor for a short to voltage. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 14**
11	Test the low reference circuit between the ECM and the MAP sensor for an open or for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
12	Test for an intermittent and for a poor connection at the ECM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 14**
13	Replace the MAP sensor. Refer to **Manifold Absolute Pressure (MAP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
14	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
15	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 16**
16	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0112

Circuit Description

The intake air temperature (IAT) sensor is a variable resistor. The IAT sensor has a signal circuit and a low reference circuit. The IAT sensor measures the temperature of the air entering the engine. The engine control module (ECM) supplies 5 volts to the IAT signal circuit, and a ground for the IAT low reference circuit. When the IAT sensor is cold, the sensor resistance is high. When the air temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the IAT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the IAT signal circuit. If the ECM detects an excessively low IAT signal voltage, indicating a high temperature, DTC P0112 sets.

Conditions for Running the DTC

- P0117, P0118, P0125, P0128, P0502 are not set.
- The engine is running for more than 5 minures and 20 seconds.
- The vehicle speed is more than 24 km/h (15 mph).
- The calculated air flow is less than 16 gs.

Conditions for Setting the DTC

The IAT sensor parameter is more than 128°C (262°F) for more than 3 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0112 Circuit

Step	Action	Values	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**

2	**IMPORTANT:** **The cooling fans are commanded On when certain DTC's are set.** Observe the DTC info parameter with a scan tool.Is DTC P0641 or P0651 set?	-	Go to **DTC P0641** or **DTC P0651**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Disconnect the intake air temperature (IAT) sensor. 2. Observe the IAT sensor parameter with a scan tool. Is the IAT sensor parameter less than the specified value?	-39°C (-38°F)	Go to **Step 6**	Go to **Step 5**
5	Test the signal circuit of the IAT sensor for a short to ground or for a short to the IAT low reference circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 7**
6	Test for an intermittent and for a poor connection at the IAT sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 8**
7	Test for an intermittent and for a poor connection at the engine control module (ECM) harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 9**
8	Replace the IAT sensor. Refer to **Intake Air Temperature (IAT) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 10**	-
	Replace the ECM. Refer to **Engine Control**			

9	**Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 10**	-
10	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 11**
11	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0113

Circuit Description

The intake air temperature (IAT) sensor is a variable resistor. The IAT sensor has a signal circuit and a low reference circuit. The IAT sensor measures the temperature of the air entering the engine. The engine control module (ECM) supplies 5 volts to the IAT signal circuit, and a ground for the IAT low reference circuit. When the IAT sensor is cold, the sensor resistance is high. When the air temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the IAT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the IAT signal circuit. If the ECM detects an excessively high IAT signal voltage, indicating a low temperature, DTC P0113 sets.

Conditions for Running the DTC

- P0117, P0118, P0125, P0128, P0502 are not set.
- The engine is running for more than 5 minures and 20 seconds.
- The vehicle speed is less than 24 km/h (15 mph).
- The engine coolant temperature (ECT) is more than -40°C (-40°F).

Conditions for Setting the DTC

The IAT sensor parameter is less than -39°C (-38°F) for more than 3 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the

diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refer to the step number on the diagnostic table.

6: This step tests for the proper operation of the circuit in the low voltage range.

DTC P0113 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **The cooling fans are commanded On when certain DTC's are set.** Observe the DTC info parameter with a scan tool.Is DTC P0641 or P0651 set?	-	Go to **DTC P0641** or **DTC P0651**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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.	-		Go to **Intermittent**

	Did the DTC fail this ignition?		Go to **Step 4**	**Conditions**
4	1. Disconnect the intake air temperature (IAT) sensor. 2. Measure the voltage from the signal circuit of the IAT sensor to a good ground with a DMM. Is the voltage more than the specified value?	5.2 V	Go to **Step 5**	Go to **Step 6**
5	**IMPORTANT:** **If a short to voltage occurs the sensor may be damaged.** Test the signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
6	Connect a 3-amp fused jumper wire between the signal circuit of the IAT sensor and the low reference circuit of the IAT sensor. Refer to **Using Fused Jumper Wires** in Wiring Systems. Is the IAT sensor parameter more than the specified value?	149°C (300°F)	Go to **Step 10**	Go to **Step 7**
7	Connect a 3-amp fused jumper wire between the signal circuit of the IAT sensor and a good ground. Is the IAT sensor parameter more than the specified value?	149°C (300°F)	Go to **Step 9**	Go to **Step 8**
8	Test the signal circuit of the IAT sensor for an open circuit or for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
9	Test the IAT sensor low reference circuit for high resistance or for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
10	Test the IAT signal circuit for a short to any 5-volt reference circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 11**
11	Test for an intermittent and for a poor connection at the IAT sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 13**
	Test for an intermittent and for a poor connection at the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor**			

12	**Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 14**
13	Replace the IAT sensor. Refer to **Intake Air Temperature (IAT) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
14	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
15	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 16**
16	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0117

Circuit 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 volts to the ECT signal circuit, and a ground for the ECT low reference circuit. When the ECT is cold, the sensor resistance is high. When the ECT increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the ECT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the ECT signal circuit. If the ECM detects an excessively low ECT signal voltage, which is a high temperature indication, DTC P0117 sets.

Conditions for Running the DTC

The engine has been running for more than 2 minutes and 8 seconds.

Conditions for Setting the DTC

The ECT sensor parameter is more than 138°C (280°F) for more than 6 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0117 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **The cooling fans are commanded On when certain DTC's are set.** Observe the DTC info parameter with a scan tool.Is DTC P0641 or P0651 set?	-	Go to **DTC P0641** or **DTC P0651**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
	1. Disconnect the engine coolant temperature			

4	(ECT) sensor. 2. Observe the ECT sensor parameter with a scan tool. Is the ECT sensor parameter less than the specified value?	-39°C (-38°F)	Go to **Step 6**	Go to **Step 5**
5	Test the signal circuit of the ECT sensor for a short to ground or a short to any low reference circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 7**
6	Test for an intermittent and for a poor connection at the ECT sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 8**
7	Test for an intermittent and for a poor connection at the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 9**
8	Replace the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 10**	-
9	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 10**	-
10	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 11**
11	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0118

Circuit Description

The engine coolant temperature (ECT) sensor is a variable resistor, that measures the temperature of the engine coolant. The ECT sensor has a signal circuit and a low reference circuit. The engine control module (ECM) supplies 5 volts to the ECT signal circuit, and a ground for the ECT low reference circuit. When the ECT is cold, the sensor resistance is high. When the ECT increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the ECT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the ECT signal circuit. If the ECM detects an excessively high ECT signal voltage, which is a low temperature indication, DTC P0118 sets.

Conditions for Running the DTC

The engine has been running for more than 60 seconds.

Conditions for Setting the DTC

The ECT sensor parameter is less than -39°C (-38°F) for more than 6 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

6: This step tests for the proper operation of the circuit in the low voltage range.

DTC P0118 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics				

Connector End View Reference: **Engine Controls Connector End Views** or **Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **The cooling fans are commanded On when certain DTCs are set.** Observe the DTC info parameter with a scan tool.Is DTC P0641 or P0651 set?		Go to **DTC P0641** or **DTC P0651**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Disconnect the engine coolant temperature (ECT) sensor. 2. Measure the voltage from the signal circuit of the ECT sensor to a good ground with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Is the voltage more than the specified value?	5.2 V	Go to **Step 5**	Go to **Step 6**
5	**IMPORTANT:** **If a short to voltage occurs, the ECT sensor may be damaged.** Test the ECT signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?		Go to **Step 15**	Go to **Step 12**
6	1. Connect a 3-amp fused jumper wire between the signal circuit of the ECT sensor and the low reference circuit of the ECT sensor. Refer to **Using Fused Jumper Wires** in Wiring Systems.	149°C (300°F)		

	2. Observe the ECT sensor parameter with a scan tool. Is the ECT sensor parameter more than the specified value?		Go to **Step 10**	Go to **Step 7**
7	1. Connect a 3-amp fused jumper wire between the signal circuit of the ECT sensor and a good ground. 2. Observe the ECT sensor parameter with a scan tool. Is the ECT sensor parameter more than the specified value?	149°C (300°F)	Go to **Step 9**	Go to **Step 8**
8	Test the signal circuit of the ECT sensor for a high resistance or for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
9	Test the ECT sensor low reference circuit for a high resistance or for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
10	**IMPORTANT:** **If a short to voltage occurs this DTC may set and damage the ECT sensor.** Test the signal circuit of the ECT sensor for a short to any 5-volt reference circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 11**
11	Test for an intermittent and for a poor connection at the ECT sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 13**
12	Test for an intermittent and for a poor connection at the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 14**
13	Replace the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
14	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** .	-		

	Did you complete the replacement?		Go to **Step 15**	-
15	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 16**
16	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0120

Circuit Description

The throttle position (TP) sensors 1 and 2 are located within the throttle body assembly. Each sensor has the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The TP sensor provides the engine control module (ECM) with a signal voltage proportional to the throttle plate movement. The TP sensor 1 signal voltage at closed throttle is near the 5-volt reference and decreases as the throttle plate is opened. The TP sensor 2 signal voltage at closed throttle is near the low reference and increases as the throttle plate is opened. When TP sensor 1 signal voltage is not within the predicted range, this DTC will set.

Conditions for Running the DTC

- The ignition switch is in the crank or run position.
- DTC P0641 is not set.
- The ignition voltage is greater than 2.25 volts.

Conditions for Setting the DTC

TP sensor 1 voltage is less than 0.27 volts or more than 4.67 volts, as observed on the scan tool.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0120 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check- Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the throttle position (TP) sensor voltage with the accelerator pedal in the rest position with a scan tool. Does the scan tool indicate voltage less than the first value or greater than the second value?	0.27 V 4.67 V	Go to **Step 5**	Go to **Step 3**
3	Is DTC P2135 also set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 4**
4	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Does the DTC fail this ignition?		Go to **Step 5**	Go to **Intermittent Conditions**
5	1. Turn OFF the ignition. 2. Disconnect the throttle body harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the TP sensor 1 voltage parameter with a scan tool. Does the scan tool indicate that the voltage is less than the specified value?	0.25 V	Go to **Step 6**	Go to **Step 11**
6	1. Connect a fused jumper wire between the TP sensor 5-volt reference circuit and the TP sensor signal circuit at the throttle body harness connector. 2. Observe the TP sensor 1 voltage parameter with a scan tool. Does the scan tool indicate the TP sensor 1 voltage is more than the specified value?	4.8 V	Go to **Step 7**	Go to **Step 8**
7	1. Turn OFF the ignition for 90 seconds. 2. Allow the engine control module (ECM) to completely power down. This can be verified by the loss of communication on the scan tool. 3. Measure the resistance from the low reference circuit of the TP sensor to the ECM case with the DMM. Is the resistance less than the specified value?	5 ohm	Go to **Step 17**	Go to **Step 13**
8	Measure the voltage of the TP sensor 1 5-volt reference circuit with a scan tool. Does the DMM indicate voltage more than the specified value?	4.8 V	Go to **Step 10**	Go to **Step 9**
9	Does the DMM indicate voltage less than the specified value on the TP sensor 1 5-volt reference circuit?	5 V	Go to **Step 14**	Go to **Step 16**
10	Test the TP sensor 1 signal circuit for an open or for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 12**
	Test the TP sensor 1 signal circuit for a short to			

11	voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 19**
12	Test the TP sensor 1 signal circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 19**
13	Test the TP sensor 1 low reference circuit for an open or for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 19**
14	Test the TP sensor 1 5-volt reference circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 15**
15	Test the TP sensor 1 5-volt reference circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 19**
16	Test the TP sensor 1 5-volt reference circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	-
17	Inspect for poor connections at the throttle body harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and**Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 18**
18	Replace the throttle body assembly. Refer to **Throttle Body Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 21**	-
19	Inspect for poor connections at the ECM harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 20**
20	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 21**	-
21	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?		Go to **Step 2**	Go to **Step 22.**
22	**IMPORTANT:** **Be aware that repairing one individual condition may correct more than one DTC.** Observe the Capture Info with a scan tool.Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0122

Circuit Description

The throttle position (TP) sensor 1 and sensor 2 are located within the throttle body assembly. Each sensor has the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

This provides the engine control module (ECM) with a signal voltage proportional to the throttle plate movement. TP sensor 1 signal voltage at closed throttle is near the 5-volt reference and decreases as the throttle plate is opened. TP sensor 2 signal voltage at closed throttle is near the low reference and increases as the throttle plate is opened. If the ECM detects the TP sensor 1 signal voltage is less than the predicted range, DTC P0122 sets.

Conditions for Running the DTC

- The ignition switch is in the crank or run position.
- DTC P0641 is not set.
- The ignition voltage is more than 5.23 volts.

Conditions for Setting the DTC

The ECM detects that the TP sensor 1 voltage is less than 0.27 volts.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.

- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0122 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the TP sensor 1 voltage parameter with the accelerator pedal in the rest position with a scan tool. Is the TP sensor 1 voltage parameter less than the specified value?	0.27 V	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the throttle body harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the 5-volt reference	4.8-5.2		

	circuit of throttle position (TP) sensor 1 to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Does the DMM indicate voltage within the specified range?	V	Go to **Step 5**	Go to **Step 6**
5	1. Connect a fused jumper wire between the 5-volt reference circuit and the signal circuit of TP sensor 1. 2. Observe the TP sensor 1 voltage parameter with a scan tool. Is the TP sensor 1 voltage parameter within the specified range?	4.8-5.2 V	Go to **Step 11**	Go to **Step 7**
6	Test the TP sensor 1 5-volt reference circuit for the following conditions: • An open • A short to ground • High resistance Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 8**
7	Test the TP sensor 1 signal circuit for the following conditions: • An open • A short to ground • High resistance Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 8**
8	Test for an intermittent and for a poor connection at the throttle body. Refer to **Testing for Intermittent Conditions and Poor Connections** and**Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
9	Test for an intermittent and for a poor connection at the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor**	-		

	Connections and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?		Go to **Step 12**	Go to **Step 10**
10	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** Did you complete the replacement?	-	Go to **Step 12**	-
11	Replace the throttle body assembly. Refer to **Throttle Body Assembly Replacement** Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 13**
13	Observe the capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0123

Circuit Description

The throttle position (TP) sensor 1 and sensor 2 are located within the throttle body assembly. Each sensor has the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

This provides the engine control module (ECM) with a signal voltage proportional to the throttle plate movement. TP sensor 1 signal voltage at closed throttle is near the 5-volt reference and decreases as the throttle plate is opened. TP sensor 2 signal voltage at closed throttle is near the low reference and increases as the throttle plate is opened. If the ECM detects the TP sensor 1 signal voltage is more than the predicted range, DTC P0123 sets.

Conditions for Running the DTC

- The ignition switch is in the crank or run position.

- DTC P0641 is not set.
- The ignition voltage is more than 5.23 volts.

Conditions for Setting the DTC

The ECM detects that the TP sensor 1 voltage is more than 4.67 volts.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0123 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the TP sensor 1 voltage parameter with the accelerator pedal in the rest position with a scan tool. Is the TP sensor 1 voltage parameter more than the specified value?	4.67 V	Go to **Step 4**	Go to **Step 3**
	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds.			

3	3. Start the engine. 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. Did the DTC fail this ignition ?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the throttle body harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the 5-volt reference circuit of throttle position (TP) sensor 1 to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Does the DMM indicate voltage within the specified range?	4.8-5.2 V	Go to **Step 5**	Go to **Step 7**
5	Measure the voltage from the 5-volt reference circuit to the low reference circuit of TP sensor 1 with a DMM. Refer to **Circuit Testing** in Wiring Systems. Does the DMM indicate voltage within the specified range?	4.8-5.2 V	Go to **Step 6**	Go to **Step 8**
6	1. Connect a fused jumper wire between the 5-volt reference circuit and the signal circuit of TP sensor 1. 2. Observe the TP sensor 1 voltage parameter with a scan tool. Is the TP sensor 1 voltage parameter more than the specified value?	4.8 V	Go to **Step 15**	Go to **Step 9**
7	Test the TP sensor 1 5-volt reference circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 10**
8	Test the TP sensor 1 low reference circuit for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 12**
9	Test the TP sensor 1 signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.	-		

	Did you find and correct the condition?		Go to **Step 16**	Go to **Step 10**
10	Test for shorted terminals and for a poor connection at the throttle body. Refer to **Testing for Intermittent Conditions and Poor Connections** and**Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 11**
11	Test for shorted terminals and for a poor connection at the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 14**
12	Test for an intermittent and for a poor connection at the throttle body. Refer to **Testing for Intermittent Conditions and Poor Connections** and**Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 13**
13	Test for an intermittent and for a poor connection at the ECM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 14**
14	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** Did you complete the replacement?	-	Go to **Step 16**	-
15	Replace the throttle body assembly. Refer to **Throttle Body Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 16**	-
16	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 17**
17	Observe the capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0125

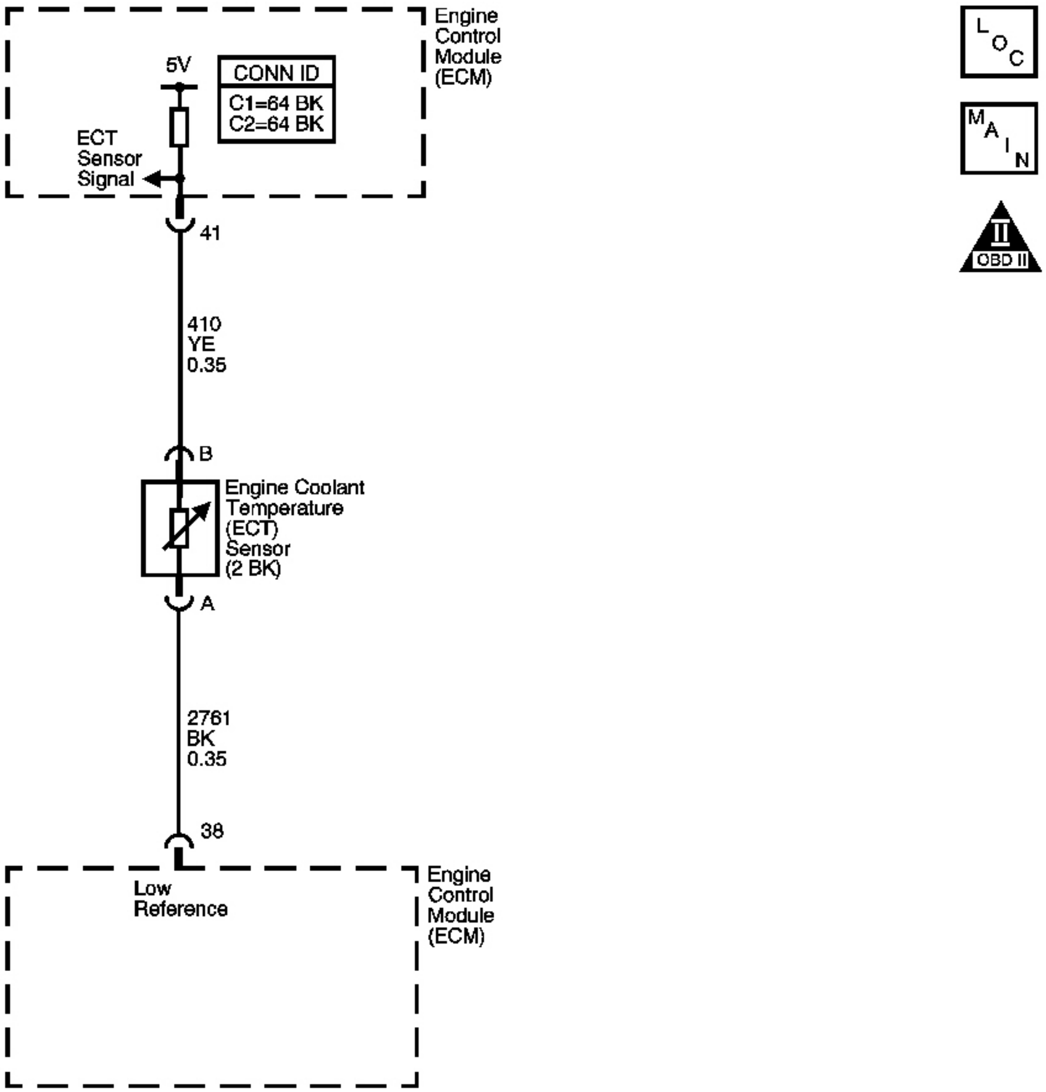


Fig. 3: DTC P0125 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

An engine coolant temperature (ECT) sensor monitors the temperature of the coolant. This input is used by the engine control module (ECM) for engine control and as an enabling criteria for some diagnostics.

The air flow into the engine is accumulated and used to determine if the vehicle has been driven within the conditions that would allow the engine coolant to heat up normally to the Closed Loop temperature. If the coolant temperature does not increase normally or does not reach the Closed Loop temperature, the diagnostics that use engine coolant temperature as enabling criteria may not run when expected.

This DTC will only run once per ignition cycle within the enabling conditions.

If the ECM detects the calibrated amount of air flow and engine run time have been met, and the engine coolant has not met the Closed Loop temperature, DTC P0125 sets.

Conditions for Running the DTC

- DTCs P0105, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0128, P0130, P0131, P0132, P0133, P0134, P0135, P0171, P0172, P0201-P0204, P0300, P0301-P0304, P0326, P0327, P0336, P0420, P0440, P0442, P0446, P0452, P0453, P0480, P0481, P0502, P0503, P1133, P1171, P1441 are not set.
- The minimum air temperature is more than -7°C (+19°F).
- The start-up engine coolant temperature (ECT) is less than 35°C (95°F).
- The engine run time is between 30 seconds and 30 minutes.
- The vehicle has traveled more than 0.8 kilometers (0.5 miles) at more than 40 km/h (25 mph).
- The calculated air flow is more than 20 g/s.

Conditions for Setting the DTC

- The calibrated amount of air flow has been met.
- The calibrated amount of engine run time has been met.
- The calibrated vehicle speed and distance have been met.
- The minimum ECT for Closed Loop of 40°C (104°F) has not been met.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0125 Circuit

Step	Action	Values	Yes	No

Schematic Reference: Engine Controls Schematics
Connector End View Reference:Engine Controls Connector End Views or **Engine Control Module (ECM) Connector End Views**

1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **The cooling fans are commanded ON when certain engine coolant temperature (ECT) DTCs are set.** Is the cooling system coolant low?	-	Go to **Draining and Filling Cooling System** in Engine Cooling	Go to **Step 3**
3	Test and verify the proper operation of the thermostat. Refer to **Thermostat Diagnosis** in Engine Cooling. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 4**
4	1. Disconnect the ECT sensor. 2. Inspect for the following conditions: • Corrosion on the ECT sensor terminals • Improper or corroded terminals at the ECT harness connector • Loose terminals in the ECT harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 5**
5	Measure the voltage from the signal circuit of the ECT sensor to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage within the specified range?	4.8-5.2 V	Go to **Step 6**	Go to **Step 8**
6	Measure the voltage from the signal circuit of the ECT sensor to the low reference circuit of the ECT sensor with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage within the specified range?	4.8-5.2 V	Go to **Step 9**	Go to **Step 7**
7	Test the ECT sensor low reference circuit for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 11**
8	Test the ECT sensor signal circuit for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.	-		

	Did you find and correct the condition?		Go to **Step 14**	Go to **Step 11**
9	1. Turn OFF the ignition. 2. Remove the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . 3. Place the sensor on a work surface away from any heat source. 4. Allow the sensor to reach the ambient air temperature for 30-60 minutes. 5. Observe and record the ambient air temperature of the vehicle environment using an accurate thermometer. 6. Measure the resistance of the ECT sensor and record the value. 7. Compare the resistance measurement of the ECT sensor to the ambient air temperature on the Temperature vs. Resistance table. Refer to **Temperature vs Resistance** . Is the resistance measurement of the ECT sensor within the specified range?	-	Go to **Step 10**	Go to **Step 12**
10	Install the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . Is the action complete?	-	Go to **Intermittent Conditions**	-
11	Test for an intermittent and for a poor connection at the ECM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 13**
12	Replace the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 14**	-
13	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 14**	-
14	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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.	-		

	Did the DTC fail this ignition?		Go to **Step 2**	Go to **Step 15**
15	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0128

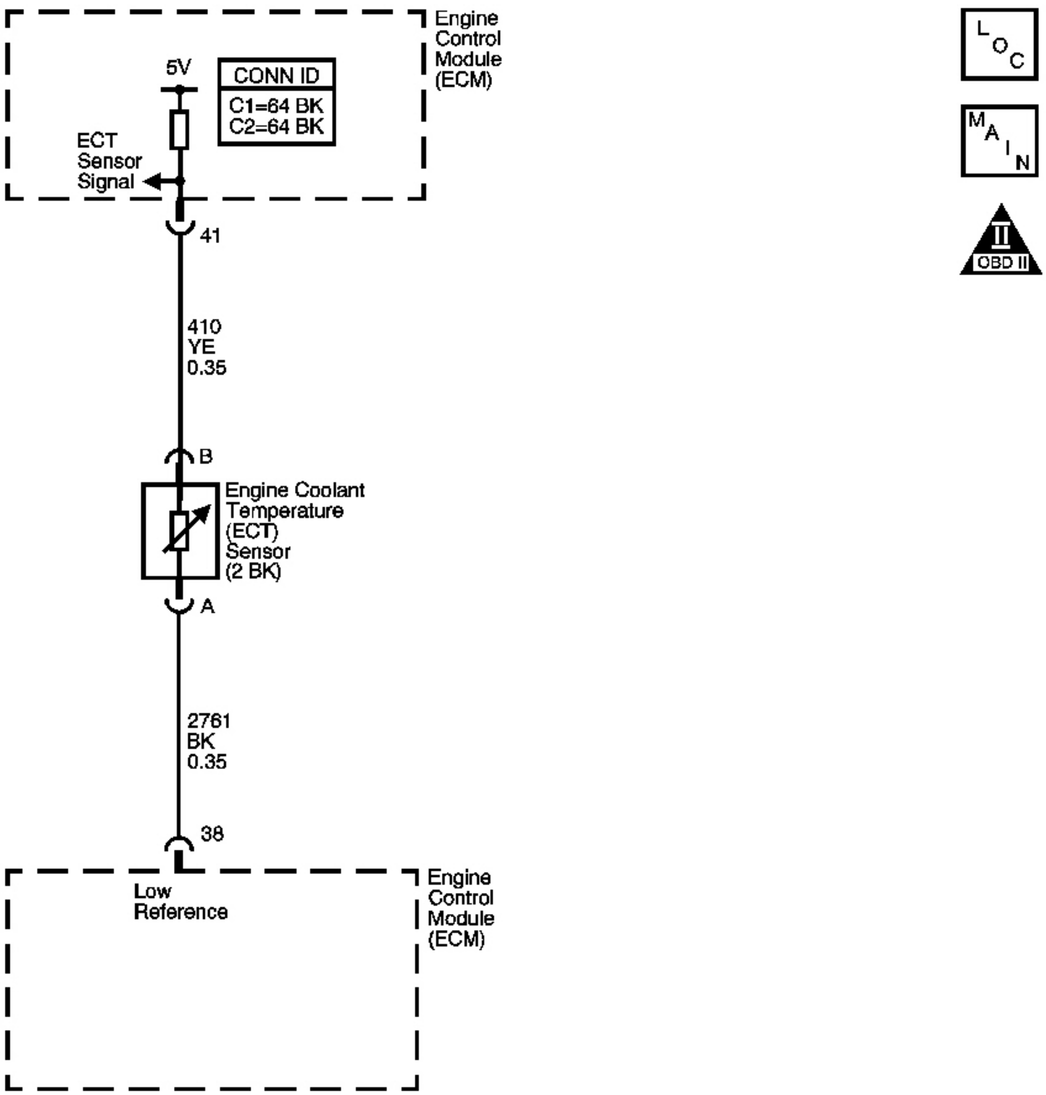


Fig. 4: DTC P0128 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

An engine coolant temperature (ECT) sensor monitors the temperature of the coolant. This input is used by the engine control module (ECM) for engine control and as an enabling criteria for some diagnostics.

The air flow coming into the engine is accumulated and used to determine if the engine has been driven within 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 regulating temperature of the thermostat, diagnostics that use ECT as enabling criteria may not run when expected.

This DTC will only run once per ignition cycle within the enabling condition. If the ECM detects the calibrated amount of air flow and engine run time have been met, and the ECT has not met the minimum thermostat regulating temperature, DTC P0128 sets.

Conditions for Running the DTC

- DTCs P0105, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0125, P0130, P0171, P0172, P0201-P0204, P0300, P0301-P0304, P0336, P0440, P0442, P0446, P0480, P0481, P0502, P0503, P0602, P1441, P1621 are not present.
- The start-up ECT is less than 65°C (149°F).
- The intake air temperature (IAT) is more than -7°C (+19°F).
- The engine run time is between 30 seconds and 30 minutes.
- The vehicle is driven more than 2.4 kilometers (1.5 miles) at more than 40 km/h (25 mph).
- The calculated air flow is more than 20 g/s.

Conditions for Setting the DTC

The PCM detects that:

- The calibrated amount of engine run time has been met
- The calibrated amount of engine air flow has been met
- The calibrated vehicle speed and distance have been met.
- The calibrated ECT of 70°C (158°F) has not been met

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles

that the diagnostic runs and does not fail.

- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0128 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **The cooling fans are commanded ON when certain engine coolant temperature (ECT) DTCs are set.** Is the cooling system coolant low?	-	Go to **Draining and Filling Cooling System** in Engine Cooling	Go to **Step 3**
3	Test and verify the proper operation of the thermostat. Refer to **Thermostat Diagnosis** in Engine Cooling. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 4**
4	1. Disconnect the ECT sensor. 2. Inspect for the following conditions: • Corrosion on the ECT sensor terminals • Improper or corroded terminals at the ECT harness connector • Loose terminals in the ECT harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 5**
5	Measure the voltage from the signal circuit of the ECT sensor to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage within the specified range?	4.8-5.2 V	Go to **Step 6**	Go to **Step 8**
6	Measure the voltage from the signal circuit of the ECT sensor to the low reference circuit of the ECT sensor with a DMM. Refer to **Circuit**	4.8-5.2		

	Testing in Wiring Systems. Is the voltage within the specified range?	V	Go to **Step 9**	Go to **Step 7**
7	Test the ECT sensor low reference circuit for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 11**
8	Test the ECT sensor signal circuit for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 11**
9	1. Turn OFF the ignition. 2. Remove the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . 3. Place the sensor on a work surface away from any heat source. 4. Allow the sensor to reach the ambient air temperature for 30-60 minutes. 5. Observe and record the ambient air temperature of the vehicle environment using an accurate thermometer. 6. Measure the resistance of the ECT sensor and record the value. 7. Compare the resistance measurement of the ECT sensor to the ambient air temperature on the Temperature vs. Resistance table. Refer to **Temperature vs Resistance** . Is the resistance measurement of the ECT sensor within the specified range?	-	Go to **Step 10**	Go to **Step 12**
10	Install the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . Is the action complete?	-	Go to **Intermittent Conditions**	-
11	Test for an intermittent and for a poor connection at the ECM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 13**
12	Replace the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 14**	-
13	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 14**	-

14	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 15**
15	Observe the Capture Info. with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0130

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The engine control module (ECM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the ECM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperatures and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream. Low HO2S voltage indicates a lean exhaust stream.

If the ECM detects the loop status is open too long, DTC P0130 will set.

Conditions for Running the DTC

- DTCs P0068, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0122, P0123, P0125, P0128, P0171, P0172, P0201, P0202, P0203, P0204, P0220, P0300-P0304, P0315, P0336, P0442, P0446, P0452, P0453, P0455, P0496, P0506, P0507, P0601, P0602, P0604, P0606, P0641, P0651, P1516, P1621, P1680, P1681, P2101, P2120, P2125, P2135, P2138, P2176 are not set.
- The Engine Run Time parameter is more than 200 seconds.
- The Engine Speed parameter is between 1,200-3,400 RPM.
- The TP Angle parameter is between 10-40 percent.
- The ECT Sensor parameter is more than 70°C (158°F).
- The APP Angle parameter is more than 1.2 percent.
- The above conditions are met for 2 seconds.

Conditions for Setting the DTC

The ECM detects that the Loop Status parameter is open for 12.5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: An HO2S heater fault may set this DTC.

3: If the voltage is varying above and below the specified value, the condition is not present.

DTC P0130 Circuit

Step	Action	Value (s)	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Command the heated oxygen sensor (HO2S) 1 heater ON with a scan tool. 3. Wait 15 seconds to allow the HO2S 1 heater current to stabilize. 4. Observe the HO2S 1 heater current parameter with a scan tool.	0.217-1.56 A		

	Is the HO2S 1 heater current parameter within the specified range?		Go to **Step 3**	Go to **DTC P0135 or P0141**
3	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to **Scan Tool Data List** . 3. Operate the engine at 2,000 RPM for 30 seconds. 4. Observe the HO2S 1 voltage parameter with a scan tool. Is the HO2S 1 voltage parameter varying above and below the specified range?	300-600 mV	Go to **Step 4**	Go to **Step 5**
4	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 5**	Go to **Intermittent Conditions**
5	1. Turn OFF the ignition. 2. Disconnect the HO2S 1. 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S 1 voltage parameter with a scan tool. Is the HO2S 1 voltage parameter more than the specified value?	800 mV	Go to **Step 6**	Go to **Step 7**
6	**IMPORTANT:** **The normal voltage on the high signal circuit is between 400-500 mV.** **IMPORTANT:** **The sensor may be damaged if the circuit is shorted to a voltage source.** Test the HO2S 1 high signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 17**

7	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S 1 harness connector on the engine harness side and the low signal circuit of the HO2S 1 harness connector on the engine harness side. 2. Observe the HO2S 1 voltage parameter with a scan tool. Is the HO2S 1 voltage parameter within the specified range?	400-500 mV	Go to **Step 9**	Go to **Step 8**
8	1. Remove the jumper wire from the previous step. 2. Test the HO2S 1 heater low control circuit for a short to one of the following circuits: • The HO2S 1 low signal circuit • The HO2S 1 high signal circuit Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 14**
9	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire from the high signal circuit of the HO2S 1 harness connector on the engine harness side and ground. 3. Observe the HO2S 1 voltage parameter with a scan tool. Is the HO2S 1 voltage parameter within the specified range?	400-500 mV	Go to **Step 11**	Go to **Step 10**
10	1. Remove the jumper wire from the previous step. 2. Test the HO2S low signal circuit for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 15**
11	Measure the voltage from the high signal circuit of the HO2S 1 harness connector on the engine harness side to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems.	1.0 V		

	Is the voltage more than the specified value?		Go to **Step 12**	Go to **Step 13**
12	**IMPORTANT:** **The normal voltage on the low signal circuit is between 20-100 mV.** Test the HO2S 1 low signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 17**
13	Test the HO2S 1 high signal circuit for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 15**
14	Test for an intermittent and for a poor connection at the HO2S 1. Refer to **Testing for Intermittent Conditions and Poor Connections** and**Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 16**
15	Test for an intermittent and for a poor connection at the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 17**
16	Replace the HO2S 1. Refer to **Heated Oxygen Sensor Replacement - Position 1** . Did you complete the replacement?	-	Go to **Step 18**	-
17	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 18**	-
18	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 19**
19	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0131

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The engine control module (ECM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the ECM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperatures and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream. Low HO2S voltage indicates a lean exhaust stream.

If the ECM detects an HO2S voltage that stays below a specified value, DTC P0131 will set.

Conditions for Running the DTC

- DTCs P0068, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0122, P0123, P0125, P0128, P0201 P0202, P0203, P0204, P0220, P0300-P0304, P0315, P0336, P0442, P0452, P0453, P0455, P0496, P0506, P0507, P0601, P0602, P0604, P0606, P0641, P0651, P1516, P1680, P1681, P2101, P2120, P2125, P2135, P2138, P2176 are not set.
- The ECT Sensor parameter is more than 70°C (158°F).
- The Ignition 1 Signal parameter is more than 11 volts.
- The Fuel Level Sensor parameter is more than 10 percent.
- The Engine Run Time parameter is more than 10 seconds.
- The Loop Status parameter is closed.
- The TP Angle parameter is between 15-50 percent.
- The MAP Sensor parameter is more than 25 kPa.
- The APP Angle parameter is more than 1.2 percent.
- The above conditions are met for 4 seconds.

Conditions for Setting the DTC

The ECM detects that the HO2S 1 Voltage parameter is less than 52 mV for 125 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: When the system is operating correctly, the HO2S 1 voltage should toggle above and below the bias voltage. You may need to operate the vehicle within the Freeze Frame conditions and Conditions for Setting the DTC in order to duplicate the malfunction that was detected by the ECM.

4: The specified value is what is measured on a correctly operating system.

DTC P0131 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Control Module (ECM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Operate the engine at normal operating temperature. 2. Operate the engine above 1,200 RPM for 2 minutes. 3. Observe the heated oxygen sensor (HO2S) 1 voltage parameter with a scan tool. Does the scan tool indicate that the HO2S 1 voltage is less than the specified values?	52 mV	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**

4	1. Turn OFF the ignition. 2. Disconnect the HO2S sensor. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the high signal circuit of the HO2S 1 on the vehicle harness side to a good ground with a DMM. Does the voltage measure within the specified value?	350-550 mV	Go to **Step 6**	Go to **Step 5**
5	Test the HO2S 1 high signal circuit for a short to ground or a short to the HO2S 1 low signal circuit. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 8**
6	1. The HO2S 1 is detecting a lean condition or may be contaminated. Inspect for the following conditions: • HO2S connector water intrusion • Silicon-contaminated HO2S • An exhaust leak between the HO2S 1 and the engine. Refer to **Exhaust Leakage** in Engine Exhaust. • Vacuum leaks • Incorrect fuel pressure Refer to **Fuel System Diagnosis** . • Lean fuel injectors Refer to **Fuel Injector Balance Test with Special Tool** . 2. Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 7**
7	Inspect for poor connections at the harness connector of the HO2S 1 sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 9**
8	Inspect for poor connections at the harness connector of the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor**	-		

	Connections and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?		Go to **Step 11**	Go to **Step 10**
9	**IMPORTANT:** **Before replacing the HO2S determine and remove any source of contamination.** Replace the HO2S 1. Refer to **Heated Oxygen Sensor Replacement - Position 1** .Did you complete the replacement?	-	Go to **Step 11**	-
10	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 11**	-
11	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 12**
12	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0132

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The engine control module (ECM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the ECM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperatures and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream. Low HO2S voltage indicates a lean exhaust stream.

If the ECM detects an HO2S voltage that stays above the specified value, DTC P0132 will set.

Conditions for Running the DTC

Rich Test Enable:

- DTCs P0068, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0122, P0123, P0125, P0128, P0201 P0202, P0203, P0204, P0220, P0300-P0304, P0315, P0336, P0442, P0446, P0452, P0453, P0455, P0496, P0506, P0507, P0601, P0602, P0604, P0606, P0641, P0651, P1516, P1621, P1680, P1681, P2101, P2120, P2125, P2135, P2138, P2176 are not set.
- The ECT Sensor parameter is more than 70°C (158°F).
- The Ignition 1 Signal parameter is more than 11 volts.
- The Fuel Level Sensor parameter is more than 10 percent.
- The Engine Run Time parameter is more than 10 seconds.
- The Loop Status parameter is closed.
- The TP Angle parameter is between 15-50 percent.
- The APP Angle parameter is more than 1.2 percent.
- The MAP Sensor parameter is more than 25 kPa.
- The above conditions are met for 4 seconds.

  OR

Decel Fuel Cutoff Test Enable:

- DTCs P0068, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0122, P0123, P0125, P0128, P0201 P0202, P0203, P0204, P0220, P0300-P0304, P0315, P0336, P0442, P0446, P0452, P0453, P0455, P0496, P0506, P0507, P0601, P0602, P0604, P0606, P0641, P0651, P1516, P1621, P1680, P1681, P2101, P2120, P2125, P2135, P2138, P2176 are not set.
- The Loop Status parameter is closed.
- The Decel Fuel Cutoff is active for more than 2.5 seconds.

Conditions for Setting the DTC

Rich Test:

The ECM detects that the HO2S 1 parameter is more than 946 mV for 50 seconds.

OR

Decel Fuel Cutoff Test:

The ECM detects that the HO2S 1 parameter is more than 1,042 mV for 50 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the

diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: When the system is operating correctly, the HO2S 1 voltage should toggle above and below the bias voltage. You may need to operate the vehicle within the Freeze Frame conditions and Conditions for Setting the DTC in order to duplicate the malfunction that was detected by the ECM.

4: The specified value is what is measured on a correctly operating system.

DTC P0132 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Control Module (ECM) Connector End Views orEngine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Operate the engine at normal operating temperature. 2. Operate the engine above 1,200 RPM for 2 minutes. 3. Observe the heated oxygen sensor (HO2S) 1 voltage parameter with a scan tool. Does the scan tool indicate that the HO2S voltage is more than the specified value?	946 mV	Go to **Step 4**	Go to **Step 3**
	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine.			

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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the HO2S 1 sensor. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the high signal circuit of the HO2S 1 on the vehicle harness side to a good ground with a DMM. Does the voltage measure within the specified value?	350-550 mV	Go to **Step 6**	Go to **Step 5**
5	Test the HO2S 1 high signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 8**
6	The HO2S 1 is detecting a rich condition or may be contaminated. Inspect for the following conditions: • HO2S connector water intrusion • Silicon-contaminated HO2S 1 • Fuel-contaminated engine oil • Incorrect fuel pressure-Refer to **Fuel System Description** . • An inaccurate manifold absolute pressure (MAP) sensor-Refer to **Scan Tool Data List** . • Rich fuel injectors-Refer to **Fuel Injector Balance Test with Special Tool** . Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 7**
7	Inspect for poor connections at the harness connector of the HO2S 1 sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 9**

8	Inspect for poor connections at the harness connector of the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 10**
9	**IMPORTANT:** **Before replacing a contaminated HO2S determine and repair the cause of the contamination.** Replace the HO2S 1. Refer to **Heated Oxygen Sensor Replacement - Position 1** .Did you complete the replacement?	-	Go to **Step 11**	-
10	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 11**	-
11	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 12**
12	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0133

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The engine control module (ECM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the ECM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperatures and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream. Low HO2S voltage indicates a lean exhaust stream.

This diagnostic will only run once per ignition cycle. The ECM monitors the rich-to-lean and lean-to-rich transition time. A transition is defined as the HO2S voltage changes from above 650 mV to below 350 mV or from below 350 mV to above 650 mV. If the ECM detects that the transition time is too long, DTC P0133 will set.

Conditions for Running the DTC

- DTCs P0068, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0122, P0123, P0125, P0128, P0201 P0202, P0203, P0204, P0220, P0300-P0304, P0315, P0336, P0442, P0446, P0452, P0453, P0455, P0496, P0506, P0507, P0601, P0602, P0604, P0606, P0641, P0651, P1516, P1621, P1680, P1681, P2101, P2120, P2125, P2135, P2138, P2176 are not set.
- The ECT Sensor parameter is more than 70°C (158°F).
- The Ignition 1 Signal parameter is more than 11 volts.
- The Fuel Level Sensor parameter is more than 10 percent.
- The Engine Run Time parameter is more than 200 seconds.
- The Engine Speed parameter is between 1,000-3,500 RPM.
- The MAP Sensor parameter is between 10-104 kPa.
- The Loop Status parameter is closed.
- The TP Angle parameter is between 6-60 percent.
- The EVAP Purge Solenoid DC parameter is more than 10 percent.
- The above conditions are met for more than 60 seconds.

Conditions for Setting the DTC

The ECM detects that the HO2S 1 rich-to-lean or lean-to-rich average response time is more than a calibrated value.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.

- Clear the MIL and the DTC with a scan tool.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

> **2:** When the system is operating correctly, the HO2S 1 voltage should toggle above and below the specified values. You may need to operate the vehicle within the Freeze Frame conditions and Conditions for Setting the DTC in order to duplicate the malfunction that was detected by the ECM.
>
> **4:** The specified value is what is measured on a correctly operating system.
>
> **5:** The specified value is what is measured on a correctly operating system.

DTC P0133 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Control Module (ECM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **If any other DTCs are set except for heated oxygen sensor (HO2S) DTCs, refer to the other DTCs first before proceeding with this table.** 1. Operate the engine at normal operating temperature. 2. Operate the engine above 1,200 RPM for 2 minutes. 3. Observe the HO2S 1 voltage parameter with a scan tool. Does the scan tool indicate that the heated oxygen sensor (HO2S) 1 voltage is varying above and below the specified values?	350-650 mV	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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.	-		

	Did the DTC fail this ignition?		Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the HO2S 1. 3. Turn ON the ignition, with engine OFF. 4. Measure the voltage from the high signal circuit of the HO2S 1 on the vehicle harness side to a good ground with a DMM. Does the voltage measure within the specified value?	350-550 mV	Go to **Step 5**	Go to **Step 9**
5	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the HO2S 1 high signal circuit and the HO2S 1 low signal circuit. 3. Turn ON the ignition. 4. Monitor the HO2S 1 voltage for the sensor that applies to this DTC with the scan tool. Does the scan tool indicate that the HO2S 1 voltage is less than the specified value?	20 mV	Go to **Step 6**	Go to **Step 10**
6	1. Turn OFF the ignition. 2. Remove the 3-amp fused jumper wire. 3. Connect a test lamp between the ignition 1 voltage circuit and a good ground. Do not use the HO2S 1 heater low control. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	-	Go to **Step 7**	Go to **Step 11**
7	1. Connect a test lamp between the ignition 1 voltage circuit and the HO2S 1 heater low control circuit. 2. Turn ON the ignition, with the engine OFF. 3. Command the HO2S 1 heater ON and OFF with a scan tool. Does the test lamp turn ON and OFF with each command?	-	Go to **Step 14**	Go to **Step 8**
8	Does the test lamp remain illuminated with each command?	-	Go to **Step 12**	Go to **Step 13**
	Test the HO2S 1 high signal circuit for the following conditions:			

9	• Open • High Resistance • Short to Ground • Short to Voltage Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 16**
10	Test the HO2S 1 low signal circuit for an open, a high resistance, or a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 16**
11	1. Test the ignition 1 voltage circuit for an open, high resistance, or short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. 2. Replace the EMISS fuse if necessary. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Intermittent Conditions**
12	Test the HO2S 1 low control circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 16**
13	Test the HO2S 1 low control circuit for an open, a high resistance, or a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 16**
14	**IMPORTANT:** **Before replacing the HO2S, inspect and remove any source of contamination.** Inspect for the following conditions: • The use of incorrect silicon RTV sealant • Fuel contamination • An exhaust leak Refer to **Exhaust Leakage** in Engine Exhaust.	-		

	• The HO2S is installed correctly • Damaged wiring Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?		Go to **Step 19**	Go to **Step 15**
15	Inspect for poor connections at the harness connector of the HO2S 1. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 17**
16	Inspect for poor connections at the harness connector of the ECM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 18**
17	Replace the HO2S 1. Refer to **Heated Oxygen Sensor Replacement - Position 1** . Did you complete the replacement?	-	Go to **Step 19**	-
18	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 19**	-
19	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 20**
20	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0134

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The engine control module (ECM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the ECM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperatures and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream. Low HO2S voltage indicates a lean exhaust stream.

If the ECM detects that the HO2S voltage remains within the bias voltage range, DTC P0134 will set.

Conditions for Running the DTC

- DTCs P0068, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0122, P0123, P0125, P0128, P0201 P0202, P0203, P0204, P0220, P0300-P0304, P0315, P0336, P0442, P0446, P0452, P0453, P0455, P0496, P0506, P0507, P0601, P0602, P0604, P0606, P0641, P0651, P1516, P1621, P1680, P1681, P2101, P2120, P2125, P2135, P2138, P2176 are not set.
- The ECT Sensor parameter is more than 70°C (158°F).
- The Ignition 1 Signal parameter is more than 11 volts.
- The Fuel Level parameter is more than 10 percent.
- The TP Angle parameter is between 15-56 percent.
- The MAP Sensor parameter is more than 20 kPa.
- The APP Angle parameter is more than 1.2 percent.
- The Engine Run Time parameter is more than 30 seconds.

Conditions for Setting the DTC

The ECM detects that the HO2S 1 parameter is between 400-500 mV for 125 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.

- Clear the MIL and the DTC with a scan tool.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: An HO2S heater fault may set this DTC.

3: If the voltage is varying above and below the specified value, the condition is not present.

DTC P0134 Circuit

Step	Action	Value (s)	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Command the heated oxygen sensor (HO2S) 1 heater ON with a scan tool. 3. Wait 15 seconds to allow the HO2S 1 heater current to stabilize. 4. Observe the HO2S 1 heater current parameter with a scan tool. Is the HO2S 1 heater current parameter within the specified range?	0.217-1.56 A	Go to **Step 3**	Go to **DTC P0135 or P0141**
3	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to **Scan Tool Data List** . 3. Operate the engine at 2,000 RPM for 30 seconds. 4. Observe the HO2S 1 voltage parameter with a scan tool. Is the HO2S 1 voltage parameter varying above and below the specified range?	400-500 mV	Go to **Step 4**	Go to **Step 5**
	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine.			

4	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. Did the DTC fail this ignition?	-	Go to **Step 5**	Go to **Intermittent Conditions**
5	1. Turn OFF the ignition. 2. Disconnect the HO2S 1. 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S 1 voltage parameter with a scan tool. Is the HO2S 1 voltage parameter more than the specified value?	800 mV	Go to **Step 6**	Go to **Step 7**
6	**IMPORTANT:** **The normal voltage on the high signal circuit is between 400-500 mV.** **IMPORTANT:** **The sensor may be damaged if the circuit is shorted to a voltage source.** Test the HO2S 1 high signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 17**
7	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S 1 harness connector on the engine harness side and the low signal circuit of the HO2S 1 harness connector on the engine harness side. 2. Observe the HO2S 1 voltage parameter with a scan tool. Is the HO2S 1 voltage parameter within the specified range?	400-500 mV	Go to **Step 9**	Go to **Step 8**
8	1. Remove the jumper wire from the previous step. 2. Test the HO2S 1 heater low control circuit for a short to one of the following circuits: • The HO2S 1 low signal circuit • The HO2S 1 high signal circuit	-		

	Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?		Go to **Step 18**	Go to **Step 14**
9	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire from the high signal circuit of the HO2S 1 harness connector on the engine harness side and ground. 3. Observe the HO2S 1 voltage parameter with a scan tool. Is the HO2S 1 voltage parameter within the specified range?	400-500 mV	Go to **Step 11**	Go to **Step 10**
10	1. Remove the jumper wire from the previous step. 2. Test the HO2S 1 low signal circuit for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 15**
11	Measure the voltage from the high signal circuit of the HO2S 1 harness connector on the engine harness side to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage more than the specified value?	1.0 V	Go to **Step 12**	Go to **Step 13**
12	**IMPORTANT:** **The normal voltage on the low signal circuit is between 20-100 mV.** Test the HO2S 1 low signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 17**
13	Test the HO2S 1 high signal circuit for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 15**
14	Test for an intermittent and for a poor connection at the HO2S 1. Refer to **Testing for Intermittent Conditions and Poor Connections** and**Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 16**

15	Test for an intermittent and for a poor connection at the ECM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 17**
16	Replace the HO2S 1. Refer to **Heated Oxygen Sensor Replacement - Position 1** . Did you complete the replacement?	-	Go to **Step 18**	-
17	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 18**	-
18	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 19**
19	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0135 OR P0141

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. A heating element inside the HO2S minimizes the time required for the sensor to reach operating temperature. Voltage is provided to the heater by the ignition 1 voltage circuit through a fuse. With the engine running, ground is provided to the heater by the HO2S heater low control circuit, though a low side driver within the engine control module (ECM). The ECM monitors the current flow through the heater for diagnosis.

If the ECM detects that the HO2S heater current is outside a specified range, DTC P0135 sets for HO2S 1 or DTC P0141 sets for HO2S 2.

Conditions for Running the DTC

- DTCs P0068, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0122, P0123, P0125, P0128, P0201 P0202, P0203, P0204, P0220, P0300-P0304, P0315, P0336, P0442, P0446, P0452, P0453, P0455, P0496, P0506, P0507, P0601, P0602, P0604, P0606, P0641, P0651, P1516, P1621, P1680, P1681,

P2101, P2120, P2125, P2135, P2138, P2176 are not set.
- The Ignition 1 Signal parameter is between 11-17 volts.
- The ECT Sensor parameter is more than 70°C (158°F).
- The Fuel Level Sensor parameter is more than 10 percent.
- The Engine Run Time parameter is more than 60 seconds.

Conditions for Setting the DTC

- The ECM detects that the affected HO2S heater current is less than 0.217 amps or more than 1.56 amps.
- The above condition is met for 200 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0135 or P0141 Circuit

Step	Action	Value (s)	Yes	No
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Control Module (ECM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	1. Turn ON the ignition, with the engine OFF. 2. Command the affected heated oxygen sensor (HO2S) heater ON with a scan tool. 3. Wait 15 seconds to allow the HO2S heater	0.217-		

2	current to stabilize. 4. Observe the affected HO2S heater current parameter with a scan tool. Is the HO2S heater current parameter within the specified range?	1.56 A	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	Inspect the EMISS fuse. Is the EMISS fuse open?	-	Go to **Step 5**	Go to **Step 6**
5	Test the ignition 1 voltage circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 8**
6	1. Disconnect the affected HO2S. 2. Turn ON the ignition, with the engine OFF. 3. Probe the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	-	Go to **Step 7**	Go to **Step 17**
7	1. Connect a test lamp between the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side and the HO2S heater low control circuit of the HO2S harness connector on the engine harness side. 2. Command the affected HO2S heater ON and OFF with a scan tool. Does the test lamp turn ON and OFF with each command?	-	Go to **Step 9**	Go to **Step 10**
	IMPORTANT:			

8	**Perform the following test on all HO2S' which are supplied voltage by the suspect circuit.** Test the ignition 1 voltage circuit on the sensor side of the HO2S connector for a short to ground. Refer to **Circuit Testing** in Wiring Systems.Is any sensor shorted to ground?	-	Go to **Step 18**	Go to **Intermittent Conditions**
9	Measure the resistance of the following circuits with a DMM: • HO2S heater low control circuit • Ignition 1 voltage circuit Refer to **Circuit Testing** in Wiring Systems. Is the resistance of either circuit more than the specified value?	3 ohm	Go to **Step 16**	Go to **Step 14**
10	Does the test lamp remain illuminated with each command?	-	Go to **Step 11**	Go to **Step 12**
11	Test the HO2S heater low control circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 15**
12	Test the HO2S heater low control circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 13**
13	Test the HO2S heater low control circuit for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 15**
14	Test for an intermittent and for a poor connection at the HO2S. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 18**
15	Test for an intermittent and for a poor connection at the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 19**
16	Repair the circuit with high resistance. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 20**	-
	Repair the open in the ignition 1 voltage circuit.			

17	Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 20**	-
18	Replace the affected HO2S. Refer to **Heated Oxygen Sensor Replacement - Position 1** or **Heated Oxygen Sensor Replacement - Position 2** . Did you complete the replacement?	-	Go to **Step 20**	-
19	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 20**	-
20	Were you sent to this diagnostic from DTC P0134?	-	Go to Step 18 in **DTC P0134**	Go to **Step 21**
21	Were you sent to this diagnostic from DTC P0140?	-	Go to Step 18 in **DTC P0140**	Go to **Step 22**
22	1. Replace the EMISS fuse if necessary. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 23**
23	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0136

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The engine control module (ECM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the ECM operates in open loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and closed loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream.

The HO2S 2 is used for catalyst monitoring. This diagnostic runs once per ignition cycle. This diagnostic consists of two tests, a passive test and an intrusive test. During the passive test, if the HO2S 2 voltage transitions below 300 mV and above 725 mV, the DTC will pass for this ignition cycle. If the DTC does not pass during the passive test, the intrusive test will begin. During the intrusive test, the control module will force the air-to-fuel ratio rich and/or lean. The control module then waits for a predicted response from the HO2S. If the HO2S voltage transitions below 300 mV and/or above 725 mV, the DTC will pass for this ignition cycle. If the control module does not receive the expected response from the HO2S, DTC P0136 will set.

Conditions for Running the DTC

DTCs P0068, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0122, P0123, P0125, P0128, P0130, P0131, P0132, P0137, P0138, P0140, P0141, P0171, P0201-P0204, P0220, P0300-P0304, P0315, P0336, P0442, P0446, P0452, P0453, P0455, P0496, P0506, P0507, P0601, P0602, P0604, P0606, P0641, P0651, P1134, P1516, P1621, P1680, P1681, P2101, P2120, P2125, P2135, P2138, P2176 are not set.

Passive Test

- The engine is running.
- The Engine Run Time parameter is less than 13.3 minutes.

Intrusive Test

- The Engine Run Time parameter is more than 13.3 minutes.
- The ignition 1 Signal parameter is between 11-18 volts.
- The Engine Speed parameter is between 1,000-5,000 RPM.
- The Vehicle Speed parameter is between 32-128 km/h (20-80 mph).
- The Short Term FT parameter is between -20 and +20 percent.
- The Air Flow Calculated parameter is between 14-100 g/s.
- The maximum number of intrusive attempts is less than 25.

Conditions for Setting the DTC

1. The ECM detects that the HO2S 2 did not transition below 300 mV and above 725 mV during the passive test.
2. One of the following tests fail:
    - Lean Intrusive Test
        - The ECM detects that the HO2S 2 is more than 300 mV for 12 seconds.
        - The HO2S 1 is less than 300 mV.

          OR
    - Rich Intrusive Test
        - The ECM detects that the HO2S 2 is less than 725 mV for 12 seconds.
        - The HO2S 1 is more than 600 mV.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

2: If the voltage does not change more that the specified value, the condition is present.

DTC P0136 Circuit

Step	Action	Value (s)	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to **Scan Tool Data List** . 3. Operate the engine at 1,500 RPM for 30 seconds. 4. While observing the HO2S 2 voltage parameter with a scan tool, quickly cycle the throttle from closed throttle to wide open throttle, 3 times. Did the HO2S 2 voltage parameter change more than the specified value?	200 mV	Go to **Step 3**	Go to **Step 4**
	1. Observe the Freeze Frame/Failure Records for this DTC.			

3	2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the HO2S 2. 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S 2 voltage parameter with a scan tool. Is the HO2S 2 voltage parameter less than the specified value?	100 mV	Go to **Step 6**	Go to **Step 5**
5	Observe the HO2S 2 voltage parameter with a scan tool. Is the HO2S 2 voltage parameter more than the specified value?	800 mV	Go to **Step 7**	Go to **Step 8**
6	Test the HO2S 2 high signal circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 9**
7	**IMPORTANT:** **The sensor may be damaged if the circuit is shorted to a voltage source.** Test the HO2S 2 high signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 18**
8	Measure the voltage from the low signal circuit of the HO2S 2 harness connector on the engine harness side to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage more than the specified value?	2 V	Go to **Step 10**	Go to **Step 11**
9	Test the HO2S 2 high signal circuit for a short to the HO2S 2 low signal circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 18**
10	Test the HO2S 2 low signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.	-		

	Did you find and correct the condition?		Go to **Step 21**	Go to **Step 18**
11	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S 2 harness connector on the engine harness side and a good ground. 2. Observe the HO2S 2 voltage parameter with a scan tool. Is the HO2S 2 voltage parameter less than the specified value?	100 mV	Go to **Step 12**	Go to **Step 14**
12	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S 2 harness connector on the engine harness side and the low signal circuit of the HO2S 2 harness connector on the engine harness side. 3. Observe the HO2S 2 voltage parameter with a scan tool. Is the HO2S 2 voltage parameter less than the specified value?	100 mV	Go to **Step 15**	Go to **Step 13**
13	Test the HO2S 2 low signal circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 18**
14	Test the HO2S 2 high signal circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 18**
15	Test the HO2S 2 heater low control circuit for a short to the HO2S 2 high signal circuit or HO2S 2 low signal circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 16**
	1. The HO2S 2 may be detecting a rich exhaust condition, a lean exhaust condition, or the HO2S may be contaminated. Inspect for the following conditions: **NOTE:** **Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.**			

16	• A silicon contaminated HO2S 2 • Any water intrusion into the HO2S 2 connector • An exhaust leak between the HO2S 2 and the engine • Any vacuum leaks • Engine oil contaminated with fuel • An incorrect fuel pressure-Refer to **Fuel System Diagnosis** . • Any lean or rich fuel injectors-Refer to **Fuel Injector Balance Test with Special Tool** . 2. Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 17**
17	Test for shorted terminals and for poor connections at the HO2S 2. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 19**
18	Test for shorted terminals and for poor connections at the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 20**
19	Replace the HO2S 2. Refer to **Heated Oxygen Sensor Replacement - Position 2** . Did you complete the replacement?	-	Go to **Step 21**	-
20	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 21**	-
21	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 22**
	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?		Go to **Diagnostic**	

22		-	**Trouble Code (DTC) List**	System OK

DTC P0137

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The engine control module (ECM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the ECM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperatures and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream. Low HO2S voltage indicates a lean exhaust stream.

If the ECM detects an HO2S voltage that stays below a specified value, DTC P0137 will set.

Conditions for Running the DTC

- DTCs P0068, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0120 P0122, P0123, P0125, P0128, P0201 P0202, P0203, P0204, P0220, P0300-P0304, P0315, P0336, P0442, P0446, P0452, P0453, P0455, P0496, P0506, P0507, P0601, P0602, P0604, P0606, P0641, P0651, P1516, P1621, P1680, P1681, P2101, P2120, P2125, P2135, P2138, P2176 are not set.
- The ECT Sensor parameter is more than 70°C (158°F).
- The Ignition 1 Signal parameter is more than 11 volts.
- The Fuel Level Sensor parameter is more than 10 percent.
- The Engine Run Time parameter is more than 10 seconds.
- The Loop Status parameter is closed.
- The TP Angle parameter is between 15-50 percent.
- The MAP Sensor parameter is more than 20 kPa.
- The APP Angle parameter is more than 1.2 percent.
- The above conditions are met for 4 seconds.

Conditions for Setting the DTC

The ECM detects that the HO2S 2 parameter is less than 43 mV for 150 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the

diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

2: When the system is operating correctly, the HO2S 2 voltage should toggle above and below the bias voltage.

DTC P0137 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Control Module (ECM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Operate the engine at normal operating temperature. 2. Operate the engine above 1,200 RPM for 2 minutes. 3. Observe the heated oxygen sensor (HO2S) 2 voltage parameter with the scan tool. Does the scan tool indicate that the heated oxygen sensor (HO2S) 2 voltage is less than the specified value?	43 mV	Go to **Step 4**	Go to **Step 3**
	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for			

3	Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the HO2S 2 sensor. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the high signal circuit of the HO2S 2 on the vehicle harness side to a good ground with a DMM. Does the voltage measure within the specified value?	350-550 mV	Go to **Step 6**	Go to **Step 5**
5	Test the HO2S 2 high signal circuit for a short to ground or a short to the low signal circuit. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 8**
6	1. The HO2S 2 may be detecting a lean exhaust condition. Check for one of the following conditions: • HO2S connector water intrusion • An exhaust leak between the HO2S 2 and the engine-Refer to **Exhaust Leakage** in Engine Exhaust. • Vacuum leaks • Incorrect fuel pressure- Refer to **Fuel System Diagnosis** . • Lean fuel injectors-Refer to **Fuel Injector Balance Test with Special Tool** . 2. Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 7**
7	Inspect for poor connections at the harness connector of the HO2S 2 sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 9**
	Inspect for poor connections at the harness connector of the engine control module (ECM). Refer to			

8	**Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 10**
9	Replace the HO2S 2. Refer to **Heated Oxygen Sensor Replacement - Position 2** . Did you complete the replacement?	-	Go to **Step 11**	-
10	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 11**	-
11	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 12**
12	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0138

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The engine control module (ECM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the ECM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperatures and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream. Low HO2S voltage indicates a lean exhaust stream.

If the ECM detects an HO2S voltage that stays above a specified value, DTC P0138 will set.

Conditions for Running the DTC

- DTCs P0068, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0122, P0123, P0125, P0128, P0201 P0202, P0203, P0204, P0220, P0300-P0304, P0315, P0336, P0442, P0446, P0452, P0453, P0455, P0496, P0506, P0507, P0601, P0602, P0604, P0606, P0641, P0651, P1516, P1621, P1680, P1681, P2101, P2120, P2125, P2135, P2138, P2176 are not set.

- The ECT Sensor parameter is more than 70°C (158°F).
- The Ignition 1 Signal parameter is more than 11 volts.
- The Fuel Level Sensor parameter is more than 10 percent.
- The Engine Run Time parameter is more than 10 seconds.
- The Loop Status parameter is closed.
- The TP Angle parameter is between 15-50 percent.
- The MAP Sensor parameter is more than 20 kPa.
- The APP Angle parameter is more than 1.2 percent.
- The above conditions are met for 4 seconds.

Conditions for Setting the DTC

The ECM detects that the HO2S 2 parameter is more than 1,042 mV for 50 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: When the system is operating correctly, the HO2S 2 voltage should toggle above and below the bias voltage.

5: This step tests the HO2S 2 high signal circuit for a short to voltage.

DTC P0138 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Control Module (ECM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Operate the engine at normal operating temperature. 2. Operate the engine above 1,200 RPM for 2 minutes. 3. Observe the heated oxygen sensor (HO2S) 2 voltage parameter with the scan tool. Does the scan tool indicate that the heated oxygen sensor (HO2S) 2 voltage is more than the specified value?	1,042 mV	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the HO2S 2 sensor. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the high signal circuit of the HO2S 2 on the vehicle harness side to a good ground with a DMM. Does the voltage measure within the specified value?	350-550 mV	Go to **Step 6**	Go to **Step 5**
5	Test the HO2S 2 high signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 8**
	1. The HO2S 2 is detecting a rich exhaust condition or may be contaminated. Inspect for one of the following conditions:			

6	• HO2S connector water intrusion • A silicon-contaminated HO2S 2 • Fuel-contaminated engine oil • Incorrect fuel pressure-Refer to **Fuel System Diagnosis** . • Rich fuel injectors- Refer to **Fuel Injector Balance Test with Special Tool** . 2. Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 7**
7	Inspect for poor connections at the harness connector of the HO2S 2. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 9**
8	Inspect for poor connections at the harness connector of the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 10**
9	**IMPORTANT:** **Before replacing a contaminated HO2S, determine and repair the cause of the contamination.** Replace the HO2S 2. Refer to **Heated Oxygen Sensor Replacement - Position 2** .Did you complete the replacement?	-	Go to **Step 11**	-
10	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 11**	-
11	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 12**
	Observe the Capture Info with a scan tool.		Go to	

12	Are there any DTCs that have not been diagnosed?	-	**Diagnostic Trouble Code (DTC) List**	System OK

DTC P0140

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The engine control module (ECM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the ECM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperatures and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream. Low HO2S voltage indicates a lean exhaust stream.

If the ECM detects that the HO2S voltage remains within the bias voltage range, DTC P0140 will set.

Conditions for Running the DTC

- DTCs P0068, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0122, P0123, P0125, P0128, P0201 P0202, P0203, P0204, P0220, P0300-P0304, P0315, P0336, P0442, P0446, P0452, P0453, P0455, P0496, P0506, P0507, P0601, P0602, P0604, P0606, P0641, P0651, P1516, P1621, P1680, P1681, P2101, P2120, P2125, P2135, P2138, P2176 are not set.
- The ECT Sensor parameter is more than 70°C (158°F).
- The Ignition 1 Signal parameter is more than 11 volts.
- The Fuel Level Sensor parameter is more than 10 percent.
- The Engine Run Time parameter is more than 30 seconds.
- The TP Angle parameter is between 15-56 percent.
- The MAP Sensor parameter is more than 20 kPa.
- The APP Angle parameter is more than 1.2 percent.
- The Loop Status parameter is closed.

Conditions For Setting The DTC

The ECM detects that the HO2S 2 parameter is between 425-473 mV for 125 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic

reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: An HO2S heater fault may set this DTC.

3: If the voltage is varying above and below the specified value, the condition is not present.

DTC P0140 Circuit

Step	Action	Value (s)	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Command the heated oxygen sensor (HO2S) 2 heater ON with a scan tool. 3. Wait 15 seconds to allow the HO2S 2 heater current to stabilize. 4. Observe the HO2S 2 heater current parameter with a scan tool. Is the HO2S 2 heater current parameter within the specified range?	0.217-1.56 A	Go to **Step 3**	Go to **DTC P0135 or P0141**
	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to **Scan Tool Data List** . 3. Operate the engine at 2,000 RPM for 30			

3	seconds. 4. Quickly cycle the throttle from closed throttle to wide open throttle 3 times while observing the HO2S 2 voltage parameter with a scan tool. Did the HO2S 2 voltage parameter change more than the specified value?	200 mV	Go to **Step 4**	Go to **Step 5**
4	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 5**	Go to **Intermittent Conditions**
5	1. Turn OFF the ignition. 2. Disconnect the HO2S 2. 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S 2 voltage parameter with a scan tool. Is the HO2S 2 voltage parameter more than the specified value?	800 mV	Go to **Step 6**	Go to **Step 7**
6	**IMPORTANT:** **The normal voltage on the high signal circuit is between 400-500 mV.** **IMPORTANT:** **The sensor may be damaged if the circuit is shorted to a voltage source.** Test the HO2S 2 high signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 17**
7	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S 2 harness connector on the engine harness side and the low signal circuit of the HO2S 2 harness connector on the engine harness side. 2. Observe the HO2S 2 voltage parameter with a	400-500 mV		

	scan tool. Is the HO2S 2 voltage parameter within the specified range?		Go to **Step 9**	Go to **Step 8**
8	1. Remove the jumper wire from the previous step. 2. Test the HO2S 2 heater low control circuit for a short to one of the following circuits: • The HO2S 2 low signal circuit • The HO2S 2 high signal circuit Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 14**
9	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire from the high signal circuit of the HO2S 2 harness connector on the engine harness side and ground. 3. Observe the HO2S 2 voltage parameter with a scan tool. Is the HO2S 2 voltage parameter within the specified range?	400-500 mV	Go to **Step 11**	Go to **Step 10**
10	1. Remove the jumper wire from the previous step. 2. Test the HO2S 2 low signal circuit for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 15**
11	Measure the voltage from the high signal circuit of the HO2S 2 harness connector on the engine harness side to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage more than the specified value?	1.0 V	Go to **Step 12**	Go to **Step 13**
12	**IMPORTANT:** **The normal voltage on the low signal circuit is between 20-100 mV.** Test the HO2S 2 low signal circuit for a short to	-		

	voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?		Go to **Step 18**	Go to **Step 17**
13	Test the HO2S 2 high signal circuit for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 15**
14	Test for an intermittent and for a poor connection at the HO2S 2. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 16**
15	Test for an intermittent and for a poor connection at the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 17**
16	Replace the HO2S 2. Refer to **Heated Oxygen Sensor Replacement - Position 2** . Did you complete the replacement?	-	Go to **Step 18**	-
17	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 18**	-
18	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 19**
19	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0171

Circuit Description

The engine control module (ECM) controls the air/fuel metering system in order to provide the best possible combination of driveability, fuel economy, and emission control. Fuel delivery is controlled differently during Open Loop and Closed Loop. During Open Loop, the ECM determines fuel delivery based on sensor signals, without oxygen sensor (O2S) input. During Closed Loop, the ECM adds oxygen sensor inputs to calculate the short and long term fuel trim. If the oxygen sensors indicate a lean condition, the fuel trim values will be above 0 percent. If the oxygen sensors indicate a rich condition, the fuel trim values will be below 0 percent. The short term fuel trim values change rapidly in response to the heated oxygen sensor (HO2S) voltage signals. The long term fuel trim makes coarse adjustments in order to maintain an air/fuel ratio of 14.7:1. This DTC is continuously monitored during engine operation. If the ECM detects an excessively lean condition, DTC P0171 sets.

Conditions for Running the DTC

- DTCs P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0122, P0123, P0125, P0128, P0130-P0134, P0201 P0217, P0300, P0301-P0304, P0326, P0327, P0336, P0340, P0341, P0446, P0502, P0503, P0601, P0602, P1441 are not set.
- The engine coolant temperature (ECT) is between 60-115°C (140-239°F).
- The intake air temperature (IAT) is between -25 to +115°C (-13 to +239°F).
- The manifold absolute pressure (MAP) is more than 28 kPa (4.06 psi).
- The vehicle speed is less than 132 km/h (82 mph).
- The engine speed is between 550-3,600 RPM.
- The barometric pressure (BARO) is more than 72 kPa (10.4 psi).
- The fuel level is more than 9.8 percent.

Conditions for Setting the DTC

- The average long term fuel trim value is above 29 percent.
- The above condition is present for 16 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- The system will become lean if a fuel injector is not supplying enough fuel.
- A lean condition could be present during high fuel demand due to a fuel pump that does not pump enough fuel.
- Fuel contamination, such as water and alcohol will effect the fuel trim.
- Use a scan tool in order to review the Failure Records. If an intermittent condition is suspected, refer to **Intermittent Conditions** .

DTC P0171 Circuit

Step	Action	Values	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Are any DTCs other than P0171 also set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	1. Install a scan tool. 2. Review the Freeze Frame/Failure Records and record the displayed data for this DTC. 3. Select Fuel and Emission data list. 4. Start the engine. 5. Observe the Long Term FT parameter with a scan tool. Does the scan tool indicate that the Long Term FT parameter is more than the specified value?	29%	Go to **Step 4**	Go to Diagnostic Aids
4	1. Operate the engine at idle. 2. Observe the O2S parameters with a scan tool. Does the scan tool indicate that the O2S parameters are within the specified range and fluctuating?	200-800 mV	Go to **Step 5**	Go to **Step 6**
5	1. Turn OFF the engine. 2. Visually and physically inspect the following items: • Splits, kinks, or improper connections at the vacuum hoses-Refer to **Emission Hose Routing Diagram** . • Low fuel pressure-Refer to **Fuel System Diagnosis** . • Fuel contamination- Refer to	-		

	Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool) **Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)** . Did you find and correct the condition?		Go to **Step 9**	Go to **Step 8**
6	1. Turn OFF the engine. 2. Turn ON the ignition, with the engine OFF. 3. Observe the manifold absolute pressure (MAP) sensor pressure parameter with a scan tool. 4. The MAP sensor pressure should be within the range specified for your altitude. Refer to **Altitude vs Barometric Pressure** . Do the MAP parameters indicate the correct barometric pressure?	-	Go to **Step 7**	Go to **DTC P0106**
7	1. Turn OFF the engine. 2. Inspect for the following conditions: • Proper O2S installation • Electrical connectors and wires are secured and not contacting the exhaust system. 3. A short between the signal circuit and the low reference or ground circuit Did you find and correct the condition?	-	Go to **Step 9**	Go to **Fuel System Diagnosis**
8	1. Operate the engine at idle. 2. Inspect for the following conditions: • Missing, loose, or leaking exhaust components • Vacuum leaks at the intake manifold, throttle body, and injector O-rings • Leaks at the air intake ducts • Leaking crankcase ventilation system Did you find and correct the condition?	-	Go to **Step 9**	Go to **Symptoms - Engine Mechanical** in Engine Mechanical.
	IMPORTANT: **After repairs, use the scan tool Fuel Trim Reset function in order to reset the Long Term Fuel Trim.** 1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds.			

9	3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 10**
10	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0172

Circuit Description

The engine control module (ECM) controls the air/fuel metering system in order to provide the best possible combination of driveability, fuel economy, and emission control. Fuel delivery is controlled differently during Open Loop and Closed Loop. During Open Loop, the ECM determines fuel delivery based on sensor signals, without oxygen sensor input. During Closed Loop, the oxygen sensor inputs are added and used by the ECM to calculate the short and long term fuel trim. If the oxygen sensors indicate a lean condition, the fuel trim values will be above 0 percent. If the oxygen sensors indicate a rich condition, the fuel trim values will be below 0 percent. The short term fuel trim values change rapidly in response to the heated oxygen sensor (HO2S) voltage signals. The long term fuel trim makes coarse adjustments in order to maintain Air/Fuel Ratio of 14.7:1. The fuel trim diagnostic will conduct a test to determine if a rich failure actually exists or if excessive vapor from the evaporative emission (EVAP) canister is causing a rich condition. This DTC is continuously monitored during engine operation. If the ECM detects an excessively rich condition, DTC P0172 sets.

Conditions for Running the DTC

- DTCs P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0122, P0123, P0125, P0128, P0130-P0134, P0201-P0206, P0217, P0300, P0310-P0304, P0326, P0327, P0336, P0430, P0341, P0446, P0502, P0503, P0601, P0602, P1441 are not set.
- The engine coolant temperature (ECT) is between 60-115°C (140-239°F).
- The intake air temperature (IAT) is between -25 to +115°C (-13 to +239°F).
- The manifold absolute pressure (MAP) is more than 28 kPa (4.06 psi).
- The vehicle speed is less than 132 km/h (82 mph).
- The engine speed is between 550-3,600 RPM.
- The barometric pressure is more than 72 kPa (10.4 psi).
- The fuel level is more than 9.8 percent.

Conditions for Setting the DTC

- The average long term fuel trim value is below -46 percent.

- The above condition is present for 16 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Fuel contamination, such as water and alcohol will effect the fuel trim.
- Use a scan tool in order to review the Failure Records. If an intermittent condition is suspected, refer to **Intermittent Conditions** .

DTC P0172 Circuit

Step	Action	Values	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Are any DTCs other than P0172 also set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	1. Install a scan tool. 2. Review the Freeze Frame/Failure Records and record displayed data for this DTC. 3. Select Fuel and Emission parameter. 4. Start the engine. 5. Observe the Long Term FT parameter with a scan tool.	-46%		

	Doe the scan tool indicate that the Long Term FT is less than the specified value?		Go to **Step 4**	Go to Diagnostic Aids
4	1. Start the engine. 2. Allow the engine to reach operating temperature. 3. Put the transmission in Park or Neutral position. 4. Turn OFF all of the accessories. 5. Allow the engine to idle. 6. Observe them manifold absolute pressure (MAP) sensor. Parameter with a scan tool. Is the MAP sensor parameter within the specified range?	19-42 kPa	Go to **Step 5**	Go to **DTC P0106**
5	1. Start and operate the engine at idle. 2. Observe O2S parameters with a scan tool. Does the scan tool indicate that the values are within the specified range and fluctuating.	200-800 mV	Go to **Step 6**	Go to **Step 7**
6	1. Turn OFF the engine. 2. Visually and physically inspect the following items: • Vacuum hoses for splits, kinks, and proper connections Refer to **Emission Hose Routing Diagram** . • The air intake duct for being collapsed or restricted • The air filter for being dirty or restricted • For objects blocking throttle body Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 7**
7	1. Turn OFF the engine. 2. Inspect the O2S for proper installation. 3. Ensure electrical connectors and wires are secured and not contacting the exhaust system. 4. Test for continuity between the signal circuit and the low reference circuit. Refer to	-		

	Circuit Testing and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?		Go to **Step 9**	Go to **Fuel System Diagnosis**
8	Inspect for the following: • Excessive fuel in the crankcase • The evaporative emissions control system • The fuel pressure regulator for proper operation-Refer to **Fuel System Diagnosis** . • Ensure that all injectors are functioning properly. Refer to **Fuel Injector Coil Test** . Did you find and correct the condition?	-	Go to **Step 9**	Go to **Symptoms - Engine Mechanical** in Engine Mechanical
9	**IMPORTANT:** **After repairs, use the scan tool Fuel Trim Reset function in order to reset the Long Term Fuel Trim.** 1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 10**
10	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DIAGNOSIS

DTC P0201-P0204

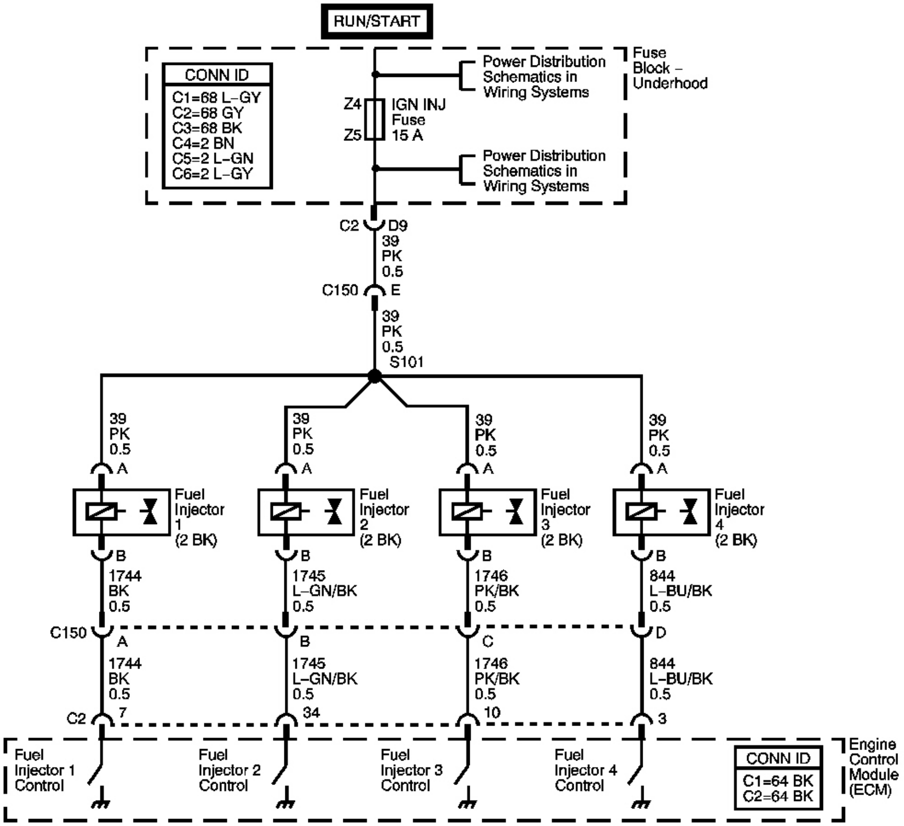


Fig. 1: DTC P0201-P0204 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The control module enables the appropriate fuel injector pulse for each cylinder. Ignition voltage is supplied to the fuel injectors. The control module controls each fuel injector by grounding the control circuit via a solid state device called a driver. The control module monitors the status of each driver. If the control module detects an incorrect voltage for the commanded state of the driver, a fuel injector control circuit DTC sets.

Conditions for Running the DTC

- The engine is running.
- The ignition voltage is between 9-18 volts.

Conditions for Setting the DTC

- The control module detects an incorrect voltage on the fuel injector control circuit.
- The above condition is met for 1.0 second.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Performing the Fuel Injector Coil Test may help isolate an intermittent condition. Refer to **Fuel Injector Coil Test** .
- For an intermittent condition, refer to **Intermittent Conditions** .

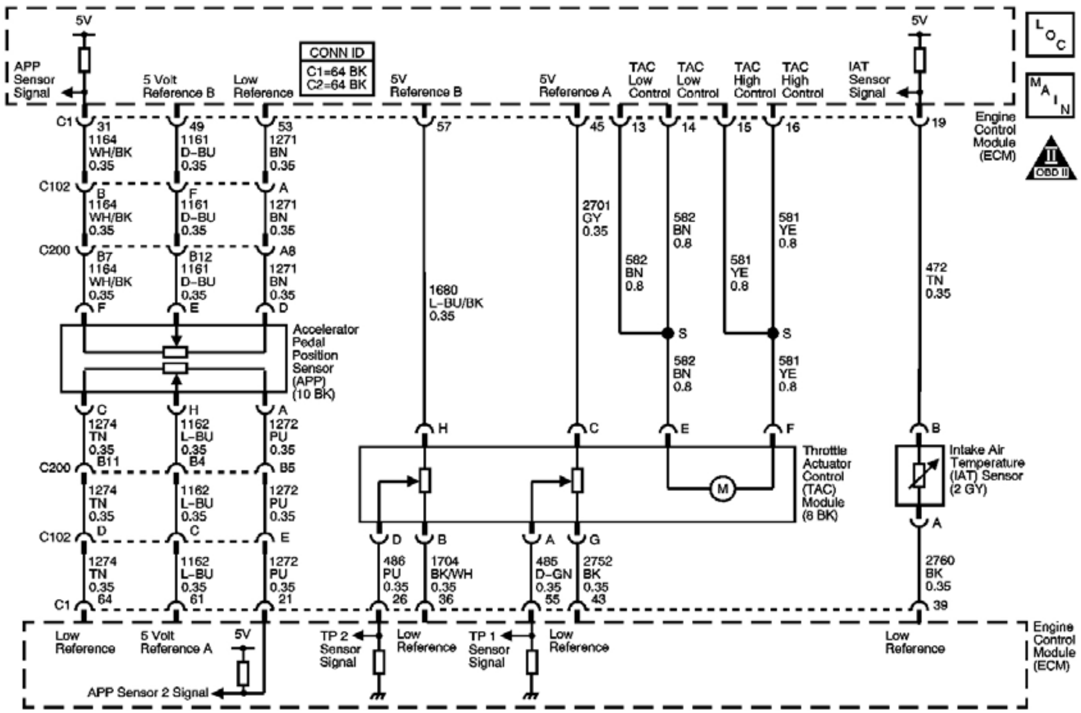
DTC P0201-P0204 Circuit

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Control Module (ECM) Connector End Views or Engine Controls Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds.		

2	3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 3**	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Remove the air cleaner outlet resonator. Refer to **Air Cleaner Outlet Resonator Replacement** . 3. Disconnect the fuel injector. 4. Turn ON the ignition, with the engine OFF. 5. Probe the ignition 1 voltage circuit of the fuel injector with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	Go to **Step 4**	Go to **Step 10**
4	1. Connect the **J 34730-405** Injector Test Lamp (Noid Light) between the control circuit and the ignition 1 voltage circuit of the fuel injector. 2. Start the engine. Does the test lamp flash?	Go to **Step 8**	Go to **Step 5**
5	Does the test lamp remain illuminated at all times?	Go to **Step 7**	Go to **Step 6**
6	Test the control circuit of the fuel injector for an open and for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 13**	Go to **Step 9**
7	Test the control circuit of the fuel injector for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 13**	Go to **Step 12**
8	Test for an intermittent and for a poor connection at the fuel injector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 13**	Go to **Step 11**
9	Test for an intermittent and for a poor connection at the ECM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 13**	Go to **Step 12**

10	Repair the open or short to ground in the ignition 1 voltage circuit of the fuel injector. Replace the fuse as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 13**	-
11	Replace the affected fuel injector. Did you complete the replacement?	Go to **Step 13**	-
12	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	Go to **Step 13**	-
13	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 14**
14	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0220



<u>**Fig. 2: DTC P0220 Circuit**</u>
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The throttle position (TP) sensors 1 and 2 are located within the throttle body assembly. Each sensor has the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The TP sensor provides the engine control module (ECM) with a signal voltage proportional to the throttle plate movement. The TP sensor 1 signal voltage at closed throttle is near the 5-volt reference and decreases as the throttle plate is opened. The TP sensor 2 signal voltage at closed throttle is near the low reference and increases as the throttle plate is opened. When the TP sensor 2 signal voltage is not within the predicted range, this DTC will set.

Conditions for Running the DTC

- The ignition switch is in the crank or run position.
- DTC P0641 is not set.
- The ignition voltage is more than 2.25 volts.

Conditions for Setting the DTC

The TP sensor 2 voltage is less than 0.27 volts or more than 4.67 volts.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0220 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the throttle position (TP) sensor voltage with the accelerator pedal in the rest position with a scan tool. Does the scan tool indicate voltage less than the first value or greater than the second value?	0.27 V 4.67 V	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Does the DTC fail this ignition?		Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the throttle body harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the TP sensor 2 voltage parameter with a scan tool. Does the scan tool indicate that the TP sensor 2 voltage is more than the specified value?	4.8 V	Go to **Step 5**	Go to **Step 12**
5	Probe the TP sensor signal circuit with a test lamp connected to ground. Does the test lamp illuminate?	-	Go to **Step 12**	Go to **Step 6**
6	Observe the TP sensor 2 parameter with a test lamp still connected to the TP sensor signal circuit. Does the scan tool indicate that the voltage is less than the specified value?	0.25 V	Go to **Step 7**	Go to **Step 11**
7	Measure the voltage of the TP sensor 2 5-volt reference circuit with a DMM. Does the DMM indicate that the voltage is more than the specified value?	4.8 V	Go to **Step 8**	Go to **Step 10**
8	1. Turn OFF the ignition for 90 seconds. 2. Allow the engine control module (ECM) to completely power down. This can be verified by the loss of communication on the scan tool. 3. Measure the resistance from the low reference circuit of the TP sensor to the ECM case with the DMM. Is the resistance less than the specified value?	5ohm	Go to **Step 9**	Go to **Step 14**
9	Test the TP sensor low reference circuit for a short to ground. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 18**
10	Does the DMM indicate that the voltage is less than the specified value on the TP sensor 2 5-volt reference circuit?	5 V	Go to **Step 15**	Go to **Step 17**
11	Test the TP sensor 2 signal circuit for an open or for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.	-		

	Did you find and correct the condition?		Go to **Step 22**	Go to **Step 13**
12	Test the TP sensor 2 signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 20**
13	Test the TP sensor 2 signal circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 20**
14	Test the TP sensor 2 low reference circuit for an open or for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 20**
15	Test the TP sensor 2 5-volt reference circuit for an open or for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 16**
16	Test the TP sensor 2 5-volt reference circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 20**
17	Test the TP sensor 2 5-volt reference circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	-
18	Inspect for poor connections at the throttle body harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 19**
19	Replace the throttle body assembly. Refer to **Throttle Body Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 22**	-
20	Inspect for poor connections at the ECM harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 21**
21	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 22**	-
	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine.			

22	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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 23**
23	**IMPORTANT:** **Be aware that repairing one individual condition may correct more than one DTC.** Observe the Capture Info with a scan tool.Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0222

Circuit Description

The throttle position (TP) sensor 1 and sensor 2 are located within the throttle body assembly. Each sensor has the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

This provides the engine control module (ECM) with a signal voltage proportional to throttle plate movement. TP sensor 1 signal voltage at closed throttle is near the 5-volt reference and decreases as the throttle plate is opened. TP sensor 2 signal voltage at closed throttle is near the low reference and increases as the throttle plate is opened. If the ECM detects that the TP sensor 2 signal voltage is less than the predicted range, DTC P0222 sets.

Conditions for Running the DTC

- The ignition switch in the crank or run position.
- DTC P0641 is not set.
- The ignition voltage is more than 5.23 volts.

Conditions for Setting the DTC

The ECM detects that the TP sensor 2 voltage is less than 0.31 volts.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module

stores this information in the Freeze Frame and/or the Failure Records.

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

Conditions for Clearing the MIL/DTC

- The ECM will turn OFF the malfunction indicator lamp (MIL) during the third consecutive trip in which the diagnostic runs and passes.
- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- The DTC can be cleared by using a scan tool.

DTC P0222 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the TP sensor 2 voltage with the accelerator pedal in the rest position with a scan tool Is TP sensor 2 voltage parameter less than the specified value?	0.31 V	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the throttle body harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the TP sensor 2 voltage parameter	5 V		

	with a scan tool Does the scan tool indicate voltage at the specified value?		Go to **Step 5**	Go to **Step 6**
5	Measure the voltage of the TP sensor 2 5-volt reference circuit with a DMM Does the DMM indicate voltage at the specified value?	5 V	Go to **Step 8**	Go to **Step 10**
6	Test the TP sensor 2 signal circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 10**
7	Test the TP sensor 2 5-volt reference circuit for the following condition: • An open • A short to ground • High resistance Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 10**
8	Test for an intermittent and for a poor connection at the throttle body connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
9	Replace the throttle body assembly. Refer to **Throttle Body Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
10	Test for an intermittent and for a poor connection at the at the engine control module (ECM) harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
11	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?		Go to **Step 2**	Go to **Step 13**
13	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0223

Circuit Description

The throttle position (TP) sensor 1 and sensor 2 are located within the throttle body assembly. Each sensor has the following components:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

This provides the engine control module (ECM) with a signal voltage proportional to throttle plate movement. TP sensor 1 signal voltage at closed throttle is near the 5-volt reference and decreases as the throttle plate is opened. TP sensor 2 signal voltage at closed throttle is near the low reference and increases as the throttle plate is opened. If the ECM detects that the TP sensor 2 signal voltage is not within the predicted range, DTC P0223 sets.

Conditions for Running the DTC

- The ignition switch in the crank or run position.
- DTC P0641 is not set.
- The ignition voltage is more than 5.23 volts.

Conditions for Setting the DTC

The ECM detects that the TP sensor 2 voltage is more than 4.7 volts.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The ECM will turn OFF the malfunction indicator lamp (MIL) during the third consecutive trip in which the diagnostic runs and passes.
- The history DTC will clear after 40 consecutive warm-up cycles have occurred without a malfunction.
- The DTC can be cleared by using a scan tool.

DTC P0223 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the TP sensor 2 voltage with the accelerator pedal in the rest position, with a scan tool. Is the TP sensor 2 voltage parameter more than the specified value?	4.7	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the throttle body connector. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage of the TP sensor 2 5-volt reference circuit with a DMM Does the DMM indicate voltage within the specified range?	4.8-5.2 V	Go to **Step 5**	Go to **Step 10**
5	With a test lamp connected to ground, probe the TP sensor signal circuit.	-		

	Does the test lamp illuminate?		Go to **Step 8**	Go to **Step 6**
6	Observe the TP sensor 2 parameter with a test lamp still connected to the TP sensor signal circuit. Does the scan tool indicate voltage at the specified value?	0 V	Go to **Step 9**	Go to **Step 7**
7	Test the TP sensor 2 signal circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 13**
8	Test the TP sensor 2 signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 11**
9	Test the TP sensor 2 low reference circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 12**
10	Test the TP sensor 2 5-volt reference circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 11**
11	Test for shorted terminals and for a poor connection at the engine control module (ECM) harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 15**
12	Test for an intermittent and for a poor connection at the throttle body harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 14**
13	Test for an intermittent and for a poor connection at the ECM harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 15**
14	Replace the throttle body assembly. Refer to **Throttle Body Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 16**	-
15	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 16**	-
	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds.			

16	3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 17**
17	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0300

System Description

The engine control module (ECM) uses information from the crankshaft position (CKP) sensor and the ignition control (IC) module in order to determine when an engine misfire is occurring. By monitoring variations in the crankshaft rotation speed for each cylinder, the ECM is able to detect individual misfire events. A misfire rate that is high enough can cause the 3-way catalytic converter (TWC) to overheat under certain driving conditions. The malfunction indicator lamp (MIL) will flash ON and OFF when the conditions for TWC overheating are present. If the ECM detects a misfire rate sufficient to cause emission levels to exceed mandated standards, DTC P0300 will set.

Conditions for Running the DTC

- DTC P0068, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0122, P0123, P0125, P0128, P0130, P0131, P0132, P0133, P0134, P0135, P0171, P0172, P0220, P0315, P0326, P0327, P0336, P0502, P0507, P0601, P0602, P0604, P0606, P0641, P0651, P0700, P1133, P1134, P1516, P1621, P1680, P1681, P2101, P2120, P2125, P2135, P2138, P2176 are not set.
- The engine speed is between 450-6,400 RPM (M/T).
- The engine speed is between 450-6,100 RPM (auto).
- The ignition voltage is between 9-18 volts.
- The engine coolant temperature (ECT) is between -7 and +123°C (20-254°F).
- The engine has been running for more that 5 seconds.
- The fuel level is more than 10 percent.

Conditions for Setting the DTC

The ECM is detecting a crankshaft rotation speed variation indicating a misfire sufficient to cause emission levels to exceed mandated standards.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.

- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

2: If the actual CKP variation values are not within the learned values, the misfire counters may increment.

DTC P0300 Circuit

Step	Action	Values	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **You must perform the crankshaft position (CKP) system variation learn procedure before proceeding with this diagnostic table. Refer to CKP System Variation Learn Procedure .** 1. Start the engine. 2. Allow the engine to idle or operate within the conditions listed in the Freeze Frame/Failure Records. 3. Monitor all of the Misfire counters with the scan tool. Are any of the Misfire Current counters incriminating?	-	Go to **Step 3**	Go to **Intermittent Conditions**
3	Are any other DTCs set?	-	Go to **Diagnostic Trouble Code**	

			(DTC) List	Go to **Step 4**
4	Can any abnormal engine noise be heard?	-	Go to **Symptoms - Engine Mechanical** in Engine Mechanical	Go to **Step 5**
5	Inspect the following components: • The vacuum hoses and seals for splits, restrictions, and improper connections-Refer to **Emission Hose Routing Diagram** . • The crankcase ventilation system for vacuum leaks-Refer to **Crankcase Ventilation System Inspection/Diagnosis** in Engine Mechanical. • The engine control module (ECM) grounds for corrosion and loose connections-Refer to **Ground Distribution Schematics** in Wiring Systems. • The exhaust system for restrictions-Refer to **Restricted Exhaust** in Engine Exhaust. • The fuel for contamination-Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool) Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)** . Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 6**
	1. Turn OFF the ignition. 2. Remove the fuel pump relay. Refer to **Relay Replacement (Within an Electrical Center)Relay Replacement (Attached to Wire Harness)** in Wiring Systems. 3. Remove the ignition coil housing assembly, keeping the ignition control (IC) module assembly connected to the harness connector. Refer to **Ignition Coil Housing Replacement** . **IMPORTANT:** **Not grounding the IC module housing may cause an erratic spark.**			

6	4. Connect a jumper wire between the top of the IC module and a good ground. 5. Install the **J 36012-A** (SA91992) Ignition System Diagnosis Harness. 6. Install a **J 26792** (J 43883) Spark Tester on the #1 spark plug jumper wire. 7. Ground the #4 spark plug jumper wire. The #4 wire is the companion to #1. 8. Crank the engine with the remaining spark plug wires connected. 9. Repeat the above steps by installing the spark tester on #4 and grounding #1. Do the same for the #2 and the #3 spark plugs. Ensure the companion wire is grounded. Does the spark tester spark on all cylinders?	-	Go to **Step 7**	Go to **Electronic Ignition (EI) System Diagnosis**
7	1. Remove the spark plug from the cylinder that indicated a misfire. Refer to **Spark Plug Replacement** . 2. Inspect the spark plug. Refer to **Spark Plug Inspection** . Does the spark plug appear to be OK?	-	Go to **Step 8**	Go to **Step 9**
8	1. Exchange the suspected spark plug with another cylinder that is operating properly. Refer to **Spark Plug Replacement** . 2. Operate the vehicle under the same conditions that the misfire occurred. Did the misfire move with the spark plug?	-	Go to **Step 15**	Go to **Step 12**
9	Is the spark plug oil or coolant fouled?	-	Go to **Symptoms - Engine Mechanical** in Engine Mechanical	Go to **Step 10**
10	Is the spark plug gas fouled?	-	Go to **Step 13**	Go to **Step 11**
11	Did the spark plug show any signs of being cracked, worn, or improperly gapped?	-	Go to **Step 14**	Go to **Step 12**
12	Perform the fuel injector coil test. Refer to **Fuel Injector Coil Test** . Did you find and correct the condition?	-	Go to **Step 19**	Go to **Symptoms - Engine Mechanical** in Engine Mechanical
	Perform the fuel system diagnosis. Refer to **Fuel**			Go to **Symptoms -**

13	**System Diagnosis** . Did you find and correct the condition?	-	Go to **Step 16**	**Engine Mechanical** in Engine Mechanical
14	Replace or gap the spark plug. Refer to **Spark Plug Replacement** . Did you complete the action?	-	Go to **Step 16**	-
15	Replace the faulty spark plug. Refer to **Spark Plug Replacement** . Did you complete the replacement?	-	Go to **Step 16**	-
16	Was the customer's concern the MIL flashing?	-	Go to **Step 17**	Go to **Step 18**
17	1. Operate the vehicle at the specified value for 4 minutes. 2. Operate the vehicle within the Conditions for Running the DTC P0420 as specified in the supporting text. Refer to **DTC P0420** . Does the DTC run and pass?	2,500 RPM	Go to **Step 18**	Go to **DTC P0420**
18	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 19**
19	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0301-P0304

System Description

The engine control module (ECM) uses information from the crankshaft position (CKP) sensor and the ignition control module (ICM) in order to determine when an engine misfire is occurring. By monitoring variations in the crankshaft rotation speed for each cylinder, the ECM is able to detect individual misfire events. A misfire rate that is high enough can cause the 3-way catalytic converter (TWC) to overheat under certain driving conditions. The malfunction indicator lamp (MIL) will flash ON and OFF when the conditions for TWC overheating are present. If the ECM detects a misfire rate for a specific cylinder sufficient to cause emission levels to exceed mandated standards, DTC P0301, P0302, P0303, or P0304 will set.

Conditions for Running the DTC

- DTC P0068, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0122, P0123, P0125, P0128, P0130, P0131, P0132, P0133, P0134, P0135, P0171, P0172, P0220, P0315, P0326, P0327, P0336, P0502, P0507, P0601, P0602, P0604, P0606, P0641, P0651, P0700, P1133, P1134, P1516, P1621, P1680, P1681, P2101, P2120, P2125, P2135, P2138, P2176 are not set.
- The engine speed is between 450-6,400 RPM (M/T).
- The engine speed is between 450-6,100 RPM (auto).
- The ignition voltage is between 9-18 volts.
- The engine coolant temperature (ECT) is between -7 and +130°C (20-254°F).
- The engine has been running more than 5 seconds.
- The fuel level is more than 10 percent.

Conditions for Setting the DTC

The ECM is detecting a crankshaft rotation speed variation indicating a misfire sufficient to cause emission levels to exceed mandated standards.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0301-P0304 Circuit

Step	Action	Values	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	1. Start the engine. 2. Allow the engine to idle or operate within the conditions listed in the Freeze			

2	Frame/Failure Records. 3. Monitor all of the misfire counters with the scan tool. Are any of the misfire current counters incriminating?	-	Go to **Step 3**	Go to **Intermittent Conditions**
3	Are any DTCs other than DTC P0300 set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 4**
4	Can any abnormal engine noise be heard?	-	Go to **Symptoms - Engine Mechanical** in Engine Mechanical	Go to **Step 5**
5	1. Turn OFF the ignition. 2. Remove the fuel pump relay. Refer to **Relay Replacement (Within an Electrical Center)Relay Replacement (Attached to Wire Harness)** in Wiring Systems. **IMPORTANT:** **DO NOT remove the ignition control (IC) module and connector from the ignition coil housing.** 3. Remove the ignition coil housing assembly. Refer to **Ignition Coil Housing Replacement** . **IMPORTANT:** **Not grounding the ignition coil housing may cause erratic spark.** 4. Connect a jumper wire between the IC module and a good ground. 5. Install the **J 36012-A** (SA91992) Ignition System Diagnostic Harness. 6. Install a **J 26792** (J 43883) Spark Tester on the affected cylinder spark plug jumper wire. 7. Ground the companion to the affected cylinder spark plug jumper wire. 8. Crank the engine with the remaining spark plug jumper wires connected.	-		

	Does the spark tester spark?		Go to **Step 7**	Go to **Step 6**
6	Inspect the affected cylinder spark plug boot for a missing or damaged ignition coil spring. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 15**
7	1. Remove the spark plug from the cylinder that indicated a misfire. 2. Inspect the spark plug. Refer to **Spark Plug Inspection** . Does the spark plug appear to be OK?	-	Go to **Step 8**	Go to **Step 9**
8	1. Exchange the suspected spark plug with another cylinder that is operating properly. Refer to **Spark Plug Replacement** . 2. Operate the vehicle under the same conditions that the misfire occurred. Did the misfire move with the spark plug?	-	Go to **Step 14**	Go to **Step 12**
9	Is the spark plug oil or coolant fouled?	-	Go to **Symptoms - Engine Mechanical** in Engine Mechanical	Go to **Step 10**
10	Is the spark plug gas fouled?	-	Go to **Step 12**	Go to **Step 11**
11	Does the spark plug show any signs of being cracked, worn, or improperly gapped?	-	Go to **Step 13**	Go to **Step 12**
12	Perform the fuel injector coil test. Refer to **Fuel Injector Coil Test** . Did you find and correct the condition?	-	Go to **Step 16**	Go to **Symptoms - Engine Mechanical** in Engine Mechanical
13	Replace or gap the spark plug. Refer to **Spark Plug Replacement** . If an improper gap is found, be sure to gap the spark plugs using a wire type gage. Did you complete the action?	-	Go to **Step 16**	-
14	Replace the faulty spark plug. Refer to **Spark Plug Replacement** . Did you complete the replacement?	-	Go to **Step 16**	-
15	Replace the ignition coil housing. Refer to **Ignition Coil Housing Replacement** . Did you complete the replacement?	-	Go to **Step 16**	-
16	Was the customer concern the malfunction indicator lamp (MIL) flashing?	-	Go to **Step 17**	Go to **Step 18**
	1. Operate the vehicle at the specified value for 4 minutes.			

17	2. Operate the vehicle within the Conditions for Running the DTC P0420 as specified in the supporting text. Refer to **DTC P0420** . Does the DTC run and pass?	2,500 RPM	Go to **Step 18**	Go to **DTC P0420**
18	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 19**
19	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0315

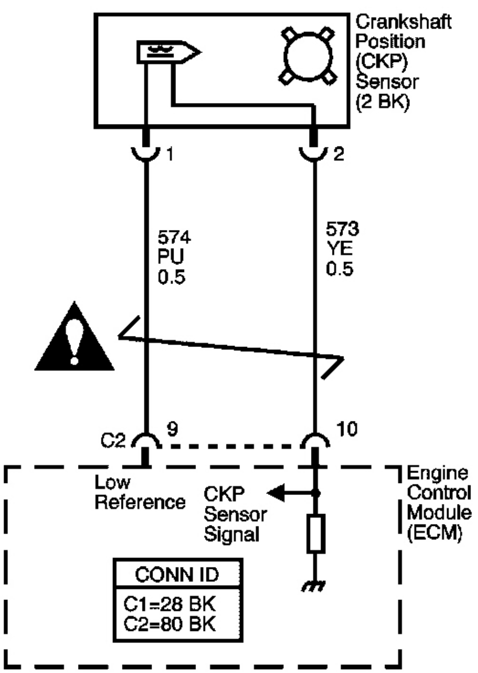


Fig. 3: DTC P0315 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The crankshaft position (CKP) system variation learn feature is used to calculate reference period errors caused by slight tolerance variations in the crankshaft, and the CKP sensor. The calculated error allows the engine control module (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 ECM stores the CKP system variation values after a learn procedure has been performed. If the actual crankshaft position variation is not within the CKP system variation compensating values stored in the ECM, DTC P0300 may set. If the ECM detects that the CKP system variation values are not stored in the ECM memory, DTC P0315 sets.

Conditions for Running the DTC

- DTCs P0336, P0340, P0341 are not set.
- The engine coolant temperature (ECT) is more than 70°C (158°F).
- The A/C is OFF.
- The brake is applied.
- The transmission is in Park or Neutral.
- The vehicle speed equals 0 km/h (0 mph).

Conditions for Setting the DTC

The CKP system variation values are not stored in the ECM memory.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0315 Circuit

Step	Action	Yes	No

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Perform the CKP system variation learn procedure. Refer to **CKP System Variation Learn Procedure** . Does the scan tool display Learned This Ignition?	Go to **Step 4**	Go to **Step 3**
3	If the CKP system variation learn procedure cannot be performed successfully, inspect for the following conditions: • Any worn crankshaft main bearings • A damaged reluctor wheel • Excessive crankshaft runout • A damaged crankshaft-Refer to **Crankshaft and Bearings Cleaning and Inspection** in Engine Mechanical. • Electromagnetic interference (EMI) in the signal circuit of the CKP sensor • The ignition switch is in the ON position until the battery is drained • An ECM power disconnect with the ignition ON may erase the stored value and set the DTC P0315 • Any debris between the CKP sensor and the reluctor wheel Did you complete the inspection?	Go to **Step 4**	-
4	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 5**
5	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0326

Circuit Description

The knock sensor (KS) system enables the engine control module (ECM) to control the ignition timing for the best possible performance while protecting the engine from potentially damaging levels of detonation. The KS is located on the intake side of the engine block. The KS produces an AC voltage signal that varies depending on the vibration level during engine operation. The ECM adjusts the spark timing based on the amplitude and the frequency of the KS signal. The ECM receives the KS signal through a signal circuit. The KS ground is supplied by the ECM through a low reference circuit. The ECM learns an average KS noise level using a calibrated average. The ECM should monitor a normal KS signal within the noise channel. When the ECM detects a KS signal that varies outside of the noise channel, the ECM will retard the spark timing until the knock goes away. If the ECM is operating on large amounts of spark retard and is unable to eliminate the knock, DTC P0326 will set.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

- The KS signal indicates an engine knock is present.
- The ECM commanded spark retard at a given engine load and speed is more than the calibrated value.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0326 Circuit

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics			

Connector End View Reference: **Engine Controls Connector End Views** or **Engine Control Module (ECM) Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Inspect for a loose or broken vehicle accessory and/or accessory bracket. 2. If a condition is found, repair as necessary. Did you find and correct the condition?	Go to **Step 4**	Go to **Step 3**
3	1. Start the engine. 2. Inspect for excessive engine mechanical noise. Refer to **Symptoms - Engine Mechanical** in Engine Mechanical - 2.2L (L61). 3. If a condition is found, repair as necessary. Did you find and correct the condition?	Go to **Step 4**	Go to **Detonation/Spark Knock**
4	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Does the DTC fail this ignition?	Go to **Step 2**	Go to **Step 5**
5	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0327

Circuit Description

The knock sensor (KS) system enables the engine control module (ECM) to control the ignition timing for the best possible performance while protecting the engine from potentially damaging levels of detonation. The KS is located on the intake side of the engine block. The KS produces an AC voltage signal that varies depending on the vibration level during engine operation. The ECM adjusts the spark timing based on the amplitude and the frequency of the KS signal. The ECM receives the KS signal through a signal circuit. The KS ground is supplied by the ECM through a low reference circuit. The ECM learns a minimum KS noise level at idle and uses calibrated values for the rest of the RPM range. The ECM should monitor a normal KS signal within the noise channel. If the ECM detects the KS signal outside of the noise channel, or the KS signal is not present, this DTC sets.

Conditions for Running the DTC

- DTCs P0122 or P0123 are not set.
- The engine has been running for more than 20 seconds.
- The engine speed is between 1,800-2,400 RPM.
- The engine coolant temperature (ECT) is more than 70°C (158°F)
- The manifold absolute pressure (MAP) is more than 35 kPa.

Conditions for Setting the DTC

- The KS signal is outside of the assigned noise channel or the KS signal is not present.
- The condition exists for 15 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Inspect the KS for physical damage. A KS that is dropped or damaged may cause a DTC to set.
- Inspect the KS for proper installation. A KS that is loose or over torqued may cause a DTC to set. The KS should be free of thread sealant. The KS mounting surface should be free of burrs, casting flash, and foreign material.
- The KS must be clear of hoses, brackets, and engine electrical wiring.
- For an intermittent condition, refer to **Intermittent Conditions** .

DTC P0327 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics				

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **If an engine mechanical noise can be heard, repair the condition before proceeding with this diagnostic. Refer to Symptoms - Engine Mechanical in Engine Mechanical - 2.2L (L61).** 1. Observe the Freeze Frame/Failure Records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Does the DTC fail this ignition?	-	Go to **Step 3**	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the knock sensor (KS). 3. Measure the resistance from the KS signal circuit on the sensor side of the KS harness connector to a good ground with the DMM. 4. Measure the resistance from the KS low reference circuit on the sensor side of the KS harness connector to a good ground with the DMM. Does the DMM display an open for both circuits?	-	Go to **Step 4**	Go to **Step 8**
4	1. Connect the DMM from the KS signal circuit to the KS low reference circuit on the sensor side of the KS harness connector. 2. Set the DMM to the 400 mV AC hertz scale and wait for the DMM to stabilize at 0 Hz. Refer to **Measuring Frequency** in Wiring Systems. **IMPORTANT:** **Do not tap on plastic engine components.**	-		

	3. Tap on the engine block with a non-metallic object near the KS while observing the signal indicated on the DMM. Does the DMM display a fluctuating frequency while tapping on the engine block?		Go to **Step 5**	Go to **Step 8**
5	1. Turn ON the ignition, with the engine OFF. 2. On the engine control module (ECM) side of the KS harness connector, measure the DC voltage from the KS signal circuit to a good ground with a DMM. 3. On the ECM side of the KS harness connector, measure the DC voltage from the KS low reference circuit to a good ground with a DMM. Is the voltage more than the specified value on any circuit?	0.5 V	Go to **Step 6**	Go to **Step 7**
6	1. Turn OFF the ignition. 2. Disconnect the ECM. 3. Test the KS signal circuit or the KS low reference circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
7	1. Turn OFF the ignition. 2. Disconnect the ECM. 3. Test the KS signal circuit and the KS low reference circuit for the following conditions: • An open • A short to ground • A high resistance • A short between both circuits Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
8	Test for an intermittent and for a poor connection at the KS. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems.	-		

	Did you find and correct the condition?		Go to **Step 12**	Go to **Step 10**
9	Test for an intermittent and for a poor connection at the ECM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
10	Replace the KS. Refer to **Knock Sensor (KS) Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
11	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Does the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 13**
13	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0336

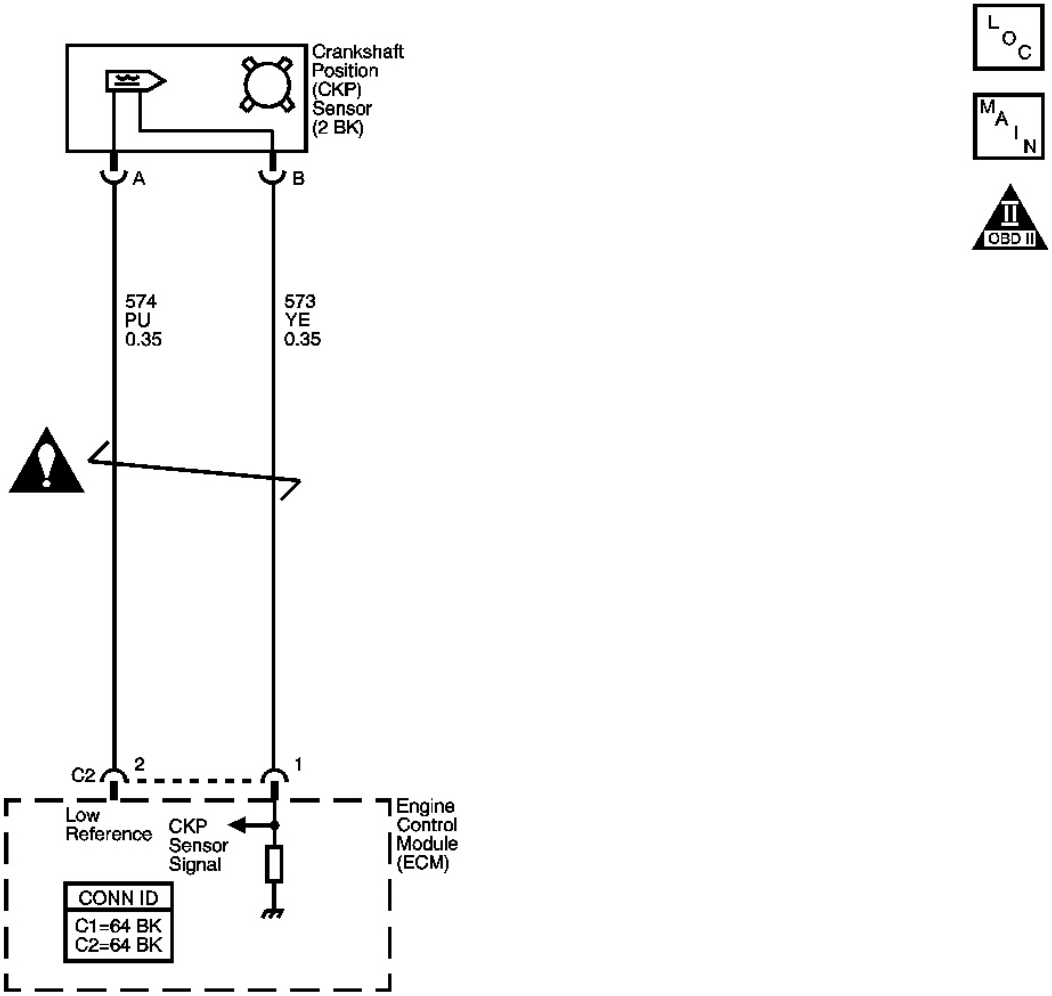


Fig. 4: DTC P0336 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The crankshaft position (CKP) sensor is a variable reluctance sensor. The CKP sensor indicates the crankshaft speed and position. The CKP sensor produces an AC voltage of different amplitude and frequency. The frequency depends on the velocity of the crankshaft. The AC voltage output depends on the crankshaft position and the battery voltage. The CKP sensor connects to the engine control module (ECM) through the following circuits:

- The CKP sensor signal
- The low reference

If the ECM detects an incorrect number of pulses from the CKP sensor, DTC P0336 sets.

Conditions for Running the DTC

The engine is cranking or running.

Conditions for Setting the DTC

The ECM detects extra or missing crankshaft sensor pulses.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0336 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Attempt to start the engine. Does the engine start and run?	-	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition cycle?		Go to **Step 4**	Go to **Intermittent Conditions**
4	Test the CKP sensor signal circuit of the CKP sensor for an intermittent condition. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Testing for Electrical Intermittents** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 5**
5	Test the low reference circuit of the CKP sensor for an intermittent condition. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Testing for Electrical Intermittents** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 6**
6	Test for an intermittent and poor connection at the ECM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Testing for Electrical Intermittents** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 7**
7	Test for an intermittent and poor connection at the CKP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Testing for Electrical Intermittents** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 8**
8	1. Remove the CKP sensor. Refer to **Crankshaft Position (CKP) Sensor Replacement** . 2. Visually inspect the CKP sensor for the following conditions: • Physical damage • Loose or improper installation • Wiring routed too closely to secondary ignition components 3. The following conditions may cause this DTC to set: • Excessive air gap between the CKP sensor and the reluctor wheel • Electromagnetic interference in the CKP sensor circuits • Foreign material passing between the CKP sensor and the reluctor wheel • Insufficient fuel	-		

	Did you find and correct the condition?		Go to **Step 11**	Go to **Step 9**
9	Visually inspect the CKP reluctor wheel for the following conditions: • Physical damage • Excessiveness end play or looseness Refer to **Crankshaft and Bearings Cleaning and Inspection** in Engine Mechanical and **Intermittent Conditions** . Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 10**
10	Replace the CKP sensor. Refer to **Crankshaft Position (CKP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 11**	-
11	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 12**
12	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0340

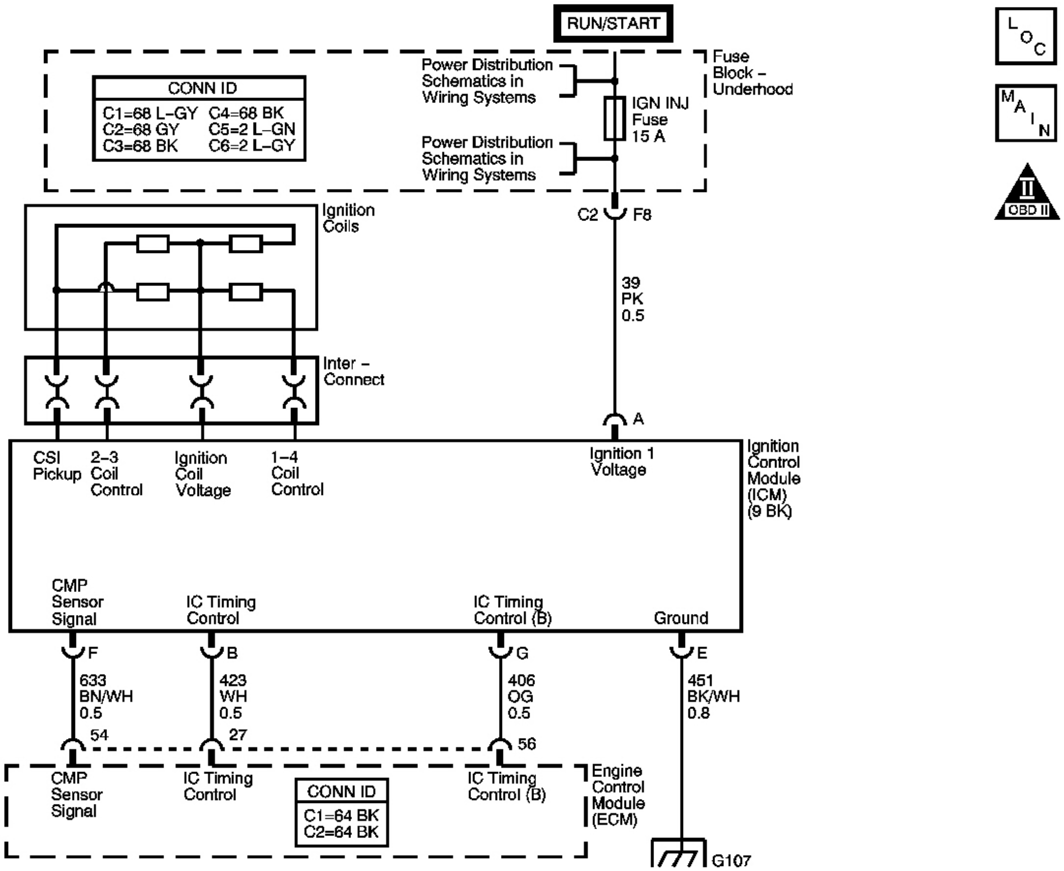


Fig. 5: DTC P0340 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

This ignition system does not use a conventional camshaft position (CMP) sensor that detects valve train position. The ignition control module (ICM) detects when #1 or #3 cylinder has fired on its compression stroke using sensing circuitry integrated within each coil. The sensing circuit detects the polarity and the strength of the secondary voltage output, the higher output is always at the event cylinder. The ICM sends a CMP signal to the engine control module (ECM) based on the voltage difference between the event and waste cylinder firing energy. This system is called compression sense ignition. By monitoring the CMP and crankshaft position (CKP) signals, the ECM can accurately time the operation of the fuel injectors. If the ECM receives an intermittent CMP signal from the ICM, the CMP Resync Counter on the scan tool will increment. When the ECM cannot use the information from the CMP signal, DTC P0340 will set.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

The PCM does not detect any change in the CMP signal for 35 crankshaft revolutions (70 combustion events) when manifold absolute pressure (MAP) is at 50 kPa or greater.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- The following conditions may cause this DTC to set:
  - Low resistance in both the #1 and #3 secondary ignition circuits
  - High resistance in both the #4 and #2 secondary ignition circuits
  - An intermittent crank signal
- An Intermittent crank signal will result in an interrupted cam signal and may set this DTC.
- To locate an intermittent problem, monitor the CMP Active Counter parameter while running the engine with a scan tool. The counter should continuously count up to 255, then reset to zero. The counter will stop counting if a fault occurs in the cam signal circuit.

  If this DTC is determined to be intermittent, refer to **Intermittent Conditions** .

Test Description

The numbers below refer to the step numbers on the diagnostic table.

> **4:** This step determines if the Ignition system is working correctly.
>
> **5:** This step determines if the interconnect is bad or if a poor connection exists between the ICM and the Coil Cassette.

DTC P0340 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Control Module (ECM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Install the scan tool. 2. Start and idle the engine. 3. Monitor the camshaft position (CMP) Active Counter parameter with the scan tool. Does the scan tool indicate the CMP active counter is incriminating?	-	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the ignition control module (ICM) electrical connector. 3. Connect a jumper wire from each terminal, except the CMP signal circuit, in the ICM harness connector to the corresponding terminal at the ICM. Refer to **Using Connector Test Adapters** in Wiring Systems. 4. Measure the DC duty cycle between the CMP signal circuit at the ICM and a good ground. 5. Start the engine. Is the duty cycle within the specified range?	45-55%	Go to **Step 6**	Go to **Step 5**
	1. Turn OFF the ignition. 2. Remove the jumper wires from the ICM. 3. Remove the ICM from the Ignition Coil Cassette. Refer to **Ignition Control Module**			

5	**Replacement** . 4. Remove the interconnect from between the coil cassette and the ICM. 5. Inspect the interconnect for a poor connection at the coil cassette or at the ICM. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 7**
6	Test the CMP signal circuit for the following conditions: • An open • High resistance • A short to ground • A short to voltage Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 8**
7	Test for an intermittent and for a poor connection at the ICM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 9**
8	Test for an intermittent and for a poor connection at the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 10**
9	Replace the ICM. Refer to **Ignition Control Module Replacement** . Did you complete the replacement?	-	Go to **Step 11**	-
10	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 11**	-
11	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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.	-		

	Did the DTC fail this ignition?		Go to **Step 2**	Go to **Step 12**
12	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0341

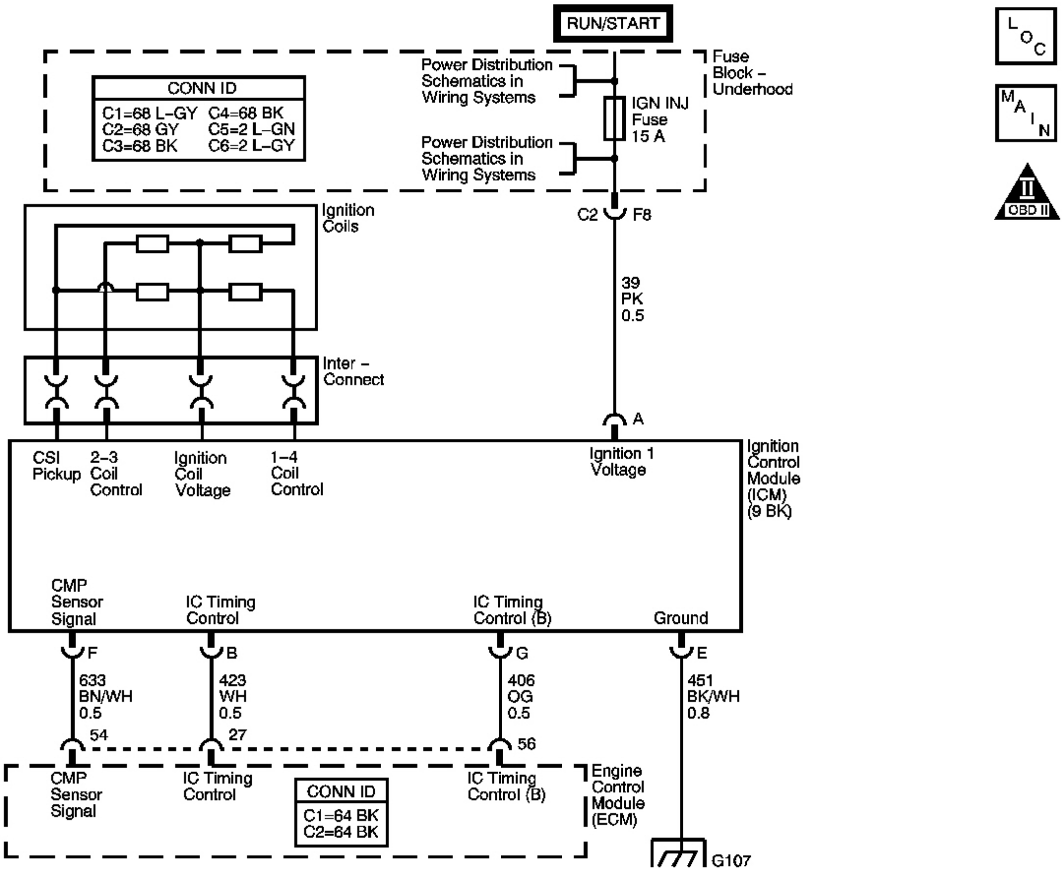


Fig. 6: DTC P0341 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

This ignition system does not use a conventional camshaft position (CMP) sensor that detects valve train position. The ignition control module (ICM) detects when #1 or #3 cylinder has fired on the compression stroke using sensing circuitry integrated within each coil. The sensing circuit detects the polarity and the strength of the secondary voltage output. The higher output is always at the event cylinder. The ICM sends a camshaft position signal to the engine control module (ECM) based on the voltage difference between the event and waste cylinder firing energy. This system is called compression sense ignition. By monitoring the camshaft position and crankshaft position signals the ECM can accurately time the operation of the fuel injectors. If the ECM receives an intermittent CMP signal from the ICM then the CMP Resync Counter on the scan tool will increment. When the ECM cannot use the information from the CMP signal, a DTC will set. If the ECM detects too many CMP Resyncs within a calibrated amount of time, DTC P0341 will set.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

The ECM detects more than 30 CMP Resync counts in a 256 second window when the manifold absolute pressure (MAP) is more than 50 kPa.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- An intermittent fault in the CKP circuits may cause the ECM to resync the cam and may set this DTC. If the ECM is resyncing the camshaft, the CMP Resync Counter on the Scan tool will increment with the engine running.
- An intermittent short to voltage on the camshaft position signal can set this DTC. A direct short to voltage on the camshaft position signal circuit will set DTC P0340, as there will be no change in the camshaft position signal input.
- Electromagnetic interference (EMI) may also set DTC P0341. Inspect the wiring harness for damage. If the harness appears to be OK, observe the CMP resync counter on the scan tool while moving connectors and wiring harnesses related to the camshaft position signal. If the CMP resync counter still does not count, while observing the scan tool, operate any non-engine related electrical components on the vehicle.

A change in display will indicate the location of the malfunction.

If this DTC is determined to be intermittent, refer to **Intermittent Conditions** .

Test Description

The numbers below refer to the step numbers on the diagnostic table.

3: This step determines if DTC P0341 is the result of a hard malfunction or an intermittent condition.

4: The counter should stop incriminating with the camshaft position signal circuit disconnected and set DTC P0340. If the counter still increments, this indicates that the ECM is malfunctioning.

5: A faulty electrical connection in the camshaft position signal circuit can cause the CMP Resync Counter to increment. Anytime a faulty electrical connection is present, the CMP Reference Activity counter will stop incriminating.

DTC P0341 Circuit

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Control Module (ECM) Connector End Views or Engine Controls Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. Are any other DTCs set?	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	1. Start the engine. 2. Observe the CMP Resync Counter parameter with the scan tool. Is the CMP Resync Counter parameter incriminating?	Go to **Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the ICM. 3. Connect a jumper wire from each terminal, except the CMP signal circuit, in the ICM harness connector to the corresponding terminal at the ICM with the J 35616 Connector Test Adapter Kit. 4. Start the engine. 5. Observe the CMP Resync parameter on the scan tool. Did the CMP Resync Counter parameter stop incrementing?	Go to **Step 5**	Go to **Step 6**

5	1. Turn OFF the ignition. 2. Test for an intermittent and for a poor connection at the ICM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 7**
6	1. Disconnect the ECM. Refer to **Engine Control Module (ECM) Replacement** . 2. Test for an intermittent and for a poor connection of the camshaft position signal circuit at the ECM connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 8**
7	Replace the ICM. Refer to **Ignition Control Module Replacement** . Did you complete the replacement?	Go to **Step 9**	-
8	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	Go to **Step 9**	-
9	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Does the DTC fail this ignition?	Go to **Step 2**	Go to **Step 10**
10	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0420

Circuit Description

A three-way catalytic (TWC) converter controls exhaust emissions of hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx). The catalyst within the converter promotes a chemical reaction which oxidizes the HC and the CO that is present in the exhaust gas. This process will convert the HC and the CO into water vapor and carbon dioxide (CO2), and will reduce the NOx, converting the NOx into nitrogen. The catalytic converter also stores oxygen. The engine control module (ECM) monitors this process by using a heated oxygen sensor (HO2S) which is in the exhaust stream past the three-way catalytic converter. The HO2S produces an output signal which indicates the oxygen storage capacity of the catalyst. This in turn indicates the catalysts ability to convert the exhaust emissions effectively. The ECM monitors the catalyst efficiency by first allowing the catalyst to heat, then waiting for a stabilization period while the engine is idling. Then, the ECM adds and removes fuel while monitoring the reaction of the HO2S 2. When the catalyst is functioning properly, the HO2S 2 response to the extra fuel is slow compared to the HO2S 1. When the HO2S 2 response is close to that of the HO2S 1, the oxygen storage capability or efficiency of the catalyst is may be degraded below an acceptable threshold. If the ECM detects the degraded condition DTC P0420 sets.

Conditions for Running the DTC

- DTCs P0068, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0122, P0123, P0125, P0128, P0130, P0131, P0132, P0133, P0134, P0135, P0137, P0138, P0140, P0141, P0171, P0172, P0201, P0202, P0203, P0204, P0220, P0300, P0326, P0327, P0336, P0340, P0341, P0442, P0446, P0452, P0453, P0496, P0500, P0506, P0507, P0601, P0602, P0603, P0604, P0606, P0641, P0651, P0700, P0701, P1133, P1134, P1137, P1138, P1516, P1680, P1681, P2120, P2125, P2135, P2138, P2176 are not set.
- The engine has been running more than 9 minutes after the throttle has moved.
- The vehicle is in a Closed Loop operation.
- The vehicle has been driven at more than 1,000 RPM for more than 35 seconds.
- The air flow parameter is less than 8 g/s.
- The ECT is between 70-125°C (158-257°F).
- The IAT is between -21 and +125°C (-6 and +176°F).
- The barometric pressure is more than 72 kPa.
- The ignition voltage is more than 9 volts.
- The catalytic converter (TWC) calculated temperature is between 600-675°C (1,112-1,247°F).
- The vehicle speed is less than 5 km/h (3 mph).
- The engine must be at idle, and between -75 and +150 RPM of the desired speed.

This DTC P0420 is sampled once at an idle when the above conditions are met. If the first test fails, the ECM will take more samples during the current ignition cycle or may take samples for up to six ignition cycles. The extra sampling is to ensure that a converter has failed, not just temporarily poisoned.

Conditions for Setting the DTC

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

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

The catalyst test may abort due to a change in the engine load. Allow the engine to return to a stabilized idle. An automatic transmission must remain in drive. A manual transmission is shifted into neutral. Do not touch the accelerator pedal, steering wheel or HVAC controls while a catalyst test is in progress.

Certain conditions may cause a catalytic converter to degrade. These conditions may include the following conditions:

- An engine misfire
- High engine oil or high coolant consumption
- Retarded spark timing
- A weak spark
- A lean fuel mixture
- A rich fuel mixture
- A damaged oxygen sensor wiring harness
- A catalyst may be temporarily degraded if a fuel with high sulfur content has been used. Drive the vehicle at highway speeds for 10 minutes and retest the converter.
- If six tests have been attempted and the DTC has not run or passed during this key cycle, turn the key to OFF for 30 seconds. Perform the Conditions for Running a second time.
- A maximum of twelve tests per key cycle will run if each test is a combination of pass, fail, or abort tests.
- After a Code Clear, the catalyst test will run once if the test is a pass.

Test Description

The number below refers to the step number on the diagnostic table.

> **6:** This step includes inspections for conditions that can cause the three-way catalytic converter to appear degraded. Before you proceed with this table, repair any conditions that you find.

DTC P0420 Circuit

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	Observe the DTC information on the scan tool.	Go to **Diagnostic**	

<table>
<tr><td>2</td><td>Are there any other component DTCs set?</td><td><u>Trouble Code (DTC) List</u></td><td>Go to Step 3</td></tr>
<tr><td>3</td><td>Allow the engine to reach operating temperature.
Ensure Closed Loop operation is achieved.
Increase the engine speed to 1,500 RPM, for 1 minute.
Monitor the HO2S 1 and the HO2S 2 voltage parameters with a scan tool.
Is the HO2S 2 voltage parameter as active as the HO2S 1 voltage parameter?</td><td>Go to Step 5</td><td>Go to Step 4</td></tr>
<tr><td>4</td><td>Clear the DTCs with a scan tool.
Start the engine.
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.
Did DTC P0420 set?</td><td>Go to Step 5</td><td>Go to Diagnostic Aids</td></tr>
<tr><td>5</td><td>IMPORTANT:
Verify that the three-way catalytic converter is a high quality part that meets the OEM specifications.

Visually and physically inspect the three-way catalytic converter for the following conditions:
Dents or damage
Severe discoloration caused by excessive temperatures
Holes or punctures
Internal rattles caused by a damaged catalyst element
Did you find a condition?</td><td>Go to Step 9</td><td>Go to Step 6</td></tr>
<tr><td>6</td><td>Visually inspect the exhaust system for the following conditions:
Leaks-Refer to <u>Exhaust Leakage</u> in Engine Exhaust.
Physical damage
Loose or missing hardware
The HO2S 2 for proper torque</td><td></td><td></td></tr>
</table>

	Did you find and correct the condition?	Go to **Step 10**	Go to **Step 7**
7	Visually inspect the catalyst monitor HO2S 2 for the following conditions: • The pigtail and wiring harness making contact with the exhaust or any good ground • Road damage Did you find a condition?	Go to **Step 8**	Go to **Step 9**
8	Replace the HO2S 2 sensor. Refer to **Heated Oxygen Sensor Replacement - Position 2** . Did you complete the replacement?	Go to **Step 10**	-
9	**IMPORTANT:** **Locate and repair the cause of the three-way catalytic converter failure before installing the replacement converter. Refer to Diagnostic Aids.** Replace the three-way catalytic converter. Refer to **Exhaust Manifold Pipe Replacement (L66)Exhaust Manifold Pipe Replacement (L61)** in Engine Exhaust.Did you complete the replacement?	Go to **Step 10**	-
10	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 11**
11	Observe the Capture Info with a scan tool. Are there any DTCs that you have not diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0442

System Description

The evaporative emission (EVAP) system is used to store fuel vapors to reduce the amount of unburned fuel from escaping into the atmosphere. The EVAP system consists of the EVAP canister, the fuel tank pressure (FTP) sensor, the EVAP lines and hoses, the EVAP canister purge solenoid valve which is normally closed, the EVAP service port, the EVAP canister vent solenoid valve which is normally open, the fuel tank, and the engine control module (ECM). The ECM monitors the EVAP system for circuit faults in the FTP sensor, the

EVAP canister purge solenoid valve and the EVAP canister vent solenoid valve circuits. The ECM also monitors the EVAP system for small and large leaks. During the DTC P0455 diagnostic, the ECM monitors the FTP sensor for an atmospheric pressure reading when all of the DTC parameters have been met with the engine running. The ECM will then command the EVAP vent solenoid ON, closed valve, and command the EVAP canister purge solenoid valve to a fixed duty cycle. The ECM will let the pressure drop in the fuel tank for a certain length of time, after which it will turn OFF the EVAP canister purge solenoid valve. If a correct amount of vacuum is achieved, the ECM will run the DTC P0442 diagnostic, which will monitor the decay in the vacuum of the sealed system over a calibrated amount of time. DTC P0442 sets when the vacuum decay is greater than the calibrated amount for a certain length of time due to a small leak.

Conditions for Running the DTC

- DTCs P0105, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0125, P0131, P0132, P0133, P0134, P0135, P0452, P0453, P0502, P0601, P0602, P1621 are not set.
- The EVAP canister vent solenoid valve is commanded ON, closed.
- The EVAP canister purge solenoid valve is commanded OFF, closed.
- The engine is running.
- The fuel level is between 15-85 percent.
- The barometric pressure (BARO) is greater than 75 kPa.
- The engine coolant temperature (ECT) and the intake air temperature (IAT) are between 4-30°C (39-86°F) at engine startup.
- The ECT and the IAT are within 8°C (15°F) of each other.
- The throttle position (TP) angle is between 7-35 percent.
- The vehicle speed is less than 113 km/h (70 mph).
- The DTC P0442 diagnostic runs once per ignition cycle after the above conditions have been met.

Conditions for Setting the DTC

- If the vacuum decay is greater than 0.02 volts with low fuel level and 0.10 volts with high fuel level, FTP sensor volts per second indicating a small EVAP leak, DTC P0442 will set.
- The above condition exists longer than 15 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other

emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- An EVAP canister purge solenoid valve or EVAP canister vent solenoid valve circuit fault may have caused this DTC to set.
- The ECM uses the FTP sensor to detect the amount of vacuum pulled on the EVAP system during the leak diagnostic tests. Ensure that the fuel pressure sensor is not skewed by verifying the FTP sensor on the scan tool is between 1.30-1.70 volts with the ignition ON and the fuel cap removed.
- Locate the small leak with the **J 41413-200** Evaporative Emission System Tester.
- The following are possible causes of a small leak:
  - The fuel cap is leaking.
  - The EVAP canister vent solenoid valve is not seating correctly.
  - The EVAP vent hose is loose or damaged.
  - The EVAP canister is leaking.
  - The fuel sender assembly O-ring is leaking.
  - The fuel tank or filler neck is leaking.
- The small leak diagnostic can detect a leak greater than 0.020 of an inch in diameter.
- A condition may exist where a leak in the EVAP system only exists under a vacuum condition. By using the scan tool Purge/Seal function to create a vacuum, seal the system and observe the FTP parameter for vacuum decay, this type of leak may be detected.

DTC P0442 Circuit

Step	Action	Yes	No
Schematic Reference: Evaporative Emissions (EVAP) Hose Routing Diagram			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	IMPORTANT: **Larger volume fuel tanks and/or those with lower fuel levels may require several minutes to stabilize.** 1. Turn the nitrogen/smoke valve to nitrogen. 2. Connect the nitrogen/smoke hose to the 0.5 mm (0.20 in) test orifice on the bottom-front of the **J 41413-200** (J 41413-100) Evaporative Emissions System Tester (EEST). 3. Use the remote switch to activate the **J 41413-200** (J 41413-100). 4. Align the red flag on the flow meter with the floating indicator. Use the remote switch to de-activate the **J**		

2	**41413-200** (J 41413-100). **IMPORTANT:** **The GE-41415-50 Fuel Tank Cap Adapter may not be available for the start of production. Once the GE-41415-50 is available, start the diagnosis at the fuel fill cap.** 5. Install the GE-41415-50 to the fuel fill pipe. 6. Remove the nitrogen/smoke hose from the test orifice and install the hose onto the GE-41415-50 . 7. Turn ON the ignition, with the engine OFF. 8. Command the EVAP canister vent solenoid valve CLOSED with a scan tool. 9. Use the remote switch to introduce nitrogen and fill the EVAP system until the floating stabilizes. 10. Compare the flow meter's stable floating indicator position to the red flag. Is the floating indicator below the red flag?	Go to Diagnostic Aids	Go to **Step 3**
3	**IMPORTANT:** **Ensure that the vehicle underbody temperature is similar to the ambient temperature and allow the surrounding air to stabilize before starting the diagnostic procedure. System flow will be less with higher temperatures.** 1. Turn OFF the ignition. 2. Connect the **J 41413-200** (J 41413-100) power supply clips to a known good 12-volt source. 3. Install the GE-41415-50 to the fuel fill pipe. 4. Connect the fuel fill cap to the GE-41415-50 . 5. Connect the **J 41413-200** (J 41413-100) nitrogen/smoke supply hose to the GE-41415-50 . 6. Turn ON the ignition with the engine OFF 7. Command the EVAP canister vent solenoid valve closed with a scan tool. 8. Turn the nitrogen/smoke valve on the **J 41413-200** (J 41413-100) control panel to SMOKE. 9. Use the remote switch to introduce smoke into the EVAP system. 10. Use the **J 41413-VLV** EVAP Service Port Vent Fitting to open the EVAP service port. 11. Remove the **J 41413-VLV** once smoke is observed.		

	12. Continue to introduce smoke into the EVAP system for an additional 60 seconds. 13. Inspect the entire EVAP system for exiting smoke with a High Intensity White Light. 14. Continue to introduce smoke at 15 second intervals until the leak source has been located Did you locate and repair a leak source?	Go to **Step 5**	Go to **Step 4**
4	1. Disconnect the GE-41415-50 from the fuel fill pipe. 2. Install the fuel fill cap to the fuel fill pipe. 3. Connect the **J 41413-200** (J 41413-100) nitrogen/smoke supply hose to the EVAP service port. 4. Use the remote switch to introduce smoke into the EVAP system. 5. Inspect the entire EVAP system for exiting smoke with a High Intensity White Light. 6. Continue to introduce smoke at 15 second intervals until the leak source has been located Did you locate and repair a leak source?	Go to **Step 5**	Go to Diagnostic Aids
5	**IMPORTANT:** **Larger volume fuel tanks and/or those with lower fuel levels may require several minutes for the floating indicator to stabilize.** 1. Turn the nitrogen/smoke valve to nitrogen. 2. Connect the nitrogen/smoke hose to the 0.5 millimeter (0.20 inch) test orifice on the bottom-front of the **J 41413-200** (J 41413-100). 3. Use the remote switch to activate the **J 41413-200** (J 41413-100). 4. Align the red flag on the flow meter with the floating indicator. Use the remote switch to de-activate the **J 41413-200** (J 41413-100). 5. Install the GE-41415-50 to the fuel fill pipe. 6. Remove the nitrogen/smoke hose from the test orifice and install the hose onto the GE-41415-50 . 7. Turn ON the ignition, with the engine OFF 8. Command the EVAP canister vent solenoid valve closed with a scan tool. 9. Use the remote switch to introduce nitrogen and fill the EVAP system until the floating stabilizes.		

	10. Compare the flow meter's stable floating indicator position to the red flag. Is the floating indicator below the red flag?	Go to **Step 6**	Go to **Step 2**
6	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0446

System Description

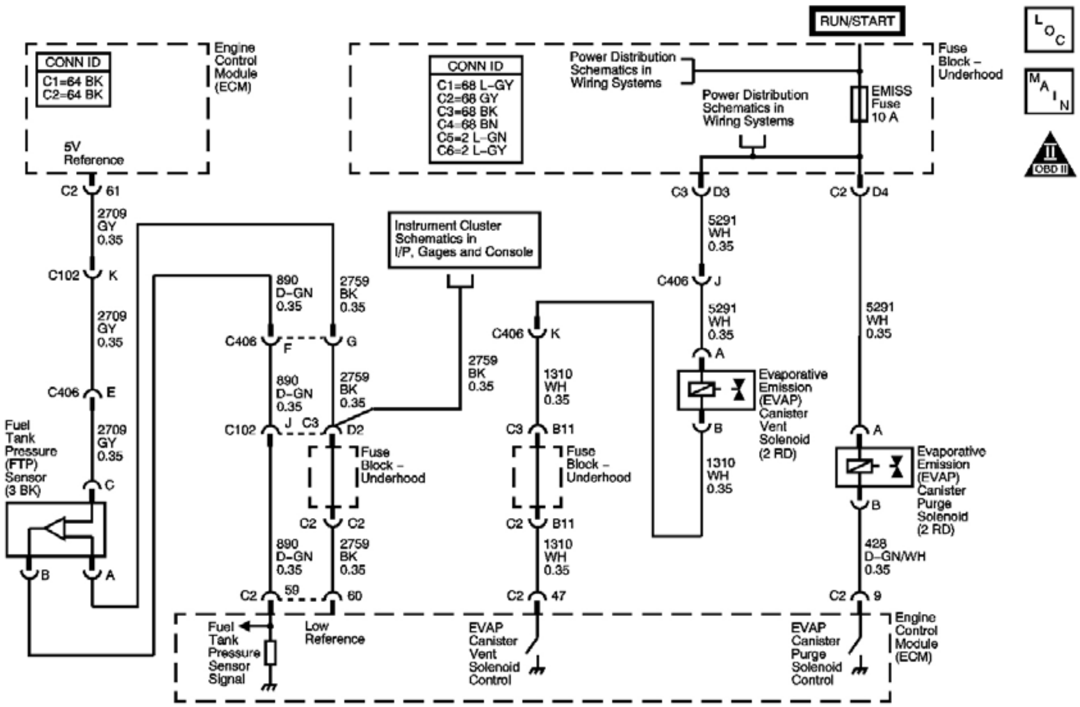


Fig. 7: DTC P0446 Circuit
Courtesy of GENERAL MOTORS CORP.

The evaporative emission (EVAP) system is used to store fuel vapors to reduce the amount of unburned fuel from escaping into the atmosphere. The EVAP system consists of the EVAP canister, the fuel tank pressure (FTP) sensor, the EVAP lines and hoses, the EVAP canister purge solenoid valve which is normally closed, the EVAP service port, the EVAP canister vent solenoid valve which is normally open, the fuel tank, and the powertrain control module (PCM). The PCM monitors the EVAP system for circuit faults in the FTP sensor, the EVAP canister purge solenoid valve and the EVAP canister vent solenoid valve circuits. The PCM also monitors the EVAP system for small and large leaks. During the DTC P0446 diagnostic, the EVAP canister purge solenoid valve is commanded to a fixed duty cycle, and the EVAP canister vent solenoid valve is commanded ON, closed, in order to build vacuum. Once vacuum is obtained, the EVAP canister vent solenoid valve is commanded OFF, open, and the vacuum should decrease rapidly. DTC P0446 sets when the vacuum decay is too slow, indicating a blocked vent system.

Conditions for Running the DTC

- DTCs P0105, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0125, P0131, P0132, P0133, P0134, P0135, P0452, P0453, P0502, P0601, P0602, P1621 are not set.
- The EVAP canister vent solenoid valve is commanded OFF, open.
- The EVAP canister purge solenoid valve is commanded open.
- The fuel level is between 15-85 percent.
- The engine coolant temperature (ECT) and the intake air temperature (IAT) are between 4-30°C (30-86° F) at engine startup.
- The throttle position (TP) angle is between 10-35 percent.
- The DTC P0446 diagnostic is run once, usually for 30 seconds if no faults exist, during the EVAP diagnostic test after the above conditions have been met.

Conditions for Setting the DTC

- If the FTP sensor voltage is more than 2.1 volts during the DTC P0446 diagnostic test indicating a blocked vent system, DTC P0446 will set.
- The above condition exists for longer than 1 minute and 40 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- A short to ground causing the EVAP canister vent solenoid valve ON will cause the valve to close. This will cause DTC P0446 to set.
- The PCM uses the FTP sensor to detect the amount of vacuum pulled on the EVAP system during the leak diagnostic tests. Ensure that the fuel pressure sensor is not skewed by verifying the FTP sensor on

the scan tool is between 1.30-1.70 volts with the ignition ON and the fuel cap removed.

- Inspect the following for causes of a blocked vent system:
  - The EVAP canister vent solenoid valve blocked or a stuck valve
  - A vent hose plugged, kinked, or pinched
  - The EVAP canister restricted

DTC P0446 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Evaporative Emissions (EVAP) Hose Routing Diagram and Engine Controls Schematics **Connector End View Reference: Engine Control Module (ECM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Inspect the evaporative emission (EVAP) system for the following conditions: • A damaged EVAP canister vent solenoid valve-Refer to **Evaporative Emission (EVAP) Canister Vent Solenoid Valve Replacement** . • A pinched EVAP vent hose • A damaged EVAP canister-Refer to **Evaporative Emission (EVAP) Canister Replacement** . Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Disconnect the EVAP purge line from the EVAP canister purge solenoid valve. 3. Turn ON the ignition, with the engine OFF. Is the Fuel Tank Pressure Sensor parameter within the Specified range?	1.30-1.70 V	Go to **Step 4**	Go to **Step 10**
	IMPORTANT: **Do not exceed the specified value in this step. Exceeding the specified value may produce incorrect test results.** 1. Turn OFF the ignition. 2. Connect the EVAP purge pipe.			

4	3. Connect the **J 41413-200** (J 41413-100) Evaporative Emissions System Tester (EEST) power supply clips to a known good 12-volt source. 4. Install the GE-41415-50 Fuel Fill Cap Adapter to the fuel fill pipe. **IMPORTANT:** **The GE-41415-50 may not be available for the start of production. Once the GE-41415-50 is available, start the diagnosis at the fuel fill cap.** 5. Connect the fuel fill cap to the GE-41415-50 . 6. Connect the **J 41413-200** (J 41413-100) nitrogen/smoke supply hose to the GE-41415-50 . 7. Turn ON the ignition, with the engine OFF 8. Command the EVAP canister vent solenoid valve closed with a scan tool. 9. Turn the nitrogen/smoke valve on the **J 41413-200** (J 41413-100) control panel to NITROGEN. 10. Use the remote switch to pressurize the EVAP system to the first specified value. 11. Observe the Fuel Tank Pressure Sensor parameter with a scan tool. 12. Command the EVAP canister vent solenoid valve open with a scan tool. Is the Fuel Tank Pressure Sensor parameter less than the second specified value?	1.30-1.70 V	Go to Diagnostic Aids	Go to **Step 5**
5	Command the EVAP canister vent solenoid valve ON and OFF with a scan tool. Do you hear or feel the EVAP canister vent solenoid valve click when commanded ON and OFF?	-	Go to **Step 6**	Go to **Step 8**
6	Disconnect the EVAP vent hose from the EVAP canister vent solenoid valve. Is the Fuel Tank Pressure Sensor parameter within the specified value?	1.30-1.70 V	Go to **Step 13**	Go to **Step 7**
7	Disconnect the EVAP vent hose from the EVAP canister. Is the Fuel Tank Pressure Sensor parameter less than the specified value?	1.30-1.70 V	Go to **Step 12**	Go to **Step 14**

8	1. Disconnect the EVAP canister vent solenoid valve. 2. Probe the control circuit of the EVAP canister vent solenoid valve with a test lamp that is connected to battery voltage. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	-	Go to **Step 9**	Go to **Step 13**
9	Test the EVAP canister vent solenoid valve control circuit for a short to ground. Refer to **Testing for Short to Ground** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 11**
10	Test for an intermittent and for a poor connection at the fuel tank pressure (FTP) sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 15**
11	Test for an intermittent and for a poor connection at the control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 16**
12	Repair the pinched or restricted EVAP vent hose. Did you complete the repair?	-	Go to **Step 17**	-
13	Replace the EVAP canister vent solenoid valve. Refer to **Evaporative Emission (EVAP) Canister Vent Solenoid Valve Replacement** . Did you complete the replacement?	-	Go to **Step 17**	-
14	Replace the EVAP canister. Refer to **Evaporative Emission (EVAP) Canister Replacement** . Did you complete the replacement?	-	Go to **Step 17**	-
15	Replace the FTP sensor. Refer to **Fuel Tank Pressure Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 17**	-
16	Replace the control module. Refer to **Engine Control Module (ECM) Connector End Views** . Did you complete the replacement?	-	Go to **Step 17**	-
	IMPORTANT: **Do not exceed the specified value in this step. Exceeding the specified value may produce incorrect test results.** 1. Turn OFF the ignition. 2. Connect all disconnected components.			

17	3. Connect the **J 41413-200** (J 41413-100) to the fuel fill pipe. 4. Turn ON the ignition, with the engine OFF 5. Command the EVAP canister vent solenoid valve closed with a scan tool. 6. Turn the nitrogen/smoke valve on the **J 41413-200** (J 41413-100) control panel to NITROGEN. 7. Use the remote switch to pressurize the EVAP system to the first specified value. 8. Observe the Fuel Tank Pressure Sensor parameter with a scan tool. 9. Command the EVAP canister vent solenoid valve open with a scan tool. Is the Fuel Tank Pressure Sensor parameter more than the second specified value?	5 in H2O 1.30 V	Go to **Step 18**	Go to **Step 2**
18	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0452

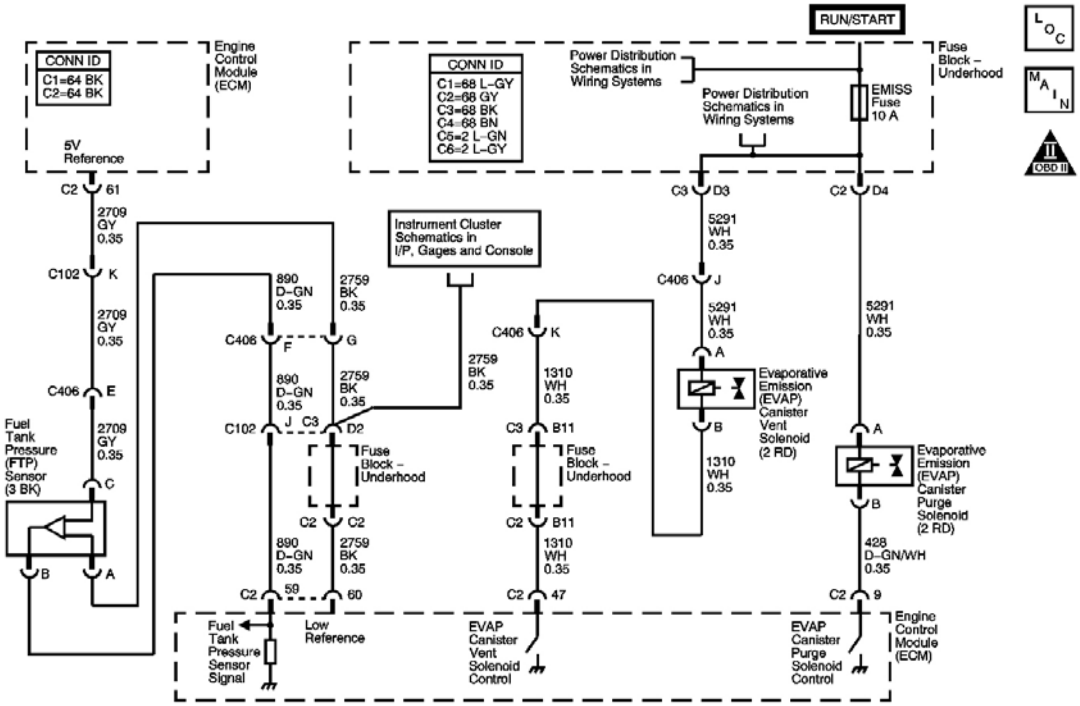


Fig. 8: DTC P0452 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The fuel tank pressure (FTP) sensor measures the difference between the air pressure or vacuum in the evaporative emission (EVAP) system, and the outside air pressure. The control module supplies a 5-volt reference and a low reference circuit to the FTP sensor. The FTP sensor signal circuit voltage varies depending on EVAP system pressure or vacuum. If the FTP sensor signal voltage goes below a calibrated value, this DTC sets.

The following table illustrates the relationship between the FTP sensor signal voltage and the EVAP system pressure/vacuum.

DTC P0452 Circuit

FTP Sensor Signal Voltage	Fuel Tank Pressure
High, Approximately 1.5 Volts or More	Negative Pressure/Vacuum
Low, Approximately 1.5 Volts or Less	Positive Pressure

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

- The FTP voltage is less than 0.1 volt.
- All conditions present for more than 25 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- If DTC P0122 and P0530 are also set, a short to ground on the 5-volt reference circuit may exist.
- If DTC P0641 is set, diagnose that DTC first.
- To locate an intermittent problem, use the scan tool to monitor FTP sensor voltage with the ignition ON, the engine OFF. Wiggling wires while watching for a change in FTP sensor voltage may locate the area where an open or short to ground in the wiring could lie.
- The signal voltage with the fuel cap OFF should read between 1.30-1.70 volts, which represents atmospheric pressure, or 0 inches of vacuum.

DTC P0452 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Control Module (ECM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Observe the Fuel Tank Pressure Sensor parameter with a scan tool. Is the Fuel Tank Pressure Sensor parameter less than the specified value?	0.1 V	Go to **Step 4**	Go to **Step 3**
	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds.			

3	3. Turn ON the ignition, with the engine OFF. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to Diagnostic Aids
4	1. Turn ON the ignition, with the engine OFF. 2. Disconnect the fuel tank pressure (FTP) sensor. 3. Measure the voltage from the 5-volt reference circuit of the FTP sensor to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage within the specified value?	4.8-5.2 V	Go to **Step 6**	Go to **Step 5**
5	Disconnect the following components, while monitoring the DMM: • The throttle position (TP) sensor • The A/C pressure sensor Is the DMM within the specified value when any of the components are disconnected?	4.8-5.2 V	Go to **Step 11**	Go to **Step 7**
6	1. Connect a 3-amp fused jumper wire between the 5-volt reference circuit of the FTP sensor and the signal circuit of the FTP sensor. 2. Observe the Fuel Tank Pressure Sensor parameter with a scan tool. Is Fuel Tank Pressure Sensor parameter within the specified value?	0.15-0.20 V	Go to **Step 9**	Go to **Step 8**
7	Test the FTP 5-volt reference circuit for an open or for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 10**
8	Test the FTP signal circuit for an open or for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 10**
9	Test for an intermittent and for a poor connection at the FTP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems.	-		

	Did you find and correct the condition?		Go to **Step 14**	Go to **Step 12**
10	Test for an intermittent and for a poor connection at the control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 13**
11	Replace the component that affected the 5-volt reference circuit. Refer to **Throttle Body Assembly Replacement** or **Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement** in Heating, Ventilation and Air Conditioning. Did you complete the replacement?	-	Go to **Step 14**	-
12	Replace the FTP sensor. Refer to **Fuel Tank Pressure Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 14**	-
13	Replace the control module. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 14**	-
14	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 15**
15	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0453

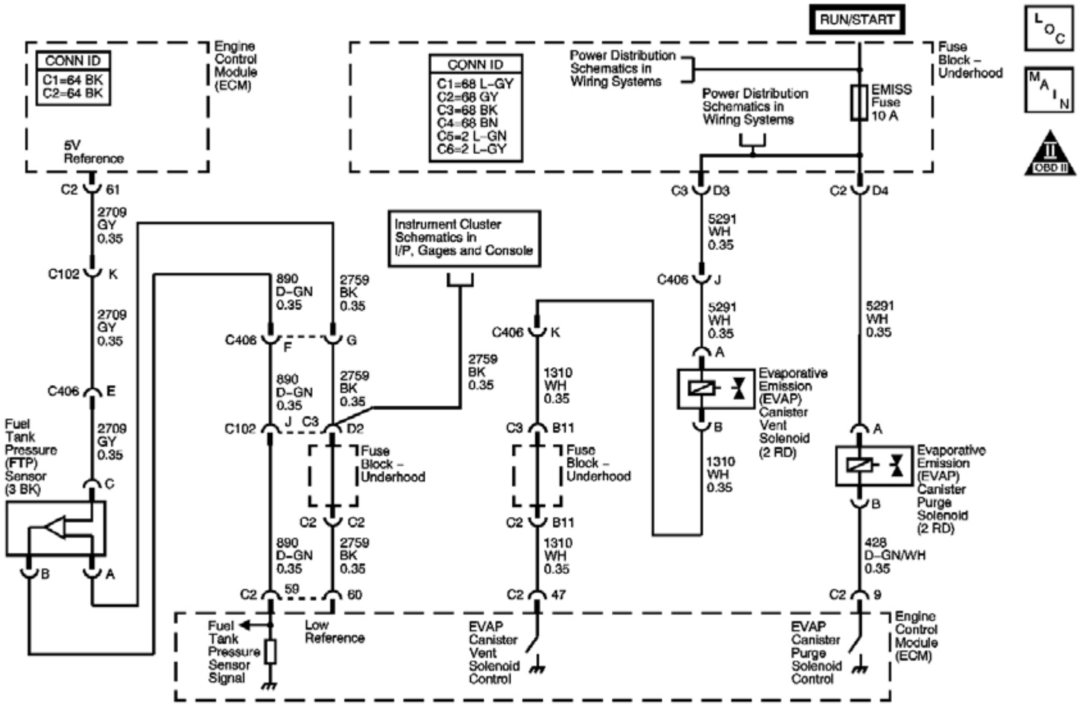


Fig. 9: DTC P0453 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The fuel tank pressure (FTP) sensor measures the difference between the air pressure or vacuum in the evaporative emission (EVAP) system, and the outside air pressure. The control module supplies a 5-volt reference and a low reference circuit to the FTP sensor. The FTP sensor signal circuit voltage varies depending on EVAP system pressure or vacuum. If the FTP sensor signal voltage increases above a calibrated value, this DTC sets.

The following table illustrates the relationship between FTP sensor signal voltage and the EVAP system pressure/vacuum.

DTC P0453 Circuit

FTP Sensor Signal Voltage	Fuel Tank Pressure
High, Approximately 1.5 Volts or More	Negative Pressure/Vacuum
Low, Approximately 1.5 Volts or Less	Positive Pressure

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

- The FTP sensor voltage is more than 4.9 volts.
- All conditions are present for more than 25 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- If DTC P0105 is also set, a short to voltage on the 5-volt reference circuit may exist.
- The A/C pressure sensor, the FTP sensor and the throttle position (TP) sensor are all tied to the same 5-volt reference source.
- To locate an intermittent problem, use the scan tool to monitor FTP sensor voltage with the ignition ON, the engine OFF. Wiggling wires while watching for a change in FTP sensor voltage may locate the area where an open or a short to voltage in the wiring could lie.
- If DTC P0651 is also set, diagnose that DTC first.
- For intermittent conditions, refer to **Intermittent Conditions** .
- The signal voltage with the fuel cap OFF should read between 1.30-1.70 volts, which represents atmospheric pressure or 0 inches of vacuum.
- Inaccurate readings will occur if resistance measurements are taken on a FTP sensor. The FTP sensor contains an internal amplifier circuit that requires applied voltage to function properly.

DTC P0453 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Control Module (ECM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	1. Turn OFF the ignition. 2. Remove the fuel cap.			

2	3. Turn ON the ignition, with the engine OFF. 4. Observe the Fuel Tank Pressure Sensor parameter with a scan tool. Is the Fuel Tank Pressure Sensor parameter more than the specified value?	4.3 V	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to Diagnostic Aids
4	1. Install the fuel cap. 2. Disconnect the fuel tank pressure (FTP) sensor. 3. Observe the Fuel Tank Pressure Sensor parameter with a scan tool. Is the Fuel Tank Pressure Sensor parameter more than the specified value?	0.2 V	Go to **Step 6**	Go to **Step 5**
5	Measure the voltage of the FTP sensor 5-volt reference circuit with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage within the specified value?	4.8-5.2 V	Go to **Step 9**	Go to **Step 10**
6	Test the FTP signal circuit for a short to voltage or for a short to a 5-volt reference circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
7	Test the FTP low reference for high resistance and an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 8**
8	Test for an intermittent and for a poor connection at the control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**

9	Test for an intermittent and for a poor connection at the FTP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 11**
10	Repair the short to voltage in the FTP 5-volt reference circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 13**	-
11	Replace the FTP sensor. Refer to **Fuel Tank Pressure Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
12	Replace the control module. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
13	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 14**
14	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0455

System Description

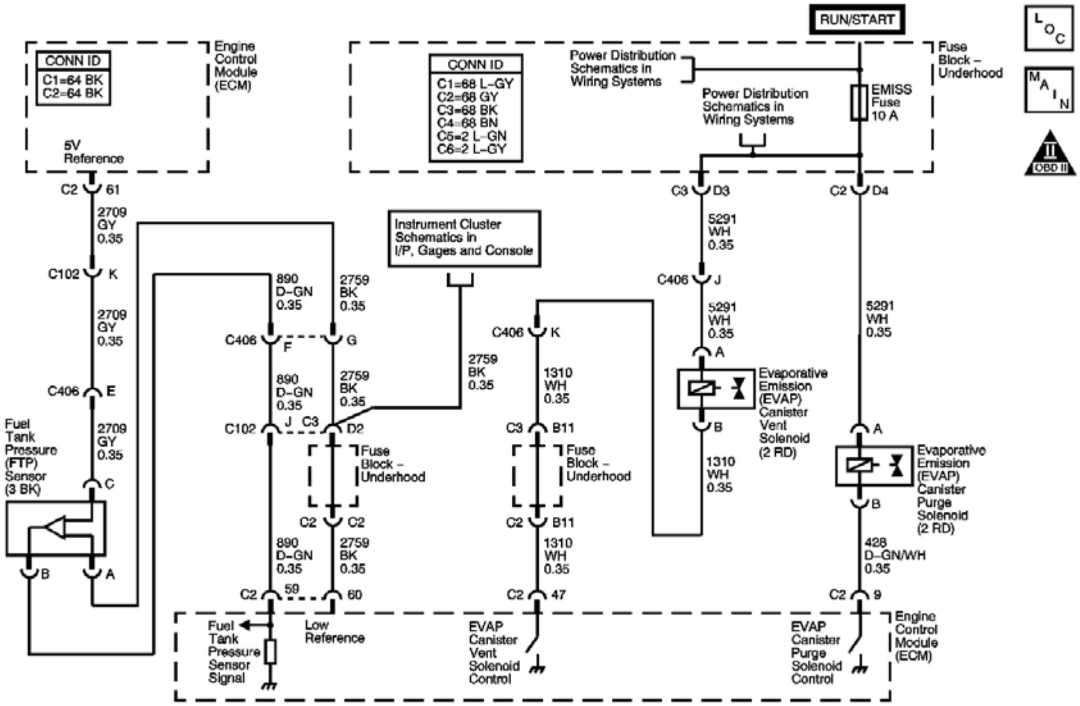


Fig. 10: DTC P0455 Circuit
Courtesy of GENERAL MOTORS CORP.

The evaporative emission (EVAP) system is used to store fuel vapors to reduce the amount of unburned fuel from escaping into the atmosphere. The EVAP system consists of the EVAP canister, the fuel tank pressure (FTP) sensor, the EVAP lines and hoses, the EVAP canister purge solenoid valve which is normally closed, the EVAP service port, the EVAP canister vent solenoid valve which is normally open, the fuel tank, and the powertrain control module (PCM). The PCM monitors the EVAP system for circuit faults in the FTP sensor, the EVAP canister purge solenoid valve and the EVAP canister vent solenoid valve circuits. The PCM also monitors the EVAP system for small and large leaks. During the DTC P0455 diagnostic, the PCM monitors the FTP sensor for an atmospheric pressure reading when all of the DTC parameters have been met with the engine running. The PCM will then command the EVAP canister vent solenoid valve ON which is a closed valve, and command the EVAP canister purge solenoid valve to a fixed duty cycle. The PCM will let the pressure drop in the fuel tank for a certain length of time after which it will turn OFF the EVAP canister purge solenoid valve. DTC P0455 sets when a certain vacuum in the fuel tank could not be achieved due to a large leak or a lack of vacuum source.

Conditions for Running the DTC

- DTCs P0105, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0125, P0131, P0132, P0133, P0134, P0135, P0452, P0453, P0502, P0601, P0602, P1621 are not set.
- The EVAP canister vent solenoid valve is commanded ON, closed.
- The EVAP canister purge solenoid valve is commanded to a fixed duty cycle.
- The engine is running.

- The fuel tank level is between 15-85 percent.
- The barometric pressure (BARO) is more than 75 kPa.
- The engine coolant temperature (ECT) and the intake air temperature (IAT) at engine startup are between 4-30°C (39-86°F).
- The ECT and the IAT are within 8°C (15°F) of each other.
- The throttle position (TP) angle is between 7-35 percent.
- The vehicle speed is less than 113 km/h (70 mph).
- The DTC P0455 diagnostic runs once per ignition cycle after the above conditions have been met.

Conditions For Setting the DTC

- If the FTP voltage is less than 3.0 volts during the DTC P0455 diagnostic test indicating a vacuum cannot be pulled on the EVAP system, DTC P0455 will set.
- The above condition exists for longer than 6 minutes and 40 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- The PCM uses the FTP sensor to detect the amount of vacuum pulled on the EVAP system during the leak diagnostic tests. Ensure that the fuel pressure sensor is not skewed by verifying the FTP sensor on the scan tool is between 1.30-1.70 volts with the ignition ON and the fuel cap removed.
- If DTC P0455 fails, a warm test will be performed and can only pass, not fail, a diagnostic test. The purpose of this test is to keep the malfunction indicator lamp (MIL) OFF during the initial test if the customer starts the vehicle with the fuel cap off.
- Visually inspect for a large leak in the EVAP system. Locate the leak with the **J 41413-200** (J 41413-100) Evaporative Emissions System Tester (EEST).
- The following are possible causes of a large leak:
  - The fuel cap is missing, is incorrectly installed or is leaking.
  - The EVAP canister vent solenoid valve is stuck open.

- The EVAP canister purge solenoid valve is stuck closed or is blocked.
- The EVAP vent hose is loose or is damaged.
- The EVAP canister is leaking.
- The fuel sender assembly O-ring is leaking.
- The fuel tank or filler neck is leaking.
- A condition may exist where a leak in the EVAP system only exists under a vacuum condition. By using the scan tool Purge/Seal function to create a vacuum, seal the system and observe the fuel tank pressure (FTP) parameter for vacuum decay, this type of leak may be detected.

DTC P0455 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls SchematicsEvaporative Emissions (EVAP) Hose Routing Diagram **Connector End View Reference: Engine Control Module (ECM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Inspect the evaporative emission (EVAP) system for the following conditions: • A loose, missing, or damaged service port schrader valve • A loose, incorrect, missing, or damaged fuel fill cap • A damaged EVAP canister purge solenoid valve 2. Raise the vehicle on a hoist. Refer to **Lifting and Jacking the Vehicle** in General Information. 3. Inspect the EVAP system for the following conditions: • Any disconnected, improperly routed, kinked, or damaged EVAP pipes and hoses • A damaged EVAP canister vent solenoid valve or EVAP canister Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 3**
3	1. Clear the DTCs with a scan tool. 2. Command the EVAP canister purge solenoid valve to 50 percent and back to 0 percent with a scan tool.	-		

	Do you hear or feel a clicking from the EVAP canister purge solenoid valve when it is commanded to 50 percent?		Go to **Step 4**	Go to **Step 5**
4	Command the EVAP canister vent solenoid valve ON and OFF with the scan tool. Do you hear or feel a click as the EVAP canister vent solenoid valve is commanded ON and OFF?	-	Go to **Step 9**	Go to **Step 7**
5	1. Disconnect the EVAP canister purge solenoid valve. 2. Turn ON the ignition, with the engine OFF. 3. Connect a test lamp between the ignition 1 voltage circuit of the EVAP canister purge solenoid valve and a known good ground. Refer to **Troubleshooting with a Test Lamp** in Wiring Systems. Does the test lamp illuminate?	-	Go to **Step 6**	Go to **Step 26**
6	1. Connect a test lamp between the ignition 1 voltage circuit of the EVAP canister purge solenoid valve and the control circuit of the EVAP canister purge solenoid valve. Refer to **Circuit Testing** in Wiring Systems. 2. Command the EVAP canister purge solenoid valve to 50 percent and then to 0 percent with a scan tool. Does the test lamp illuminate or pulsate when the EVAP canister purge solenoid valve is commanded to 50 percent and turn OFF when the EVAP canister purge solenoid valve is commanded to 0 percent?	-	Go to **Step 21**	Go to **Step 19**
7	1. Turn ON the ignition, with the engine OFF. 2. Disconnect the EVAP canister vent solenoid valve. 3. Connect a test lamp between the ignition 1 voltage circuit of the EVAP canister vent solenoid valve and a known good ground. Refer to **Troubleshooting with a Test Lamp** in Wiring Systems. Does the test lamp illuminate?	-	Go to **Step 8**	Go to **Step 27**
	1. Connect a test lamp between the ignition 1 voltage circuit of the EVAP canister vent solenoid valve and the control circuit of the EVAP canister			

8	vent solenoid valve. Refer to **Troubleshooting with a Test Lamp** in Wiring Systems. 2. Command the EVAP canister vent solenoid valve ON, with a scan tool. Does the test lamp illuminate?	-	Go to **Step 22**	Go to **Step 20**
9	**IMPORTANT:** **Larger volume fuel tanks and/or those with lower fuel levels may require several minutes for the floating indicator to stabilize.** 1. Turn the nitrogen/smoke valve to NITROGEN. 2. Connect the nitrogen/smoke hose to the 0.5 mm (0.20 in) test orifice on the bottom-front of the **J 41413-200** (J 41413-100) Evaporative Emissions System Tester (EEST). 3. Use the remote switch to activate the **J 41413-200** (J 41413-100). 4. Align the red flag on the flow meter with the floating indicator. Use the remote switch to de-activate the **J 41413-200** (J 41413-100). **IMPORTANT:** **The GE-41415-50 Fuel Tank Cap Adapter may not be available for the start of production. Once the GE-41415-50 is available, start the diagnosis at the fuel fill cap.** 5. Remove the nitrogen/smoke hose from the test orifice and install the hose onto one of the following sources: • Connect the GE-41415-50 to the fuel fill pipe, and the nitrogen/smoke hose to the fuel cap adapter. • Connect the nitrogen/smoke hose to the EVAP service port. 6. Turn ON the ignition, with the engine OFF. 7. Command the EVAP canister vent solenoid valve closed with a scan tool. 8. Use the remote switch to introduce nitrogen and fill the EVAP system until the floating stabilizes. 9. Compare the flow meters stable floating indicator position to the red flag.	-		

	Is the floating indicator below the red flag?		Go to **Step 12**	Go to **Step 10**
10	**IMPORTANT:** **Ensure that the vehicle underbody temperature is similar to the ambient temperature and allow the surrounding air to stabilize before starting the diagnostic procedure. System flow will be less with higher temperatures.** 1. Turn ON the ignition, with the engine OFF. 2. Command the EVAP canister vent solenoid valve closed with a scan tool. 3. Turn the nitrogen/smoke valve on the **J 41413-200** (J 41413-100) control panel to SMOKE. 4. Use the remote switch to introduce smoke into the EVAP system. 5. Use the **J 41413-VLV** EVAP Service Port Vent Fitting to open the EVAP service port. 6. Remove the **J 41413-VLV** once smoke is observed. 7. Continue to introduce smoke into the EVAP system for an additional 60 seconds. 8. Inspect the entire EVAP system for exiting smoke with a High Intensity White Light. 9. Continue to introduce smoke at 15 second intervals until the leak source has been located Did you locate and repair a leak source?	-	Go to **Step 35**	Go to **Step 11**
11	1. Disconnect the GE-41415-50 from the fuel fill pipe. 2. Install the fuel fill cap to the fuel fill pipe. 3. Connect the **J 41413-200** (J 41413-100) nitrogen/smoke supply hose to the EVAP service port. 4. Use the remote switch to introduce smoke into the EVAP system. 5. Inspect the entire EVAP system for exiting smoke with a High Intensity White Light. 6. Continue to introduce smoke at 15 second intervals until the leak source has been located Did you locate and repair a leak source?	-	Go to **Step 35**	Go to **Step 12**
	1. Use the remote switch to stop introducing smoke.			

12	**IMPORTANT:** **The GE-41415-50 may not be available for the start of production. Once the GE-41415-50 is available, start the diagnosis at the fuel fill cap.** 2. Install the nitrogen/smoke supply hose onto one of the following sources: • Connect GE-41415-50 to the fuel fill pipe, and the nitrogen/smoke hose to the fuel cap adapter. • Connect the nitrogen/smoke hose to the EVAP service port. 3. Connect the vehicle fuel fill cap to the GE-41415-50 . 4. Command the EVAP canister vent solenoid valve open with a scan tool. 5. Observe the Fuel Tank Pressure Sensor parameter with a scan tool. Is the scan tool Fuel Tank Pressure Sensor parameter within the specified value?	1.30-1.70 V	Go to **Step 13**	Go to **Step 23**
13	1. Seal the EVAP system using the EVAP Purge/Seal function with a scan tool. 2. Turn the nitrogen/smoke valve on the **J 41413-200** (J 41413-100) control panel to NITROGEN. 3. Use the **J 41413-200** (J 41413-100) to pressurize the EVAP system to the first specified value. Is the Fuel Tank Pressure Sensor parameter less than the second specified value?	10 in H2O 0.5 V	Go to **Step 14**	Go to **Step 23**
14	1. Use the remote switch to stop introducing nitrogen into the EVAP system. 2. Increase the EVAP canister purge solenoid valve to 100 percent. Is the Fuel Tank Pressure Sensor parameter within the specified value?	1.30-1.70 V	Go to Diagnostic Aids	Go to **Step 15**
15	Disconnect the EVAP purge vacuum source from the EVAP canister purge solenoid valve. Is the Fuel Tank Pressure Sensor parameter within the specified value?	1.30-1.70 V	Go to **Step 25**	Go to **Step 16**
16	Disconnect the EVAP purge pipe from the EVAP canister purge solenoid valve.	1.30-		

	Is the Fuel Tank Pressure Sensor parameter within the specified value?	1.70 V	Go to **Step 30**	Go to **Step 17**
17	Disconnect the EVAP purge pipe at the EVAP canister. Is the Fuel Tank Pressure Sensor parameter within the specified value?	1.30-1.70 V	Go to **Step 28**	Go to **Step 18**
18	Disconnect the EVAP vapor pipe at the EVAP canister. Is the Fuel Tank Pressure Sensor parameter within the specified value?	1.30-1.70 V	Go to **Step 32**	Go to **Step 29**
19	Test the control circuit of the EVAP canister purge solenoid valve for an open or for a short to voltage. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 24**
20	Test the control circuit of the EVAP canister vent solenoid valve for an open or for a short to voltage. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 24**
21	Test for an intermittent and for a poor connection at the EVAP canister purge solenoid valve. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 30**
22	Test for an intermittent and for a poor connection at the EVAP canister vent solenoid valve. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 31**
23	Test for an intermittent and for a poor connection at the fuel tank pressure (FTP) sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 33**
24	Test for an intermittent and for a poor connection at the control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and**Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 34**
25	Repair the pinched or obstructed EVAP canister purge solenoid valve vacuum source. Did you complete the repair?	-	Go to **Step 35**	-
26	1. Repair the open or short to ground in the ignition 1 voltage circuit of the EVAP canister purge solenoid valve. Refer to **Wiring Repairs** in Wiring Systems.	-		

	2. Replace the fuse as necessary. Did you complete the repair?		Go to **Step 35**	-
27	Repair the open or short to ground in the ignition 1 voltage circuit of the EVAP canister vent solenoid valve. Refer to **Wiring Repairs** in Wiring Systems. Replace the fuse as necessary. Did you complete the repair?	-	Go to **Step 35**	-
28	Repair the restriction in the EVAP purge pipe. Did you complete the repair?	-	Go to **Step 35**	-
29	Repair the restriction in the EVAP vapor pipe. Did you complete the repair?	-	Go to **Step 35**	-
30	Replace the EVAP canister purge solenoid valve. Refer to **Evaporative Emission (EVAP) Canister Purge Solenoid Valve Replacement** . Did you complete the replacement?	-	Go to **Step 35**	-
31	Replace the EVAP canister vent solenoid valve. Refer to **Evaporative Emission (EVAP) Canister Vent Solenoid Valve Replacement** . Did you complete the replacement?	-	Go to **Step 35**	-
32	Replace the EVAP canister. Refer to **Evaporative Emission (EVAP) Canister Replacement** . Did you complete the replacement?	-	Go to **Step 35**	-
33	Replace the FTP sensor. Refer to **Fuel Tank Pressure Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 35**	-
34	Replace the control module. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 35**	-
	IMPORTANT: **Larger volume fuel tanks and/or those with lower fuel levels may require several minutes for the floating indicator to stabilize.** 1. Turn the nitrogen/smoke valve to NITROGEN. 2. Connect the nitrogen/smoke hose to the 0.5 mm (0.20 in) test orifice on the bottom-front of the **J 41413-200** (J 41413-100). 3. Use the remote switch to activate the **J 41413-200** (J 41413-100). 4. Align the red flag on the flow meter with the floating indicator. Use the remote switch to de-activate the **J 41413-200** (J 41413-100).			

35	**IMPORTANT:** **The GE-41415-50 may not be available for the start of production. Once the GE-41415-50 is available, start the diagnosis at the fuel fill cap.** 5. Remove the nitrogen/smoke hose from the test orifice and install the hose onto one of the following sources: • Connect the GE-41415-50 to the fuel fill pipe, and the nitrogen/smoke hose to the fuel cap adapter. • Connect the nitrogen/smoke hose to the EVAP service port. 6. Turn ON the ignition, with the engine OFF. 7. Command the EVAP canister vent solenoid valve closed with a scan tool. 8. Use the remote switch to introduce nitrogen and fill the EVAP system until the floating stabilizes. 9. Compare the flow meters stable floating indicator position to the red flag. Is the floating indicator below the red flag?	-	Go to **Step 36**	Go to **Step 2**
36	1. Seal the EVAP system using the EVAP Purge/Seal function with a scan tool. 2. Turn the nitrogen/smoke valve on the **J 41413-200** (J 41413-100) control panel to NITROGEN. 3. Use the **J 41413-200** (J 41413-100) to pressurize the EVAP system to the first specified value. Is the Fuel Tank Pressure Sensor parameter less than the second specified value?	10 in H2O 0.5 V	Go to **Step 37**	Go to **Step 2**
37	1. Use the remote switch to stop introducing nitrogen into the EVAP system. 2. Increase the EVAP canister purge solenoid valve to 100 percent. Is the Fuel Tank Pressure Sensor parameter within the specified value?	1.30-1.70 V	Go to **Step 38**	Go to **Step 2**
38	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0496

System Description

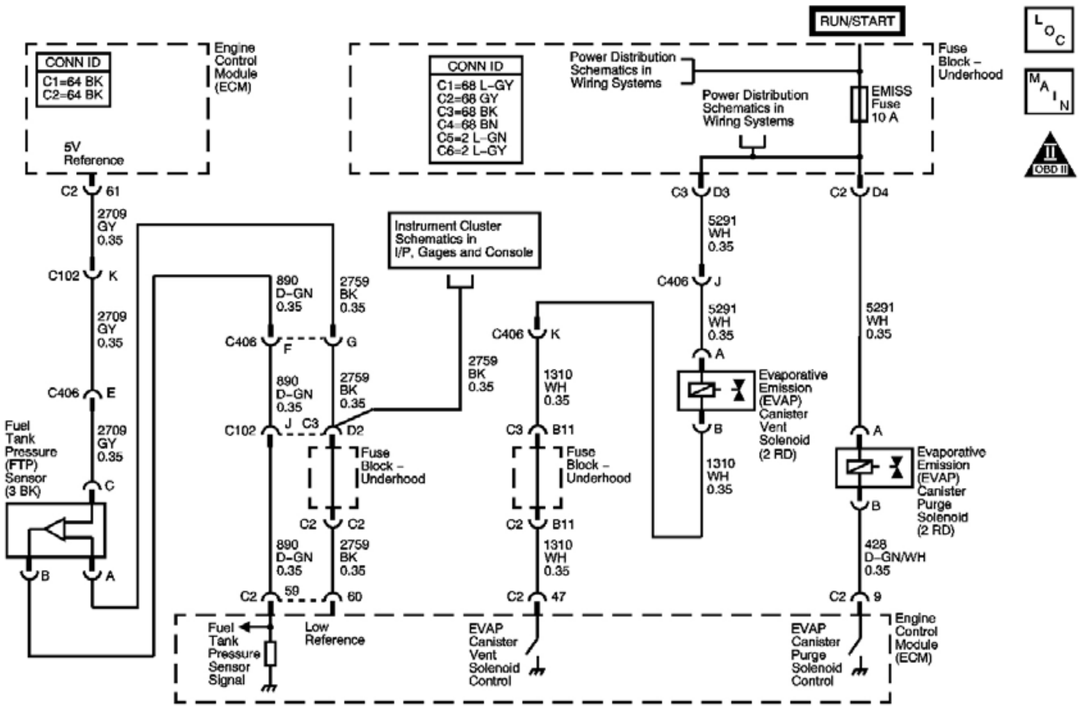


Fig. 11: DTC P0496 Circuit
Courtesy of GENERAL MOTORS CORP.

The evaporative emission (EVAP) system is used to store fuel vapors to reduce the amount of unburned fuel from escaping into the atmosphere. The EVAP canister purge solenoid valve is pulse width modulated (PWM) and is used to control the flow of fuel vapors from the EVAP canister to the intake manifold. The EVAP canister purge solenoid valve is commanded ON, PWM, whenever the EVAP system is in purge mode. Fuel vapors can be purged at anytime the powertrain control module (PCM) is in Closed Loop and the vehicle is not in a decel. The PCM controls the EVAP canister purge solenoid valve by controlling an internal driver that pulls the solenoid valve circuit to ground. During one part of the EVAP diagnostic system test, the PCM will close the EVAP canister purge solenoid valve and the EVAP canister vent solenoid valve. DTC P0496 sets when the fuel tank pressure (FTP) sensor indicates that the pressure is lower than atmospheric, vacuum, indicating the EVAP canister purge solenoid valve is stuck open.

Conditions for Running the DTC

- DTCs P0105, P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0125, P0131, P0132, P0133, P0134, P0135, P0452, P0453, P0502, P0601, P0602, P1621 are not set.
- The engine is running.
- The EVAP canister vent solenoid valve is commanded ON, closed.

- The EVAP canister purge solenoid valve is commanded OFF, closed.
- The fuel level is between 15-8 percent.
- The barometric pressure (BARO) is greater than 75 kPa.
- The engine coolant temperature (ECT) and intake air temperature (IAT) are between 4-30°C (39-86°F) at engine startup.
- The ECT and the IAT are within 8°C (15°F) of each other.
- The vehicle speed is less than 113 km/h (70 mph).
- The throttle position (TP) is between 10-35 percent.
- DTC P0496 diagnostic runs once per ignition cycle, usually for 30 seconds if no faults exist, during the EVAP diagnostic system test.

Conditions for Setting the DTC

- If the FTP sensor voltage is indicating more than 2.30 volts, continuous purge flow, during the EVAP diagnostic system test, DTC P0496 will set.
- The above condition exists for 75 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- A diagnosed EVAP canister purge solenoid valve or EVAP canister vent solenoid valve circuit fault may have caused this DTC to set.
- The PCM uses the FTP sensor to detect the amount of vacuum pulled on the EVAP system during the leak diagnostic tests. Ensure that the fuel pressure sensor is not skewed by verifying the FTP sensor on the scan tool is between 1.30-1.70 volts with the ignition ON and the fuel cap removed.
- The most likely cause of DTC P0496 is a stuck open EVAP canister purge solenoid valve. Command the EVAP canister purge solenoid valve ON, PWM, with the scan tool. The valve should click at an even rate. Replace the solenoid if the solenoid intermittently sticks.
- A condition may exist where a leak in the EVAP system only exists under a vacuum condition. By using

the scan tool Purge/Seal function to create a vacuum, seal the system and observe the FTP parameter for vacuum decay, this type of leak may be detected.

DTC P0496 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Evaporative Emissions (EVAP) Hose Routing Diagram and Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Disconnect the evaporative emission (EVAP) canister side of the purge pipe from the EVAP purge solenoid. 2. Install a hand held vacuum gage to the EVAP canister purge solenoid valve purge port. 3. Disconnect the EVAP canister purge solenoid valve harness connector. 4. Monitor vacuum on the vacuum gage. 5. Start the engine and allow the engine to idle. 6. Increase the idle to 1,200-1,500 RPM. Does the vacuum gage indicate an increase in vacuum?	-	Go to **Step 8**	Go to **Step 3**
3	1. Connect the EVAP canister purge solenoid valve harness connector. 2. Monitor vacuum on the vacuum gage. 3. Increase the idle to 1,200-1,500 RPM. Does the vacuum gage indicate an increase in vacuum?	-	Go to **Step 5**	Go to **Step 4**
4	1. Turn OFF the ignition. 2. Remove and then install the fuel fill cap. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Fuel Tank Pressure Sensor parameter with a scan tool. Is the Fuel Tank Pressure Sensor parameter within the specified value?	1.30-1.70 V	Go to Diagnostic Aids	Go to **Step 7**
5	Test the EVAP canister purge solenoid valve control circuit for a short to ground. Refer to **Testing for Short to Ground** and **Wiring Repairs** in Wiring	-		

	Systems. Did you find and correct the conditions?		Go to **Step 9**	Go to **Step 6**
6	Test for an intermittent and for a poor connection at the EVAP canister purge solenoid valve. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 8**
7	Replace the fuel tank pressure (FTP) sensor. Refer to **Fuel Tank Pressure Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 9**	-
8	Replace the EVAP canister purge solenoid valve. Refer to **Evaporative Emission (EVAP) Canister Purge Solenoid Valve Replacement** . Did you complete the replacement?	-	Go to **Step 9**	-
9	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 10**
10	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0506

Circuit Description

The throttle actuator control (TAC) motor is controlled by the engine control module (ECM). The DC motor located in the throttle body drives the throttle plate. In order to decrease idle speed, the ECM commands the throttle closed reducing air flow into the engine and the idle speed decreases. In order to increase idle speed, the ECM commands the throttle plate open allowing more air to pass the throttle plate. If the actual idle RPM does not match the desired idle RPM within a calibrated time, this DTC will set.

Conditions for Running the DTC

- DTCs P0112, P0113, P0117, P0118, P0120, P0122, P0123, P0125, P0128, P0220, P0222, P0223, P0442, P0446, P0452, P0453, P0455, P0502, P2135 are not set.
- The engine is operating for at least 2 seconds.
- The engine coolant temperature (ECT) is more than 81°C (178°F).

- The intake air temperature (IAT) is more than 32°C (90°F).
- The vehicle speed is 0 mph.

Conditions for Setting the DTC

- The actual idle speed is approximately 100 RPM lower than the desired idle speed.
- The above condition is present for 2 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

2: This test determines whether the engine can achieve the commanded RPM.

DTC P0506 Circuit

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	1. Start the engine. 2. Command the engine speed up to 1,600 RPM, down to 600 RPM, and up to 1,600 RPM with a		

2	scan tool. 3. Exit the RPM control function. Does the engine speed correspond, within 100 RPM, with each command?	Go to **Intermittent Conditions**	Go to **Step 3**
3	Inspect for any condition that can reduce idle speed by increasing engine load. Examples include: • Incorrect torque converter clutch (TCC) operation • Excessive deposits in the throttle body • Accessories that require additional torque to operate • Restricted exhaust • Mechanical conditions that limit engine speed Did you complete the action?	Go to **Step 4**	-
4	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 5**
5	**IMPORTANT:** **Be aware that repairing one individual condition may correct more than one DTC.** Observe the Capture Info with a scan tool.Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0507

Circuit Description

The throttle actuator control (TAC) motor is controlled by the engine control module (ECM). The DC motor located in the throttle body drives the throttle plate. In order to decrease idle speed, the ECM commands the throttle closed reducing air flow into the engine and the idle speed decreases. In order to increase idle speed, the ECM commands the throttle plate open allowing more air to pass the throttle plate. If the actual idle RPM does not match the desired idle RPM within a calibrated time, this DTC will set.

Conditions for Running the DTC

- DTCs P0112, P0113, P0117, P0118, P0120, P0122, P0123, P0125, P0128, P0220, P0222, P0223, P0442, P0446, P0452, P0453, P0455, P0502, P2135 are not set.
- The engine is operating for at least 2 seconds.
- The engine coolant temperature (ECT) is more than 81°C (178°F).
- The intake air temperature (IAT) is more than 32°C (90°F).
- The vehicle speed is 0 mph.

Conditions for Setting the DTC

- The actual idle speed is approximately 200 RPM greater than the desired idle speed.
- The above condition is present for 2 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

2: This test determines whether the engine can achieve the commanded RPM.

DTC P0507 Circuit

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?		Go to **Diagnostic System Check -**

		Go to **Step 2**	**Engine Controls**
2	1. Start the engine. 2. Command the engine speed up to 1,500 RPM, down to 500 RPM, and up to 1,500 RPM with a scan tool. 3. Exit the RPM control function. Does the engine speed correspond within 100 RPM with each command?	Go to **Intermittent Conditions**	Go to **Step 3**
3	Inspect for the following conditions: • Vacuum leaks • Excessive deposits in the throttle body • A faulty positive crankcase ventilation (PCV) valve Did you find and correct the condition?	Go to **Step 4**	-
4	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 5**
5	**IMPORTANT:** **Be aware that repairing one individual condition may correct more than one DTC.** Observe the Capture Info with a scan tool.Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, OR P2610

Description

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

Test Description

The number below refers to the step number on the diagnostic table.

2: A DTC P0602 indicates the ECM is not programmed.

DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610 Circuit

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Is DTC P0602, P0604, P0606, P0607 set?	Go to **Step 3**	Go to **Step 5**
3	Program the engine control module (ECM). Refer to **Service Programming System (SPS)** in Programming. Does the DTC reset?	Go to **Step 4**	Go to **Step 6**
4	1. Ensure that all tool connections are secure. 2. Ensure the programming equipment is operating correctly. 3. Ensure the correct software/calibration package is used. 4. Attempt to program the ECM. Refer to **Service Programming System (SPS)** in Programming. Does the DTC reset?	Go to **Step 5**	Go to **Step 6**
5	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	Go to **Step 6**	-
6	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 7**
7	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0641

Circuit Description

The engine control module (ECM) uses the 5-volt reference 1 circuit as a sensor feed to the following sensors:

- The A/C pressure sensor

- The throttle position (TP) 1 sensor
- The accelerator pedal position (APP) 2 sensor
- The fuel tank pressure (FTP) sensor

If the ECM detects the voltage on the 5-volt reference 1 circuit is outside a valid range, DTC P0641 sets.

Conditions for Running the DTC

- The ignition is ON.
- DTCs P0601, P0602, P0604, P0606, P1621 are not set.

Conditions for Setting the DTC

- The ECM detects the voltage on the 5-volt reference 1 circuit is less than 4.88 volts or greater than 5.13 volts.
- The above condition is present for longer than 0.5 second.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0641 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	1. Observe the Freeze Frame/Failure Records for this DTC.			

2	2. Turn OFF the ignition for at least 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 3**	Go to **Intermittent Conditions**
3	1. Visually and physically inspect the engine control module (ECM) and the engine grounds. Ensure that the grounds are clean and secure. 2. If a condition is found, repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 12**	Go to **Step 4**
4	1. Turn OFF the ignition. 2. Disconnect the A/C pressure sensor electrical connector. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage between the 5-volt reference circuit of the A/C Pressure sensor and a good ground with a DMM. Is the voltage within the specified range?	4.8-5.2 V	Go to **Step 6**	Go to **Step 5**
5	Is the voltage more than the specified value?	5.2 V	Go to **Step 9**	Go to **Step 7**
6	1. Connect the A/C pressure sensor electrical connector. 2. Disconnect the throttle position sensor. 3. Measure the voltage between the 5-volt reference 1 circuit of the throttle position sensor 1 and a good ground with a DMM. Is the voltage within the specified range?	4.8-5.2 V	Go to **Intermittent Conditions**	Go to **Step 10**
7	1. Monitor the DMM while disconnecting all other devices connected to 5-volt reference circuit 1, one at a time. 2. If voltage changes when one of the above components are disconnected, replace the	-		

	component. Refer to the appropriate replacement procedure. Was a component replaced?		Go to **Step 12**	Go to **Step 8**
8	1. Turn OFF the ignition. 2. Disconnect the ECM. 3. Test the 5-volt reference circuit 1 for a short to ground or a short to any sensor low reference circuit. 4. If a condition is found, repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 12**	Go to **Step 11**
9	1. Turn OFF the ignition. 2. Disconnect the ECM. 3. Turn ON the ignition, with the engine OFF. 4. Test the following circuits for a short to voltage: • The accelerator pedal position (APP) 2 sensor signal circuit • The A/C pressure sensor signal circuit • The throttle position (TP) 1 sensor signal circuit • The fuel tank pressure (FTP) sensor signal circuit • The 5-volt reference circuit for all sensors listed above. 5. If a condition is found, repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 12**	Go to **Step 11**
10	Replace the A/C pressure sensor. Refer to **Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement** in Heating, Ventilation, and Air Conditioning. Did you complete the replacement?	-	Go to **Step 12**	-
11	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
	1. Clear the DTCs with a scan tool.			

12	2. Turn OFF the ignition for at least 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 13**
13	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0651

Circuit Description

The engine control module (ECM) uses the 5-volt reference 2 circuit as a sensor feed to the following sensors:

- The manifold absolute pressure (MAP) sensor
- The accelerator pedal position (APP) 1 sensor
- The throttle position (TP) 2 sensor

If the ECM detects the voltage on the 5-volt reference 2 circuit is outside a valid range, DTC P0651 sets.

Conditions for Running the DTC

- The ignition is ON.
- DTCs P0601, P0602, P0604, P0606, P1621 are not set.

Conditions for Setting the DTC

- The ECM detects the voltage on the 5-volt reference 1 circuit is less than 4.88 volts or greater than 5.13 volts.
- The above condition is present for longer than 0.5 second.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze

Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0651 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 3**	Go to **Intermittent Conditions**
3	1. Visually and physically inspect the engine control module (ECM) and engine grounds. Ensure that the grounds are clean and secure. 2. If a condition is found, repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 12**	Go to **Step 4**
4	1. Turn OFF the ignition. 2. Disconnect the manifold absolute pressure (MAP) electrical connector. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage between the 5-volt reference circuit of the MAP sensor and a	4.8-5.2 V		

	good ground with a DMM. Is the voltage within the specified range?		Go to **Step 6**	Go to **Step 5**
5	Is the voltage more than the specified value?	5.2 V	Go to **Step 9**	Go to **Step 7**
6	1. Connect MAP sensor electrical connector. 2. Disconnect throttle position sensor. 3. Measure the voltage between the 5-volt reference circuit of the throttle position sensor 2 and a good ground with a DMM. Is the voltage within the specified range?	4.8-5.2 V	Go to **Intermittent Conditions**	Go to **Step 10**
7	1. Monitor the DMM while disconnecting all other devices connected to 5-volt reference circuit 2, one at a time. 2. If voltage changes when one of the above components are disconnected, replace the component. Refer to the appropriate replacement procedure. Was a component replaced?	-	Go to **Step 12**	Go to **Step 8**
8	1. Turn OFF the ignition. 2. Disconnect the ECM. 3. Test the 5-volt reference circuit 2 for a short to ground or a short to any sensor low reference circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 12**	Go to **Step 11**
9	1. Turn OFF the ignition. 2. Disconnect the ECM. 3. Turn ON the ignition, with the engine OFF. 4. Inspect the following circuits for a short to voltage: • The MAP sensor signal circuit • The accelerator pedal position (APP) 1 sensor signal circuit • The throttle position (TP) 2 sensor signal circuit • The 5-volt reference circuit for all sensors listed above. 5. If a condition is found, repair as necessary.	-		

	Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct a condition?		Go to **Step 12**	Go to **Step 11**
10	Replace the MAP sensor. Refer to **Manifold Absolute Pressure (MAP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
11	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for at least 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 13**
13	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0700

Circuit Description

The transmission control module (TCM) uses the controller area network (CAN) to signal the engine control module (ECM) that the TCM is requesting malfunction indicator lamp (MIL) illumination. This happens when the TCM has determined that a failure that affects emissions has occurred in the transmission control system. When the ECM receives the correct message from the TCM, DTC P0700 will set.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

The TCM is requesting MIL illumination.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0700 Circuit

Step	Action	Values	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Observe the DTC Information with a scan tool. Does the scan tool display any engine control module (ECM) DTCs other than P0700?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Diagnostic System Check - Automatic Transmission** in Automatic Transmission VT25-E

DIAGNOSTIC INFORMATION & PROCEDURES

DTC P0701

Circuit Description

Modules that are connected to the CAN serial data circuits monitor each other for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the modules. the modules have prerecorded information about messages that are exchanged on the serial data circuits. The supervised and periodic messages are used by the receiving module as an availability, and state of health indicator from the transmitting module. If the engine control module (ECM) detects a message that indicates a loss of communication, invalid or corrupted serial data, or an active malfunction in the transmission control module (TCM), that requires ECM intervention, DTC P0701 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0701 Transmission Control System Performance

Conditions for Running the DTC

- The ignition is in any of the following positions:
  - Unlock
  - Accessory
  - Run
  - Crank
  - OFF, but the ECM has not powered down
- The ignition 1 voltage is more than 9 Volts.
- Depending on the ignition mode, an engine run time of more than 1-3 seconds is required for certain messages.
- This DTC runs continuously within the enabling conditions.

Conditions for Setting the DTC

- The TCM has an active malfunction and is requesting ECM intervention.

  OR

- Loss of communication between the ECM and the TCM.

OR

- Invalid serial data between the ECM and the TCM.

  OR

- Loss of the state of health message between the ECM and the TCM.

  OR

- An active vehicle speed malfunction in the TCM.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

A module which loses power during the current ignition cycle, will have a Loss of Communication DTC set by the other modules that require information from the failed module.

If the TCM, using a faulty manifold absolute pressure (MAP) signal, calculates an invalid torque value, the TCM will command ECM intervention and set a DTC P0701.

If there is an active vehicle speed malfunction in the TCM, DTC P0701 will set.

If the ECM's ignition 1 voltage circuit, that is used to wake up the module is open, the TCM may set a DTC U2105 and request a limp-home mode, which will result in DTC P0701 also being set.

DTC P0701 Circuit

Step	Action	Yes	No
Schematic Reference:Engine Controls Schematics and **Data Link Connector (DLC) Schematics (A/T)Data Link Connector (DLC) Schematics (M/T)** in Data Link Communications **Connector End View Reference:Engine Controls Connector End Views** or **Engine Control Module**			

(ECM) Connector End Views

1	Did you perform the Diagnostic System Check - Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Attempt to establish communication with the engine control module (ECM). Does the scan tool communicate with the ECM?	Go to **Step 3**	Go to **Scan Tool Does Not Communicate with Class 2 Device** in Data Link Communications
3	Select the DTC Information for the body control module (BCM), on the scan tool. Does the scan tool display any DTCs which begin with a U?	Go to **Diagnostic Trouble Code (DTC) List** in Data Link Communications	Go to **Step 4**
4	Select the DTC Information for the ECM. Does the scan tool display DTC P0107 or DTC P0108?	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 5**
5	Select the DTC Information for the ECM. Does the scan tool display DTC P0502 or DTC P0503?	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 6**
6	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 7**
7	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P1133

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The engine control module (ECM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the ECM operates in

Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperatures and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream. Low HO2S voltage indicates a lean exhaust stream.

This diagnostic will only run once per ignition cycle. The ECM monitors the number of rich-to-lean and lean-to-rich transitions. If the ECM detects that the number of transitions were less than a specified value, DTC P1133 will set.

Conditions for Running the DTC

- DTCs P0068, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0122, P0123, P0125, P0128, P0201 P0202, P0203, P0204, P0220, P0300-P0304, P0315, P0336, P0442, P0446, P0452, P0453, P0455, P0496, P0506, P0507, P0601, P0602, P0604, P0606, P0641, P0651, P1516, P1621, P1680, P1681, P2101, P2120, P2125, P2135, P2138, P2176 are not set.
- The ECT Sensor parameter is more than 70°C (158°F).
- The Engine Speed parameter is between 1,000-3,500 RPM.
- The Ignition 1 Signal parameter is more than 11 volts.
- The Engine Run Time parameter is more than 200 seconds.
- The Loop Status parameter is closed.
- The TP Angle parameter is between 6-60 percent.
- The EVAP Purge Solenoid DC parameter is more than 10 percent.
- The Fuel Level Sensor parameter is more than 10 percent.
- The MAP Sensor parameter is between 10-104 kPa.
- The above conditions are met for 60 seconds.

Conditions for Setting the DTC

The ECM detects that the HO2S 1 rich-to-lean counts 2, or the lean-to-rich counts is less than a calibrated value.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles

that the diagnostic runs and does not fail.

- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: When the system is operating correctly, the HO2S 1 voltage should toggle above and below the specified values. You may need to operate the vehicle within the Freeze Frame conditions and Conditions for Setting the DTC in order to duplicate the malfunction that was detected by the ECM.

4: The specified value is what is measured on a correctly operating system.

5: The specified value is what is measured on a correctly operating system.

DTC P1133 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Control Module (ECM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **If any other DTCs are set except for heated oxygen sensor (HO2S) DTCs, refer to the other DTCs first before proceeding with this table.** 1. Operate the engine at normal operating temperature. 2. Operate the engine above 1,200 RPM for 2 minutes. 3. Observe the heated oxygen sensor (HO2S) 1 voltage parameter with a scan tool. Does the scan tool indicate that the HO2S 1 voltage is varying above and below the specified values?	350-650 mV	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?		Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the HO2S 1. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the high signal circuit of the HO2S 1 on the vehicle harness side to a good ground with a DMM. Does the voltage measure within the specified value?	350-550 mV	Go to **Step 5**	Go to **Step 9**
5	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the HO2S 1 high signal circuit and the HO2S 1 low signal circuit. 3. Turn ON the ignition. 4. Monitor the HO2S 1 voltage for the sensor that applies to this DTC with the scan tool. Does the scan tool indicate that the HO2S 1 voltage is less than the specified value?	20 mV	Go to **Step 6**	Go to **Step 10**
6	1. Turn OFF the ignition. 2. Remove the 3-amp fused jumper wire. 3. Connect a test lamp between the ignition 1 voltage circuit and a good ground. DO NOT use the HO2S 1 heater low control. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	-	Go to **Step 7**	Go to **Step 11**
7	1. Connect a test lamp between the ignition 1 voltage circuit and the HO2S 1 heater low control circuit. 2. Turn ON the ignition, with the engine OFF. 3. Command the HO2S 1 heater ON and OFF with the scan tool. Does the test lamp turn ON and OFF with each command?	-	Go to **Step 14**	Go to **Step 8**

8	Does the test lamp remain illuminated with each command?	-	Go to **Step 12**	Go to **Step 13**
9	Test the HO2S 1 high signal circuit for the following conditions: • An open • High resistance • A short to ground • A short to voltage • A short to the HO2S 1 low signal circuit Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition.	-	Go to **Step 19**	Go to **Step 16**
10	Test the HO2S 1 low signal circuit for the following conditions: • An open • A short to voltage • High resistance Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 16**
11	1. Test the ignition 1 voltage circuit for the following conditions: • An open • A short to ground • High resistance Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. 2. Replace the EMISS fuse if necessary. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 15**
12	Test the HO2S 1 heater low control circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 16**
	Test the HO2S 1 heater low control circuit for the			

13	following conditions: • An open • A short to voltage • High resistance Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 16**
14	**IMPORTANT:** **Before replacing the HO2S 1, inspect and remove any source of contamination.** Inspect for the following conditions: • The use of incorrect silicon RTV sealant • Fuel contamination • An exhaust leak Refer to **Exhaust Leakage** in Engine Exhaust. • The HO2S is installed correctly • Damaged wiring Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 15**
15	Inspect for poor connections at the harness connector of the HO2S 1. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 17**
16	Inspect for poor connections at the harness connector of the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 18**
17	Replace the HO2S 1. Refer to **Heated Oxygen Sensor Replacement - Position 1** . Did you complete the replacement?	-	Go to **Step 19**	-

18	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 19**	-
19	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 20**
20	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P1134

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The engine control module (ECM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the ECM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperatures and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream. Low HO2S voltage indicates a lean exhaust stream.

This diagnostic will only run once per ignition cycle. The ECM monitors the rich-to-lean and lean-to-rich transitions. A transition is defined as the HO2S voltage changes from above 650 mV to below 350 mV or from below 350 mV to above 650 mV. If the ECM detects that the difference between the rich-to-lean average transition time and the lean-to-rich transition time is more than a specified value, DTC P1134 will set.

Conditions for Running the DTC

- DTCs P0068, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0122, P0123, P0125, P0128, P0201 P0202, P0203, P0204, P0220, P0300-P0304, P0315, P0336, P0442, P0446, P0452, P0453, P0455, P0496, P0506, P0507, P0601, P0602, P0604, P0606, P0641, P0651, P1516, P1621, P1680, P1681, P2101, P2120, P2125, P2135, P2138, P2176 are not set.
- The ECT Sensor parameter is more than 70°C (158°F).
- The Engine Speed parameter is between 1,000-3,500 RPM.

- The Ignition 1 Signal parameter is more than 11 volts.
- The Engine Run Time parameter is more than 200 seconds.
- The Loop Status parameter is closed.
- The TP Angle parameter is between 6-60 percent.
- The EVAP Purge Solenoid DC parameter is more than 10 percent.
- The Fuel Level Sensor parameter is more than 10 percent.
- The MAP Sensor parameter is between 10-104 kPa.
- The above conditions are met for 60 seconds.

Conditions for Setting the DTC

The ECM detects that the difference between HO2S 1 rich-to-lean average transition time and the lean-to-rich average transition time is more than a calibrated value.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

> **2:** When the system is operating correctly, the HO2S 1 voltage should toggle above and below the specified values. You may need to operate the vehicle within the Freeze Frame conditions and Conditions for Setting the DTC in order to duplicate the malfunction that was detected by the ECM.
>
> **4:** The specified value is what is measured on a correctly operating system.
>
> **5:** The specified value is what is measured on a correctly operating system.

DTC P1134 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Control Module (ECM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **If any other DTCs are set except for heated oxygen sensor (HO2S) DTCs, refer to the other DTCs first before proceeding with this table.** 1. Operate the engine at normal operating temperature. 2. Operate the engine above 1,200 RPM for 2 minutes. 3. Observe the heated oxygen sensor (HO2S) 1 voltage parameter with a scan tool. Does the scan tool indicate that the HO2S 1 voltage is varying above and below the specified values?	350-650 mV	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the HO2S 1. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the high signal circuit of the HO2S 1 on the vehicle harness side to a good ground with a DMM. Does the voltage measure within the specified value?	350-550 mV	Go to **Step 5**	Go to **Step 9**
	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between			

5	the HO2S 1 high signal circuit and the HO2S 1 low signal circuit. 3. Turn ON the ignition. 4. Monitor the HO2S 1 voltage for the sensor that applies to this DTC with the scan tool. Does the scan tool indicate that the HO2S 1 voltage is less than the specified value?	20 mV	Go to **Step 6**	Go to **Step 10**
6	1. Turn OFF the ignition. 2. Remove the 3-amp fused jumper wire. 3. Connect a test lamp between the ignition 1 voltage circuit and a good ground. DO NOT use the HO2S 1 heater low control. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	-	Go to **Step 7**	Go to **Step 11**
7	1. Connect a test lamp between the ignition 1 voltage circuit and the HO2S 1 heater low control circuit. 2. Turn ON the ignition, with the engine OFF. 3. Command the HO2S 1 heater ON and OFF with a scan tool. Does the test lamp turn ON and OFF with each command?	-	Go to **Step 14**	Go to **Step 8**
8	Does the test lamp remain illuminated with each command?	-	Go to **Step 12**	Go to **Step 13**
9	Test the HO2S 1 high signal circuit for the following conditions: • Open • High resistance • Short to ground • Short to voltage Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition.	-	Go to **Step 19**	Go to **Step 16**
10	Test the HO2S 1 low signal circuit for an open, a high resistance, or a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.	-		

	Did you find and correct the condition?		Go to **Step 19**	Go to **Step 16**
11	1. Test the ignition 1 voltage circuit for an open, a high resistance, or a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. 2. Replace the EMISS fuse if necessary. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 15**
12	Test the HO2S 1 heater low control circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 16**
13	Test the HO2S 1 heater low control circuit for an open, a high resistance, or a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 16**
14	**IMPORTANT:** **Before replacing the HO2S 1, inspect and remove any source of contamination.** Inspect for the following conditions: • The use of incorrect silicon RTV sealant • Fuel contamination • An exhaust leak Refer to **Exhaust Leakage** in Engine Exhaust. • The HO2S is installed correctly • Damaged wiring Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 15**
15	Inspect for poor connections at the harness connector of the HO2S 1. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 17**
	Inspect for poor connections at the harness connector of the engine control module (ECM).			

16	Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 18**
17	Replace the HO2S 1. Refer to **Heated Oxygen Sensor Replacement - Position 1** . Did you complete the replacement?	-	Go to **Step 19**	-
18	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 19**	-
19	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 20**
20	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P1137

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The engine control module (ECM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the ECM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperatures and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream. Low HO2S voltage indicates a lean exhaust stream.

If the ECM detects an HO2S voltage that stays below a specified value, DTC P1137 will set.

Conditions for Running the DTC

- DTCs P0068, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0122, P0123, P0125, P0128, P0201 P0202, P0203, P0204, P0220, P0300-P0304, P0315, P0336, P0442, P0446, P0452, P0453, P0455, P0496, P0506, P0507, P0601, P0602, P0604, P0606, P0641, P0651, P1516, P1621, P1680, P1681, P2101, P2120, P2125, P2135, P2138, P2176 are not set.

- The ECT Sensor parameter is more than 70°C (158°F).
- The Power Enrichment parameter is active.
- The Ignition 1 Signal parameter is more than 11 volts.
- The Loop Status parameter is closed.
- The Fuel Level Sensor parameter is more than 10 percent.
- The Engine Run Time parameter is more than 10 seconds.
- The above conditions are met for 5 seconds.

Conditions for Setting the DTC

The ECM detects that the HO2S 1 parameter is more than 700 mV and the HO2S 2 parameter is less than 399 mV for 10 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

2: When the system is operating correctly, the HO2S 2 voltage should toggle above and below the bias voltage.

DTC P1137 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics				

Connector End View Reference: Engine Control Module (ECM) Connector End Views or Engine Controls Connector End Views

1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Operate the engine at normal operating temperature. 2. Operate the engine above 1,200 RPM for 2 minutes. 3. Observe the heated oxygen sensor (HO2S) 2 voltage parameter with the scan tool. Does the scan tool indicate that the HO2S 2 voltage is less than the specified value?	399 mV	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the HO2S 2 sensor. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the high signal circuit of the HO2S 2 on the vehicle harness side to a good ground with a DMM. Does the voltage measure within the specified value?	350-550 mV	Go to **Step 6**	Go to **Step 5**
5	Test the HO2S 2 high signal circuit for a short to ground or a short to the low signal circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 8**
	The HO2S 2 may be detecting a lean exhaust condition. Inspect for one of the following conditions:			

6	• HO2S connector water intrusion • An exhaust leak between the HO2S 2 and the engine-Refer to **Exhaust Leakage** in Engine Exhaust. • Vacuum leaks • Incorrect fuel pressure- Refer to **Fuel System Diagnosis** . • Lean fuel injectors-Refer to **Fuel Injector Balance Test with Special Tool** . Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 7**
7	Inspect for poor connections at the harness connector of the HO2S 2 sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 9**
8	Inspect for poor connections at the harness connector of the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 10**
9	Replace the HO2S 2. Refer to **Heated Oxygen Sensor Replacement - Position 2** . Did you complete the replacement?	-	Go to **Step 11**	-
10	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 11**	-
11	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 12**
	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?		Go to **Diagnostic**	

12		-	**Trouble Code (DTC) List**	System OK

DTC P1138

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The engine control module (ECM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the ECM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperatures and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream. Low HO2S voltage indicates a lean exhaust stream.

If the ECM detects an HO2S voltage that stays above a specified value, DTC P1138 will set.

Conditions for Running the DTC

- DTCs P0068, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0122, P0123, P0125, P0128, P0201 P0202, P0203, P0204, P0220, P0300-P0304, P0315, P0336, P0442, P0446, P0452, P0453, P0455, P0496, P0506, P0507, P0601, P0602, P0604, P0606, P0641, P0651, P1516, P1621, P1680, P1681, P2101, P2120, P2125, P2135, P2138, P2176 are not set.
- The Deceleration Fuel Cutoff parameter is active.
- The Ignition 1 Signal parameter is more than 11 volts.
- The ECT Sensor parameter is more than 70°C (158°F).
- The Loop Status parameter is Closed.
- The Fuel Level Sensor parameter is more than 10 percent.
- The Engine Run Time parameter is more than 10 seconds.
- The above conditions are met for 7 seconds.

Conditions for Setting the DTC

The ECM detects that the HO2S 2 parameter is more than 648 mV for more than 10 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze

Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: When the system is operating correctly, the HO2S 2 voltage should toggle above and below the specified values. You may need to operate the vehicle within the Freeze Frame conditions and Conditions for Setting the DTC in order to duplicate the malfunction that was detected by the ECM.

DTC P1138 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Control Module (ECM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **If any other DTCs are set except for heated oxygen sensor (HO2S) DTCs, refer to the other DTCs first before proceeding with this table.** 1. Operate the engine at normal operating temperature. 2. Operate the engine above 1,200 RPM for 2 minutes. 3. Observe the heated oxygen sensor (HO2S) 2 voltage parameter with a scan tool. Does the scan tool indicate that the HO2S 2 voltage is more than the specified values?	648 mV	Go to **Step 4**	Go to **Step 3**
	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds.			

3	3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the HO2S 2. 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S 2 voltage parameter with a scan tool. Is the HO2S 2 voltage parameter more than the specified value?	800 mV	Go to **Step 5**	Go to **Step 6**
5	**IMPORTANT:** **The normal voltage on the high signal circuit is between 400-500 mV.** **IMPORTANT:** **The sensor may be damaged if the circuit is shorted to a voltage source.** Test the HO2S 2 high signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 10**
6	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S 2 harness connector on the engine harness side and the low signal circuit of the HO2S 2 harness connector on the engine harness side. 2. Observe the HO2S 2 voltage parameter with a scan tool. Is the HO2S 2 voltage parameter within the specified range?	400-500 mV	Go to **Step 7**	Go to **Step 8**
7	1. Remove the jumper wire from the previous step. 2. Test the HO2S 2 low signal circuit for and Open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.	-		

	Did you find and correct the condition?		Go to **Step 13**	Go to **Step 10**
8	The HO2S 2 is detecting a rich condition or may be contaminated. Inspect for the following conditions: • HO2S connector water intrusion • Silicon-contaminated HO2S 2 • Fuel-contaminated engine oil • Incorrect fuel pressure-Refer to **Fuel System Diagnosis** . • Rich fuel injectors-Refer to **Fuel Injector Balance Test with Special Tool** . Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 9**
9	Inspect for poor connections at the harness connector of the HO2S 2. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 11**
10	Inspect for poor connections at the harness connector of the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
11	Replace the HO2S 2. Refer to **Heated Oxygen Sensor Replacement - Position 2** . Did you complete the replacement?	-	Go to **Step 13**	-
12	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
13	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 14**

14	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P1171

System Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The engine control module (ECM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the ECM operates in Open Loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperatures and Closed Loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream. Low HO2S voltage indicates a lean exhaust stream.

If the ECM detects an HO2S voltage that stays below a specified value, DTC P1171 will set.

Conditions for Running the DTC

- DTCs P0122, P0123, P0131, P0132, P0133, P0134 are not set.
- The ECT Sensor parameter is more than 20°C (68°F).
- The Engine Run Time parameter is more than 20 seconds.
- The Loop Status parameter is closed.
- The Power Enrichment parameter is active.

Conditions for Setting the DTC

The ECM detects that the HO2S 1 parameter is less than 300 mV for 5 seconds.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC

- A current DTC Last Test Failed clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other

non-emission related diagnostic.
- Clear the DTC with a scan tool.

Diagnostic Aids

- A restricted fuel filter can supply adequate amounts of fuel at idle, but may not be able to supply enough fuel during heavy acceleration. Water or alcohol in the fuel may cause low HO2S 1 voltage during acceleration.
- High resistance in the ignition coil control circuits may cause this condition.
- Manifold absolute pressure (MAP) sensor-High resistance in the MAP sensor circuits may cause this condition.
- Inspect for faulty or plugged fuel injectors.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: When the system is operating correctly, the HO2S 1 voltage should toggle above and below the bias voltage. You may need to operate the vehicle within the Freeze Frame conditions and Conditions for Setting the DTC in order to duplicate the malfunction that was detected by the ECM.

4: The specified value is what is measured on a correctly operating system.

DTC P1171 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Control Module (ECM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Operate the engine at normal operating temperature. 2. Operate the engine above 1,200 RPM for 2 minutes. 3. Observe the heated oxygen sensor (HO2S) 1 voltage parameter with a scan tool. Does the scan tool indicate that the heated oxygen sensor (HO2S) 1 voltage is less than the specified value?	300 mV	Go to **Step 4**	Go to **Step 3**
	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds.			

3	3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the HO2S sensor. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the high signal circuit of the HO2S 1 on the vehicle harness side to a good ground with a DMM. Does the voltage measure within the specified value?	350-550 mV	Go to **Step 6**	Go to **Step 5**
5	Test the HO2S 1 high signal circuit for a short to ground or a short to the HO2S 1 low signal circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 8**
6	1. The HO2S 1 is detecting a lean condition or may be contaminated. Inspect for the following conditions: • HO2S connector water intrusion • Silicon-contaminated HO2S • An exhaust leak between the HO2S 1 and the engine. Refer to **Exhaust Leakage** in Engine Exhaust. • Vacuum leaks • Incorrect fuel pressure-Refer to **Fuel System Diagnosis** . • Lean fuel injectors-Refer to **Fuel Injector Balance Test with Special Tool** . 2. Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 7**
7	Inspect for poor connections at the harness connector of the HO2S 1 sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 9**

8	Inspect for poor connections at the harness connector of the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 10**
9	**IMPORTANT:** **Before replacing the HO2S, determine and remove any source of contamination.** Replace the HO2S 1. Refer to **Heated Oxygen Sensor Replacement - Position 1** .Did you complete the replacement?	-	Go to **Step 11**	-
10	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 11**	-
11	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 12**
12	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P1516

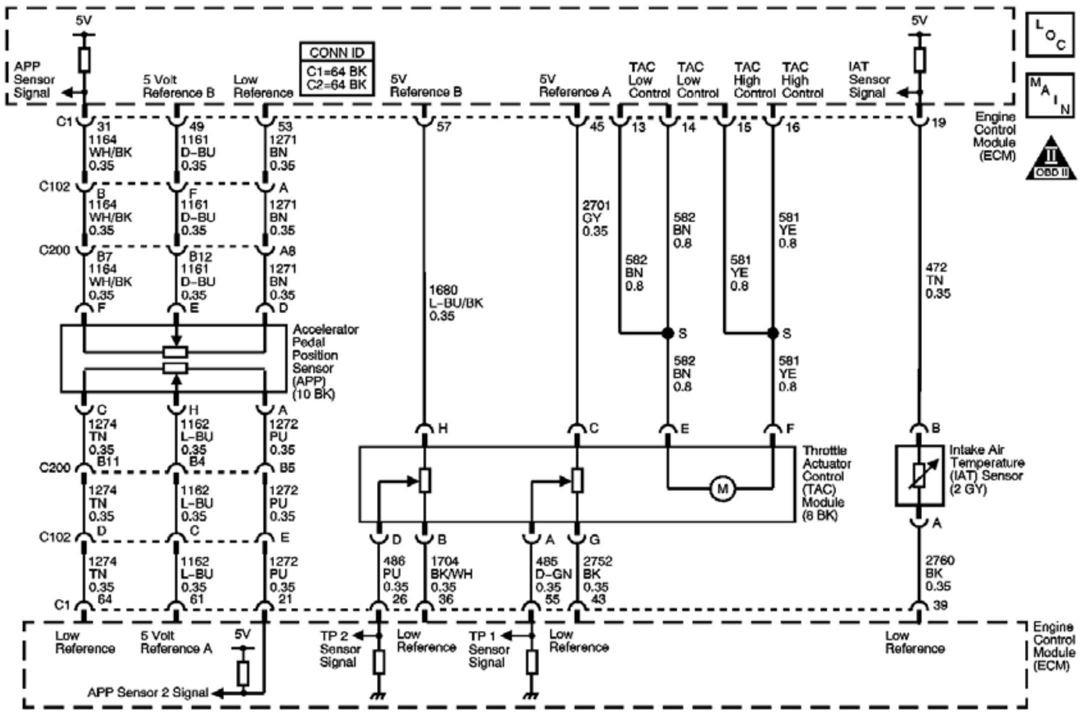


Fig. 1: DTC P1516 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The commanded throttle position is compared to the actual throttle position. Both values should be within a calibrated range of each other. The engine control module (ECM) continuously monitors the commanded and actual throttle positions. If the ECM detects that the difference in these values are greater than the calibrated range, DTC 1516 will set.

Conditions for Running the DTC

- The ignition is ON.
- The ignition voltage is greater than 8 volts.
- The system is not in Battery Saver Mode.
- The engine is running.
- DTC P0068 is not set.

Conditions for Setting the DTC

The difference between the predicted and the actual throttle position is more than a calibrated amount.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

8: The throttle valve is spring loaded in a slightly open position and should move in either direction without binding. The throttle valve should always be under spring pressure.

11: When the ignition is turned ON, the ECM operates the throttle control motor to verify the integrity of the system prior to start-up. This can be seen by the momentary flash of the test lamp as the ignition is turned ON.

DTC P1516 Circuit

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Are DTCs P0120, P0220, P2120, P2125, P2135, P2138, P1275 and P1280 also set?	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	**IMPORTANT:** **The throttle angle and pedal angle may not correspond during this procedure.** 1. Turn ON the ignition with the engine OFF. 2. Observe the TP sensor 1 and 2 angle parameters.		

	3. Apply and release the accelerator pedal several times. Does the TP sensor 1 and 2 angle parameters increase as the pedal is applied and decrease as the pedal is released?	Go to **Step 4**	Go to **Step 5**
4	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 5**	Go to **Intermittent Conditions**
5	1. Turn ON the ignition, with the engine OFF. 2. Probe both sides of the ETC fuse with a test lamp. Does the test lamp illuminate on both sides of the fuse?	Go to **Step 6**	Go to **Step 16**
6	1. Turn OFF the ignition. 2. Probe both sides of the ETC fuse with a test lamp. Does the test lamp illuminate on both sides of the fuse?	Go to **Step 22**	Go to **Step 7**
7	1. Turn OFF the ignition. 2. Disconnect the ECM connector containing the ETC ignition 1 voltage circuit. 3. Turn ON the ignition. 4. Probe the ignition 1 voltage circuit with a test lamp. Does the test lamp illuminate?	Go to **Step 8**	Go to **Step 23**
8	1. Turn OFF the ignition. 2. Inspect the throttle body for the following conditions: • A throttle valve that is NOT in the rest position • A throttle valve that is binding open or closed • A throttle valve that is free to move open or closed WITHOUT spring pressure. Refer to Diagnostic Aids Did you find any of these conditions with the throttle		

	body?	Go to **Step 24**	Go to **Step 9**
9	**IMPORTANT:** **The test lamp may momentarily flash when testing these circuits. This is considered normal.** 1. Disconnect the throttle body harness connector. 2. Turn ON the ignition, with the engine OFF. 3. Probe the TAC motor control 1 and 2 circuits with the test lamp connected to ground. Did the test lamp illuminate and remain illuminated on either circuit?	Go to **Step 13**	Go to **Step 10**
10	**IMPORTANT:** **The test lamp may momentarily flash when testing these circuits. This is considered normal.** Probe the TAC motor control 1 and 2 circuits with the test lamp connected to battery positive.Did the test lamp illuminate and remain illuminated on either circuit?	Go to **Step 14**	Go to **Step 11**
11	1. Turn OFF the ignition. 2. Connect the test lamp between the TAC motor control 1 and battery ground. 3. Observe the test lamp as you turn ON the ignition. Does the test lamp flash ON and then turn OFF?	Go to **Step 12**	Go to **Step 15**
12	1. Turn OFF the ignition. 2. Connect a test lamp between the TAC motor control 2 circuit and battery ground. 3. Observe the test lamp as you turn ON the ignition. Does the test lamp flash ON and then OFF?	Go to **Step 18**	Go to **Step 15**
13	1. Turn OFF the ignition. 2. Disconnect the ECM connector that contains the TAC motor control circuits. 3. Turn ON the ignition, with the engine OFF. 4. Probe the TAC motor control 1 and 2 circuits with the test lamp connected to ground. Does the test lamp illuminate?	Go to **Step 20**	Go to **Step 19**
	1. Turn OFF the ignition. 2. Disconnect the ECM connector that contains the TAC motor control circuits.		

14	3. Probe the TAC motor control 1 and 2 circuits with the test lamp connected to battery positive. Does the test lamp illuminate?	Go to **Step 21**	Go to **Step 19**
15	1. Turn OFF the ignition. 2. Disconnect the ECM connector that contains the TAC motor control circuits. 3. Test the TAC motor control 1 and 2 circuits for an open or for high resistance. 4. Repair the circuit as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 26**	Go to **Step 19**
16	Test the ETC ignition 1 voltage circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 26**	Go to **Step 17**
17	Test the motor control 1 circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 26**	Go to **Step 24**
18	Test for a poor connection or terminal tension at the throttle body connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 26**	Go to **Step 24**
19	Test for a poor connection or terminal tension at the ECM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 26**	Go to **Step 22**
20	Repair the short to voltage on the circuit where the test lamp remained illuminated. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 26**	-
21	Repair the short to ground on the circuit where the test lamp remained illuminated. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 26**	-
22	Repair the short to voltage on the ETC ignition 1 voltage circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 26**	-
23	Repair the open or the high resistance in the ignition 1 voltage circuit. Refer to **Wiring Repairs** in Wiring Systems.		

	Did you complete the repair?	Go to **Step 26**	-
24	Replace the throttle body assembly. Refer to **Throttle Body Assembly Replacement** . Did you complete the replacement?	Go to **Step 26**	-
25	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	Go to **Step 26**	-
26	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 27**
27	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P1599

Circuit Description

The engine control module (ECM) has the ability to set a diagnostic trouble code (DTC) if the engine stalls when the ignition has not been turned OFF. This DTC may aid in intermittent diagnosis of a customer complaint of intermittent engine stall. The scan tool Failure Record information can be duplicated under the same stall conditions in an attempt to reproduce the occurrence. Since DTC P1599 is a type D DTC, the ECM will not command the malfunction indicator lamp (MIL) ON. This DTC can set due to a driver error. For example, a vehicle equipped with a manual transaxle in which the clutch was release too quickly causing the engine to stall, will set DTC P1599.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

- The engine is in Run mode.
- Ignition voltage is present at the ECM.
- CKP pulses at ECM are not detected.

Action Taken When the DTC Sets

The control module records the operating conditions at the time the diagnostic fails. The first time the

diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the Message/DTC

- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the DTC with a scan tool.

Diagnostic Aids

- Since many things can cause a stalling condition use the snapshot taken of DTC P1599 to compare the values taken when the DTC set to the Typical Scan Data Value table. Look for conditions that could have caused the stall and how long ago the stall occurred. If other DTCs are set, especially DTC P0336, diagnose those DTCs first.
- DTC P1599 may be set if the engine speed drops below 400 RPM, near stall, and then recovers.
- If the condition is intermittent, refer to **Intermittent Conditions** .
- Verify drive did not induce the stall condition.

DTC P1599 Circuit

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Symptoms - Engine Controls**

DTC P1640

Circuit Description

The engine control module (ECM) contains an output driver module (ODM) that controls four devices:

- The A/C relay
- The main relay
- The EVAP vent solenoid
- The EVAP purge solenoid

The ODM provides grounded output control of the above devices through separate control circuits. The ODM monitors the voltage level at each of the control circuits when the device is commanded ON or OFF. Each ODM output has an internal feedback circuit that connects to the ECM microprocessor. The ECM monitors voltage through the ignition 1 voltage circuit. Excessive voltage or current may cause damage to the ECM. If the ODM detects excessive current or voltage on an output control circuit, this DTC will set.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

- The ODM has detected a voltage greater than 33 volts.

  OR

  Excessive current is detected on any circuit to the ODM.
- The above condition is present for 6 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- A condition with the charging system may cause this DTC to set. Refer to **Diagnostic System Check - Engine Electrical** in Engine Electrical.
- For an intermittent condition, refer to **Intermittent Conditions** .

DTC P1640 Circuit

Step	Action	Yes	No

Schematic Reference:Engine Controls Schematics
Connector End View Reference: Engine Control Module (ECM) Connector End Views or Engine Controls Connector End Views

1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Is DTC P0446, P0560, P0563 or P1441 set?	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	Observe the General Info - Output Data List with a scan tool. Do any parameters indicate a fault present?	Go to **Step 4**	Go to **Step 5**
4	Test for a short to voltage on the control circuit of the component that indicated a fault. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 6**	Go to **Step 5**
5	Replace the engine control module (ECM). Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	Go to **Step 6**	-
6	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Does the DTC fail this ignition?	Go to **Step 2**	Go to **Step 7**
7	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P1670

Circuit Description

The engine control module (ECM) contains an output driver module (ODM) that controls the fuel pump relay. The ODM monitors the voltage level at the control circuit when the device is commanded ON or OFF. The ODM output has an internal feedback circuit that connects to the ECM microprocessor. The ECM monitors voltage through the ignition 1 voltage circuit. Excessive voltage or current may cause damage to the ECM. If the ODM detects excessive current or voltage on the output control circuit, this diagnostic trouble code (DTC) will set.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

- The ODM has detected a voltage greater than 33 volts.

  OR

- Excessive current is detected on any circuit to the ODM.
- The above conditions are present for 6 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- A condition with the charging system may cause this DTC to set. Refer to **Diagnostic System Check - Engine Electrical** in Engine Electrical.
- For an intermittent condition, refer to **Intermittent Conditions** .

DTC P1670 Circuit

Step	Action	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Control Module (ECM) Connector End Views** or **Engine Controls Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	Is DTC P0560 set?	Go to **Diagnostic**	

2		**System Check - Engine Electrical** in Engine Electrical	Go to **Step 3**
3	Observe the General Info - Output Data List with a scan tool. Do any parameters indicate a fault present?	Go to **Step 4**	Go to **Step 5**
4	Test for a short to voltage on the control circuit of the component that indicated a fault. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 6**	Go to **Step 5**
5	Replace the engine control module (ECM). Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	Go to **Step 6**	-
6	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Does the DTC fail this ignition?	Go to **Step 2**	Go to **Step 7**
7	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P1682

Circuit Description

The electronic throttle control (ETC) system uses an ignition voltage supply separate from the engine control module (ECM) supply. If the ECM detects a voltage difference between the two circuits, this diagnostic trouble code (DTC) will set.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

The ETC ignition voltage is less than 10 volts for more than 10 seconds.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.

- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC

- A current DTC Last Test Failed clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- Clear the DTC with a scan tool.

DTC P1682 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Control Module (ECM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Observe the Freeze Frame/Failure Records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF for 10 seconds. Does the DTC fail this ignition?	-	Go to **Step 3**	Go to **Intermittent Conditions**
3	With a test lamp connected to ground, probe both sides of the ETC fuse. Does the test lamp illuminate on both sides of the fuse?	-	Go to **Step 5**	Go to **Step 4**
4	Does the test lamp illuminate on one side of the fuse?	-	Go to **Step 6**	Go to **Main Relay Diagnosis**
5	1. Turn OFF the ignition. 2. Disconnect the engine control module (ECM). 3. Test both ETC ignition circuits for an open or for a high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 7**
	1. Turn OFF the ignition.			

6	2. Disconnect the ECM. 3. Test both ETC ignition circuits for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. 4. Replace the fuse if necessary. Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 7**
7	Test for an intermittent and for a poor connection at the ECM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 8**
8	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 9**	-
9	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Does the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 10**
10	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2101

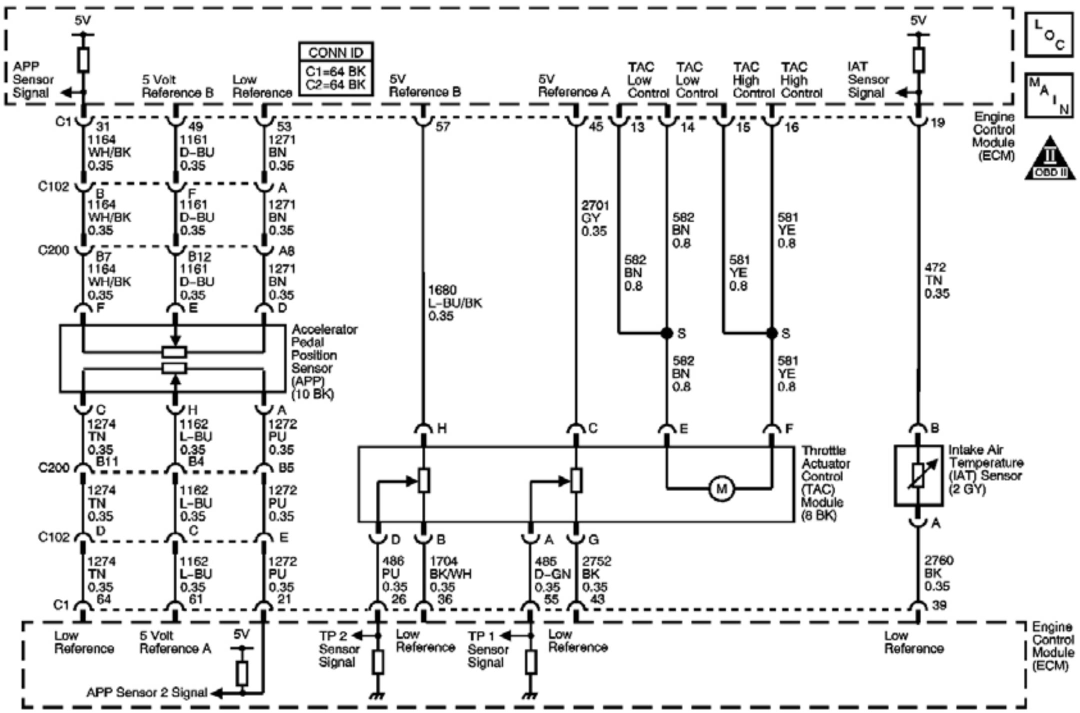


Fig. 2: DTC P2101 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The commanded throttle position is compared to the actual throttle position. Both values should be within a calibrated range of each other. The engine control module (ECM) continuously monitors the commanded and actual throttle positions. If the ECM detects that the difference in these values are greater than the calibrated range, DTC P2101 will set.

Conditions for Running the DTC

- The ignition is ON.
- The system is not in Battery Saver Mode.
- DTC P0068 is not set.
- The battery voltage is more than 8 volts.

Conditions for Setting the DTC

The difference between the predicted and the actual throttle position is more than a calibrated amount.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Inspect for a condition in which the throttle valve may have been held open.
- Inspect for conditions in which ice may have formed in the throttle bore.
- If the condition is intermittent, refer to **Intermittent Conditions** .

Test Description

The number below refers to the step number on the diagnostic table.

> **3:** The throttle valves are spring loaded in a slightly open position and should move in either direction without binding. The throttle valves should always be under spring pressure.

DTC P2101 Circuit

Step	Action	Value	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Observe the DTC information. Are DTCs P0120, P0220 or P2135 also set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
	1. Turn OFF the ignition. 2. Visually inspect the throttle body for the			

3	following conditions: • Throttle valves that are NOT in the rest position • Throttle valves that are binding open or closed • Throttle valves that are free to move open or closed WITHOUT spring pressure-Refer to Diagnostic Aids. Did you find any of these conditions with the throttle body?	-	Go to **Step 11**	Go to **Step 4**
4	**IMPORTANT:** **Disconnecting the throttle body connector will cause additional codes to set.** 1. Disconnect the throttle body connector. 2. Turn ON the ignition, with the engine OFF. 3. Measure the voltage of the TAC motor control 1 and TAC motor control 2 circuits of the throttle actuator motor with a DMM connected to ground. Is the voltage more than the specified value for both circuits?	11 V	Go to **Step 8**	Go to **Step 5**
5	Is the voltage less than the specified value?	2 V	Go to **Step 7**	Go to **Step 6**
6	Test the TAC motor control circuit that measured above the specified value for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 8**
7	Test the TAC motor control circuit that measured below the specified value for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 10**
8	Test the TAC motor control 1 and TAC motor control 2 circuits for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 9**
9	Test for a poor connection or terminal tension at the throttle body connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 11**

10	Test for a poor connection or terminal tension at the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
11	Replace the throttle body assembly. Refer to **Throttle Body Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
12	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
13	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 14**
14	Observe the Capture Info with a scan tool. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2119

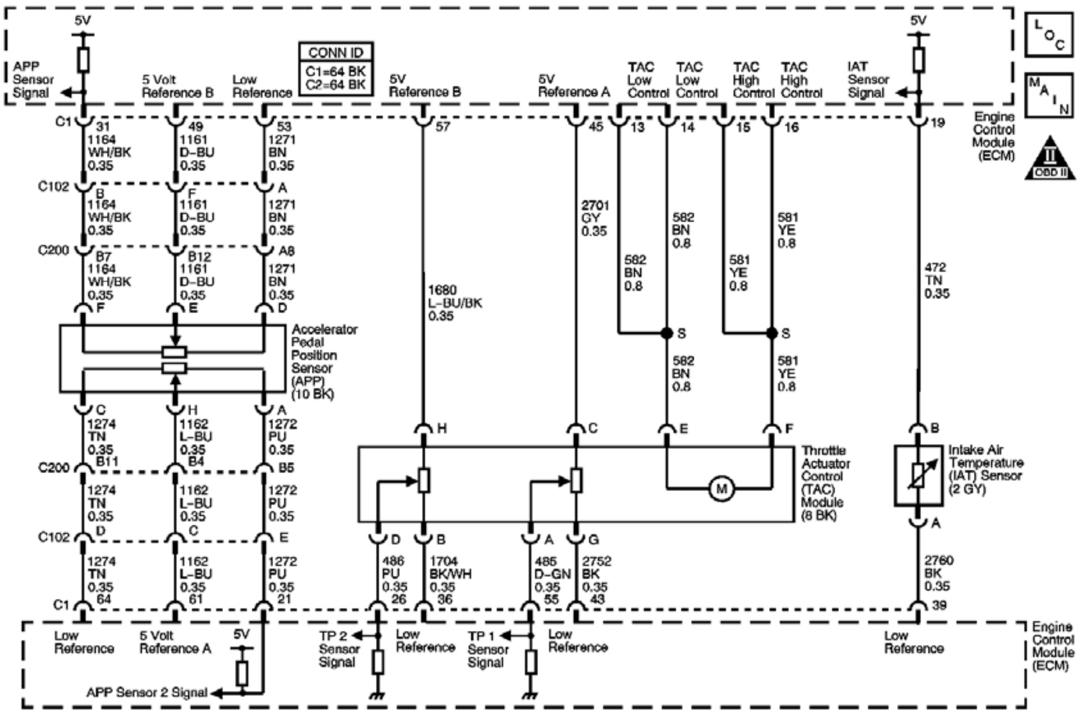


Fig. 3: DTC P2119 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

During Battery Saver Mode, the engine control module (ECM) determines if the throttle plate is returning to the correct de-energized position. If the ECM determines the throttle plate is not at the correct position during Battery Saver Mode, this DTC is set.

Conditions for Running the DTC

- The ignition is ON and the engine is OFF.
- The ignition voltage is more than 8.5 volts.
- The Battery Saver Mode is active.

Conditions for Setting the DTC

The ECM detects that the throttle plate is not at the correct position during Battery Saver Mode.

Action Taken When the DTC Sets

The PCM stores conditions which were present when the DTC set as Failure Records only. This information will not be stored as Freeze Frame Records.

Conditions for Clearing the MIL/DTC

- The DTC becomes history when the conditions for setting the DTC are no longer present.
- The history DTC clears after 40 malfunction free warm-up cycles.
- The PCM receives a clear code command from the scan tool.

Diagnostic Aids

Inspect for mechanical conditions or binding that may be temperature related. Components may not move freely in extreme heat or cold due to the presence of contaminants or ice formation.

Test Description

The number below refers to the step number on the diagnostic table.

> **8:** More than one TAC system related DTC may set. This is due to the many redundant tests run continuously on this system. Locating and repairing one individual condition may correct more than one DTC. Keep this in mind when reviewing captured DTC info.

DTC P2119 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Are DTCs P0120 and P0220 also set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	1. Turn OFF the ignition for 15 seconds. 2. Turn ON the ignition, with the engine OFF. 3. Ensure that the pedal is in the rest position for at least 20 seconds. 4. Observe the indicated throttle position parameter with a scan tool. Does the scan tool indicate that the throttle position is within the specified values?	32-44%	Go to **Step 6**	Go to **Step 4**
4	Remove the throttle body assembly. Refer to **Throttle Body Assembly Replacement** . Did you find any obstructions preventing the throttle plate from returning to the default position?	-	Go to **Step 5**	Go to **Step 6**
5	Remove the obstruction.	-		

	Did you complete the action?		Go to **Step 7**	-
6	Replace the throttle body assembly. Refer to **Throttle Body Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 7**	-
7	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 8**
8	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2120

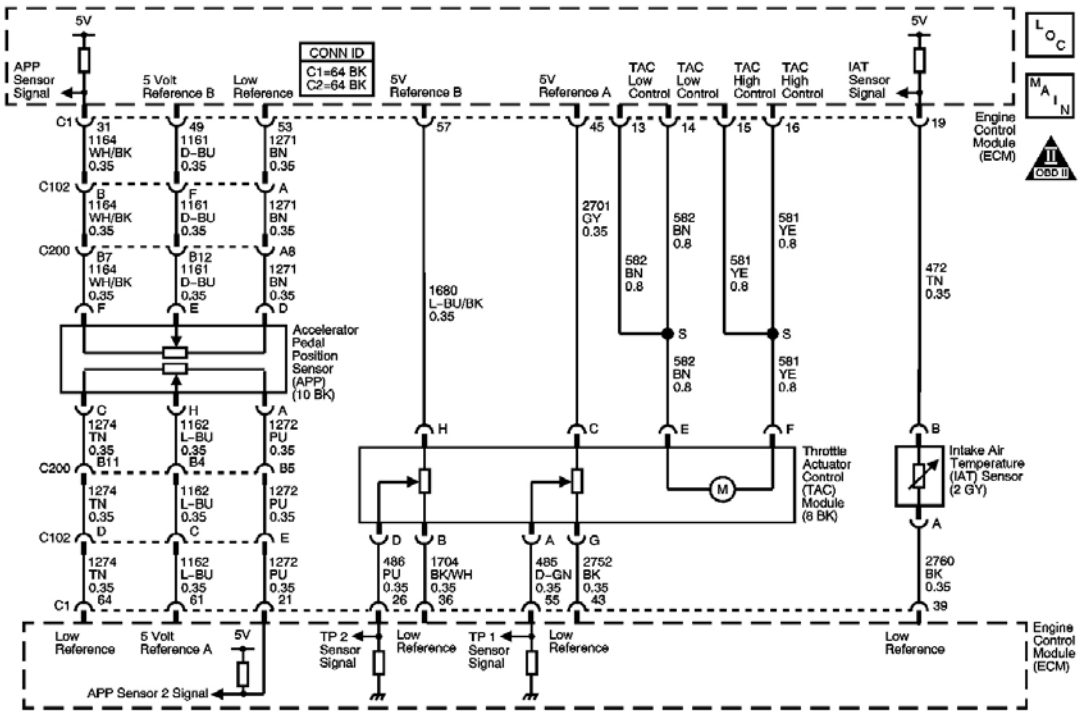


Fig. 4: DTC P2120 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The accelerator pedal position (APP) sensors 1 and 2 are located within the accelerator pedal assembly. Each sensor has the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The APP sensor provides the engine control module (ECM) with a signal voltage proportional to accelerator pedal movement. The APP sensor 1 signal voltage at rest position is near the low reference and increases as the pedal is actuated. The APP sensor 2 signal voltage at rest position is also near the low reference and increases as the pedal is actuated. When the ECM detects that the APP sensor 1 signal voltage is outside the predicted range, DTC P1275 sets.

Conditions for Running the DTC

- The ignition is ON.
- The ignition voltage is greater than 5.25 volts.
- DTC P0651 is not set.

Conditions for Setting the DTC

The APP sensor 1 voltage is less than 0.13 volts or more than 4.87 volts.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P2120 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the accelerator pedal position (APP) sensor 1 voltage with the accelerator pedal in the rest position with a scan tool. Does the scan tool indicate voltage less than the first value or greater than the second value?	0.13 V 4.87 V	Go to **Step 5**	Go to **Step 3**
3	Is DTC P2138 also set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 4**
4	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Does the DTC fail this ignition?	-	Go to **Step 5**	Go to **Intermittent Conditions**
5	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the APP sensor 1 voltage parameter with a scan tool. Does the scan tool indicate that the voltage is less than the specified value?	0.13 V	Go to **Step 6**	Go to **Step 11**
6	1. Connect a fused jumper wire between the APP sensor 1 5-volt reference circuit and the APP sensor 1 signal circuit at the accelerator pedal harness connector. 2. Observe the APP sensor 1 voltage parameter with a scan tool.	4.8 V		

	Does the scan tool indicate that the APP sensor 1 voltage is more than the specified value?		Go to **Step 7**	Go to **Step 8**
7	1. Turn OFF the ignition for 90 seconds. 2. Allow the engine control module (ECM) to completely power down. This can be verified by the loss of communication on the scan tool. 3. Measure the resistance from the low reference circuit of the APP sensor to the ECM case with the DMM. Is the resistance less than the specified value?	5 ohm	Go to **Step 17**	Go to **Step 13**
8	Measure the voltage of the APP sensor 1 5-volt reference circuit with a DMM. Does the DMM indicate that the voltage is more than the specified value?	4.8 V	Go to **Step 10**	Go to **Step 9**
9	Does the DMM indicate that the voltage is less than the specified value on the APP sensor 1 5-volt reference circuit?	5 V	Go to **Step 14**	Go to **Step 16**
10	Test the APP sensor 1 signal circuit for an open or for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 12**
11	Test the APP sensor 1 signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 19**
12	Test the APP sensor 1 signal circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 19**
13	Test the APP sensor 1 low reference circuit for an open or for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 19**
14	Test the APP sensor 1 5-volt reference circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 15**
15	Test the APP sensor 1 5-volt reference circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 19**
	Test the APP sensor 1 5-volt reference circuit for a			

16	short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	-
17	Inspect for poor connections at the accelerator pedal harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 18**
18	Replace the accelerator pedal assembly. Refer to **Accelerator Pedal Position Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 21**	-
19	Inspect for poor connections at the ECM harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 20**
20	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 21**	-
21	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 22**
22	**IMPORTANT:** **Be aware that repairing one individual condition may correct more than one DTC.** Observe the Capture Info with a scan tool.Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2122

Circuit Description

The accelerator pedal position (APP) sensor 1 and sensor 2 are located within the accelerator pedal assembly. Each sensor has the following circuits:

- A 5-volt reference circuit

- A low reference circuit
- A signal circuit

This provides the engine control module (ECM) with a signal voltage proportional to accelerator pedal movement. The APP sensor 1 signal voltage at rest position is near the low reference and increases as the pedal is actuated. The APP sensor 2 signal voltage at rest position is also near the low reference and increases as the pedal is actuated. If the ECM detects the APP sensor 1 signal voltage is not within the predicted range, DTC P2122 sets.

Conditions for Running the DTC

- The ignition is ON.
- The ignition voltage is more than 5.23 volts.
- DTC P0641 is not set.

Conditions for Setting the DTC

The ECM detects that the APP sensor 1 voltage is less than 0.13 volts.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P2122 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-		Go to **Diagnostic System Check -**

			Go to **Step 2**	**Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the accelerator pedal position (APP) sensor 1 voltage with the accelerator pedal in the rest position, with a scan tool. Is the APP sensor 1 voltage parameter less than the specified value?	0.13 V	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal connector. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the 5-volt reference circuit of APP sensor 1 to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Does the DMM indicate voltage within the specified range?	4.8-5.2 V	Go to **Step 5**	Go to **Step 6**
5	1. Connect a fused jumper wire between the 5-volt reference circuit and the signal circuit of APP sensor 1. 2. Observe the APP sensor 1 voltage parameter with a scan tool. Is the APP sensor 1 voltage parameter within the specified range?	4.8-5.2 V	Go to **Step 11**	Go to **Step 7**
	Test the APP 5-volt reference circuit for the following conditions: • An open • A short to ground			

6	• High resistance Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 8**
7	Test the APP sensor 1 signal circuit for the following conditions: • An open • A short to ground • High resistance Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 8**
8	Test for an intermittent and for a poor connection at the APP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
9	Test for an intermittent and for a poor connection at the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 10**
10	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** Did you complete the replacement?	-	Go to **Step 12**	-
11	Replace the accelerator pedal assembly. Refer to **Accelerator Pedal Position Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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.	-		

	Did the DTC fail this ignition?		Go to **Step 2**	Go to **Step 13**
13	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2123

Circuit Description

The accelerator pedal position (APP) sensor 1 and sensor 2 are located within the accelerator pedal assembly. Each sensor has the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

This provides the engine control module (ECM) with a signal voltage proportional to accelerator pedal movement. The APP sensor 1 signal voltage at rest position is near the low reference and increases as the pedal is actuated. The APP sensor 2 signal voltage at rest position is also near the low reference and increases as the pedal is actuated. If the ECM detects the APP sensor 1 signal voltage is not within the predicted range, DTC P2123 sets.

Conditions for Running the DTC

- The ignition is ON.
- The ignition voltage is more than 5.23 volts.
- DTC P0641 is not set.

Conditions for Setting the DTC

The ECM detects that the APP sensor 1 voltage is more than 4.87 volts.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles

that the diagnostic runs and does not fail.

- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P2123 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the APP sensor 1 voltage parameter with the accelerator pedal in the rest position with a scan tool. Is the APP sensor 1 voltage parameter more than the specified value?	4.8 V	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition ?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the APP sensor 1 voltage parameter with a scan tool. Is the APP sensor 1 voltage parameter more than the specified value?	0 V	Go to **Step 9**	Go to **Step 5**
	Measure the voltage from the 5-volt reference circuit of accelerator pedal position (APP) sensor 1			

5	to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Does the DMM indicate voltage within the specified range?	4.8-5.2 V	Go to **Step 6**	Go to **Step 7**
6	Measure the voltage from the 5-volt reference circuit to the low reference circuit of APP sensor 1 with a DMM. Refer to **Circuit Testing** in Wiring Systems. Does the DMM indicate voltage within the specified range?	4.8-5.2 V	Go to **Step 15**	Go to **Step 8**
7	Test the APP sensor 1 5-volt reference circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 10**
8	Test the APP sensor 1 low reference circuit for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 12**
9	Test the APP sensor 1 signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 10**
10	Test for shorted terminals and for a poor connection at the APP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 11**
11	Test for shorted terminals and for a poor connection at the engine control module (ECM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 14**
12	Test for an intermittent and for a poor connection at the APP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 13**
13	Test for an intermittent and for a poor connection at the ECM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 14**
14	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 16**	-

15	Replace the accelerator pedal assembly. Refer to **Accelerator Pedal Position Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 16**	-
16	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 17**
17	Observe the capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2125

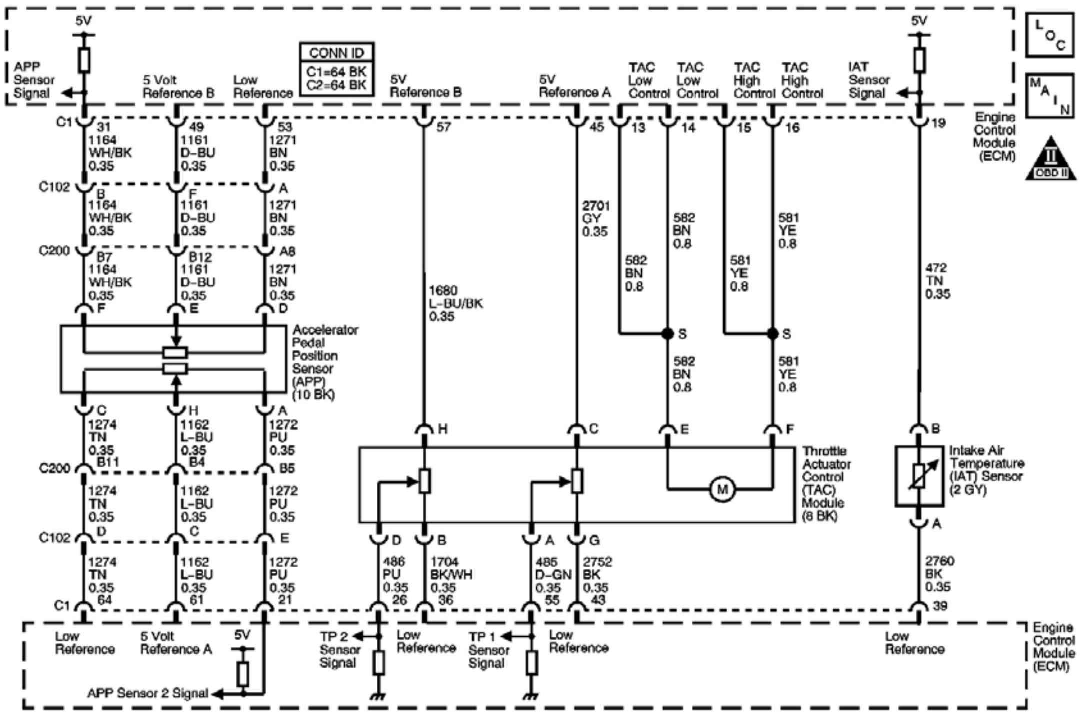


Fig. 5: DTC P2125 Circuit

Courtesy of GENERAL MOTORS CORP.

Circuit Description

The accelerator pedal position (APP) sensors 1 and 2 are located within the accelerator pedal assembly. Each sensor has the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The APP sensor provides the engine control module (ECM) with a signal voltage proportional to accelerator pedal movement. The APP sensor 1 signal voltage at rest position is near the low reference and increases as the pedal is actuated. The APP sensor 2 signal voltage at rest position is also near the low reference and increases as the pedal is actuated. When the ECM detects that the APP sensor 2 signal voltage is outside the predicted range, DTC P2125 will set.

Conditions for Running the DTC

- The ignition is ON.
- The ignition voltage is greater than 5.25 volts.
- DTC P0641 is not set.

Conditions for Setting the DTC

The APP sensor 2 voltage is less than 0.13 volts, or more than 4.87 volts.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P2125 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the accelerator pedal position (APP) sensor 2 voltage with the accelerator pedal in the rest position with a scan tool. Does the scan tool indicate that the voltage is less than the first value or greater than the second value?	0.13 V 4.87 V	Go to **Step 5**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Does the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the APP sensor 2 voltage parameter with a scan tool. Does the scan tool indicate that the voltage is more than the specified value?	4.8 V	Go to **Step 5**	Go to **Step 12**
5	Probe the APP sensor 2 signal circuit with a test lamp connected to ground. Does the test lamp illuminate?	-	Go to **Step 12**	Go to **Step 6**
6	Observe the APP sensor 2 parameter with the test lamp still connected to the APP sensor 2 signal circuit. Does the scan tool indicate that the voltage is less than the specified value?	0.13 V	Go to **Step 7**	Go to **Step 11**

7	Measure the voltage of the APP sensor 2 5-volt reference circuit with a DMM. Does the DMM indicate that the voltage is more than the specified value?	4.8 V	Go to **Step 8**	Go to **Step 10**
8	1. Turn OFF the ignition for 90 seconds. 2. Allow the engine control module (ECM) to completely power down. This can be verified by the loss of communication on the scan tool. 3. Measure the resistance from the low reference circuit of the APP sensor to the ECM case with the DMM. Is the resistance less than the specified value?	5 ohm	Go to **Step 9**	Go to **Step 14**
9	Test the APP sensor low reference circuit for a short to ground. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 18**
10	Does the DMM indicate that the voltage is less than the specified value on the APP sensor 2 5-volt reference circuit?	5 V	Go to **Step 14**	Go to **Step 16**
11	Test the APP sensor 2 signal circuit for an open or for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 13**
12	Test the APP sensor 2 signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 20**
13	Test the APP sensor 2 signal circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 20**
14	Test the APP sensor 2 low reference circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 20**
15	Test the APP sensor 2 5-volt reference circuit for an open or for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 16**
16	Test the APP sensor 2 5-volt reference circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 20**
	Test the APP sensor 2 5-volt reference circuit for a			

17	short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	-
18	Inspect for poor connections at the accelerator pedal harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 19**
19	Replace the accelerator pedal assembly. Refer to **Accelerator Pedal Position Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 22**	-
20	Inspect for poor connections at the ECM harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 21**
21	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 22**	-
22	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 23**
23	**IMPORTANT:** **Be aware that repairing one individual condition may correct more than one DTC.** Observe the Capture Info with a scan tool.Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2127

Circuit Description

The accelerator pedal position (APP) sensor 1 and sensor 2 are located within the accelerator pedal assembly. Each sensor has the following circuits:

- A 5-volt reference circuit

- A low reference circuit
- A signal circuit

This provides the engine control module (ECM) with a signal voltage proportional to accelerator pedal movement. The APP sensor 1 signal voltage at rest position is near the low reference and increases as the pedal is actuated. The APP sensor 2 signal voltage at rest position is also near the low reference and increases as the pedal is actuated. If the ECM detects that the APP sensor 2 signal voltage is not within the predicted range, DTC P2127 sets

Conditions for Running the DTC

- The ignition is ON.
- The ignition voltage is more than 5.23 volts.
- DTC P0641 is not set.

Conditions for Setting the DTC

The ECM detects that the APP sensor 2 voltage is less than 0.13 volts.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P2127 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-		Go to **Diagnostic System Check -**

			Go to **Step 2**	**Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the APP sensor 2 voltage with the accelerator pedal in the rest position with a scan tool. Is APP sensor 2 voltage parameter less than the specified value?	0.13 V	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the APP sensor 2 voltage parameter with a scan tool. Does the scan tool indicate voltage at the specified value?	5 V	Go to **Step 5**	Go to **Step 6**
5	Measure the voltage of the accelerator pedal position (APP) sensor 2 5-volt reference circuit, with a DMM. Does the DMM indicate voltage within the specified range?	4.8-5.2 V	Go to **Step 8**	Go to **Step 10**
6	Test the APP sensor 2 signal circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 10**
7	Test the APP sensor 2 5-volt reference circuit for the following conditions: • An open • A short to ground • High resistance	-		

	Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?		Go to **Step 12**	Go to **Step 10**
8	Test for an intermittent and for a poor connection at the accelerator pedal connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
9	Replace the accelerator pedal assembly. Refer to **Accelerator Pedal Position Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
10	Test for an intermittent and for a poor connection at the at the engine control module (ECM) harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
11	Replace the ECM. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 13**
13	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2128

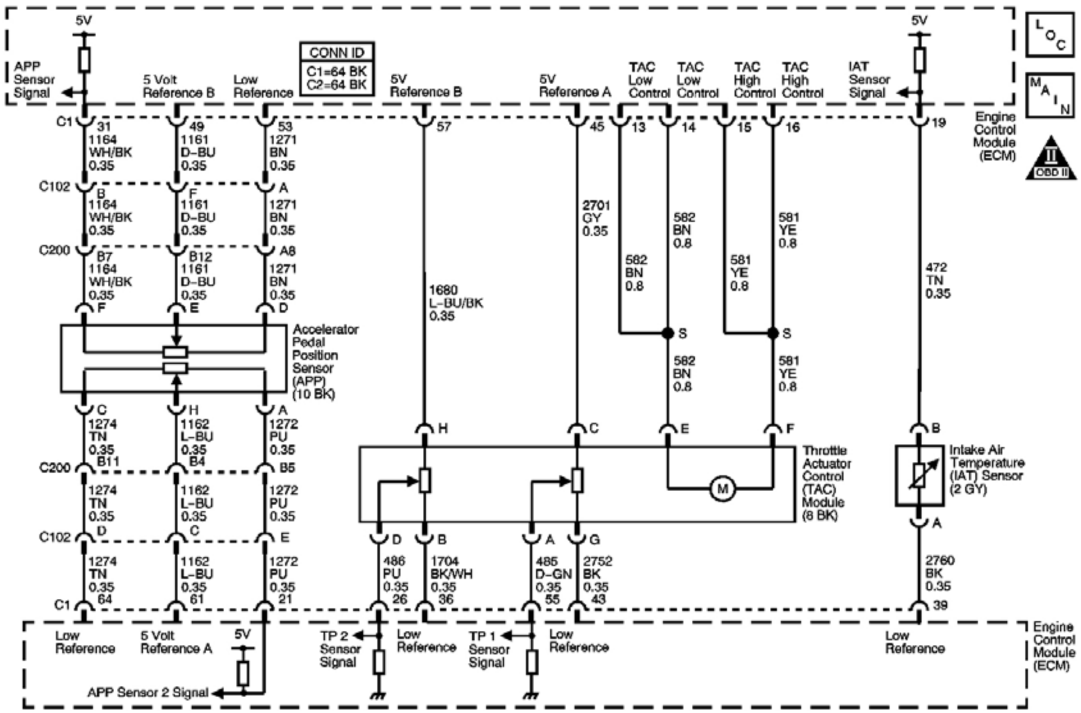


Fig. 6: DTC P2128 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The accelerator pedal position (APP) sensors 1 and 2 are located within the accelerator pedal assembly. Each sensor has the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The APP sensor provides the engine control module (ECM) with a signal voltage proportional to accelerator pedal movement. The APP sensor 1 signal voltage at rest position is near the low reference and increases as the pedal is actuated. The APP sensor 2 signal voltage at rest position is also near the low reference and increases as the pedal is actuated.

Conditions for Running the DTC

- The battery voltage is more than 5.25 volts.
- The ignition is ON.

Conditions for Setting the DTC

The voltage difference between APP sensor 1 and APP sensor 2 exceeds a predetermined value.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

The ECM compares the signal of each of the APP sensor to each other throughout the entire range of operation. Clear the DTCs and actuate the pedal through the entire range with the ignition ON and the engine OFF.

Use the J 35616 Connector Test Adapter Kit for any test that requires probing the ECM harness connector or a component harness connector. Using this kit will prevent damage to the harness connector terminals.

For intermittent conditions, refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems.

Test Description

The number below refers to the step number on the diagnostic table.

> **2:** Any circuit faults on either APP sensor 1 or APP sensor 2 will set one of the DTCs listed. Refer to the appropriate table for diagnosis.

DTC P2128 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-		Go to **Diagnostic System Check -**

			Go to **Step 2**	**Engine Controls**
2	Observe the DTC information with a scan tool. Is DTC P0641 or P0651 also set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	1. Turn the ignition OFF. 2. Disconnect the accelerator pedal position (APP) sensor electrical connector. 3. Disconnect the engine control module (ECM). 4. Measure the resistance of the following circuits for each of the APP sensors with a DMM: • The low reference circuit • The signal circuit • The 5-volt reference circuit Did any of the circuits measure more than the specified value?	5 ohm	Go to **Step 7**	Go to **Step 4**
4	Test the signal circuit of the APP sensor 1 for a short to the signal circuit of the APP sensor 2. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 5**
5	Test for an intermittent and for a poor connection at the accelerator pedal harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 6**
6	Test for an intermittent and for a poor connection at the ECM harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 8**
7	Repair the high resistance in the circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 9**	-
8	Replace the APP sensor. Refer to **Accelerator Pedal Position Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 7**	-
	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for			

9	Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 8**
10	**IMPORTANT:** **Be aware that repairing one individual condition may correct more than one DTC.** Observe the Capture Info with a scan tool.Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2135

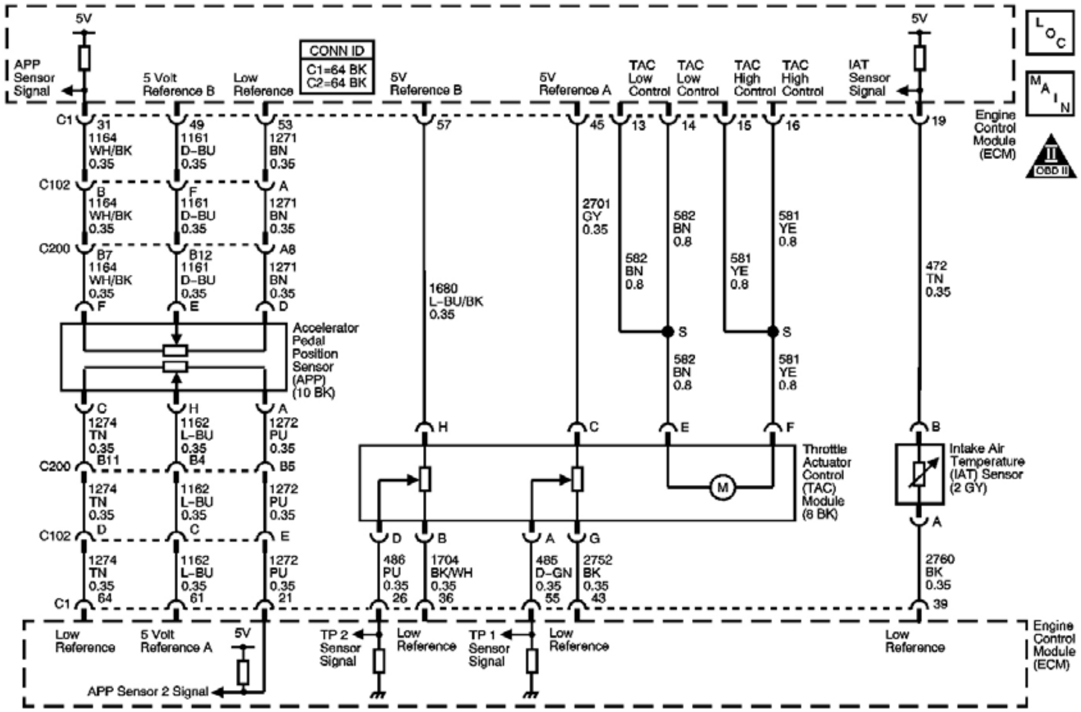


Fig. 7: DTC P2135 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The throttle position (TP) sensor 1 and the TP sensor 2 are potentiometer type sensors. Both sensor types have the following circuits:

- A 5-volt reference circuit

- A low reference circuit
- A signal circuit

The TP sensor provides the engine control module (ECM) with a signal voltage proportional to the throttle plate movement. The TP sensor 1 signal voltage at closed throttle is near the 5-volt reference and decreases as the throttle plate is opened. The TP sensor 2 signal voltage at closed throttle is near the low reference and increases as the throttle plate is opened. When the control module detects that the TP sensor 1 and the TP sensor 2 signal circuits are out of correlation with each other, DTC P2135 will set.

Conditions for Running the DTC

- The engine is running
- The ignition voltage is more than 5.25 volts.
- DTCs P0641 and P0651 are not set.

Conditions for Setting the DTC

The ECM detects that the difference between TP sensor 1 and TP sensor 2 is more than the predicted value.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC

- A current DTC Last Test Failed clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- Clear the DTC with a scan tool.

DTC P2135 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Observe the DTC Information with a scan tool. Is DTC P0120 or P0220 also set?	-	Go to **Diagnostic**	

			Trouble Code (DTC) List	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Disconnect the throttle body harness connector. 3. Disconnect the engine control module (ECM) harness connector. 4. Measure the resistance of the following circuits for each of the throttle position (TP) sensors with a DMM: • The low reference circuit • The signal circuit • The 5-volt reference circuit Is the resistance more than the specified value for any circuit?	5 ohm	Go to **Step 7**	Go to **Step 4**
4	Test the signal circuit of the TP sensor 1 for a short to the signal circuit of the TP sensor 2. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 5**
5	Test for an intermittent and for a poor connection at the throttle body harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 6**
6	Test for an intermittent and for a poor connection at the ECM harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 8**
7	Repair the high resistance in the circuit that measured above the specified value. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 9**	-
8	Replace the throttle body. Refer to **Engine Control Module (ECM) Replacement** . Did you complete the replacement?	-	Go to **Step 9**	-
9	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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.	-		

	Did the DTC fail this ignition?		Go to **Step 2**	Go to **Step 10**
10	**IMPORTANT:** **Be aware that repairing one individual condition may correct more than one DTC.** Observe the Capture Info with a scan tool.Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2138

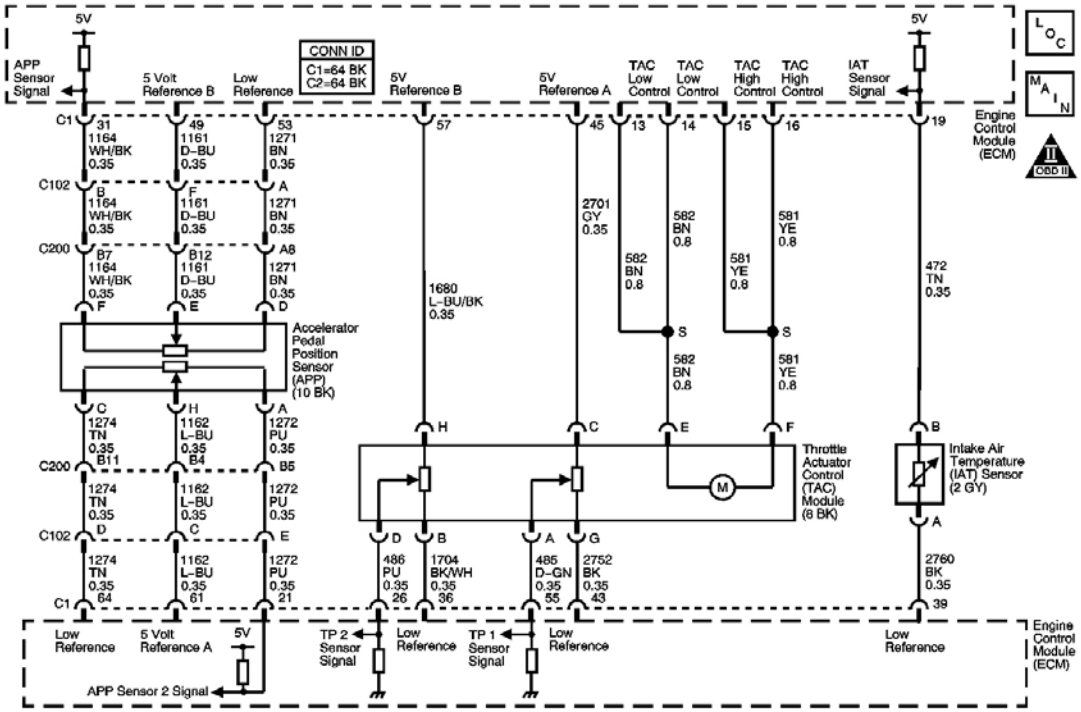


Fig. 8: DTC P2138 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The accelerator pedal position (APP) sensors 1 and 2 are located within the accelerator pedal assembly. Each sensor has the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The APP sensor provides the engine control module (ECM) with a signal voltage proportional to accelerator pedal movement. The APP sensor 1 signal voltage at rest position is near the low reference and increases as the pedal is actuated. The APP sensor 2 signal voltage at rest position is also near the low reference and increases as the pedal is actuated.

Conditions for Running the DTC

- The battery voltage is more than 5.25 volts.
- The ignition is ON.

Conditions for Setting the DTC

The voltage difference between APP sensor 1 and APP sensor 2 exceeds a predetermined value.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

The ECM compares the signal of each of the APP sensor to each other throughout the entire range of operation. Clear the DTCs and actuate the pedal through the entire range with the ignition ON and the engine OFF.

Use the J 35616 Connector Test Adapter Kit for any test that requires probing the ECM harness connector or a component harness connector. Using this kit will prevent damage to the harness connector terminals.

For intermittent conditions, refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems.

Test Description

The number below refers to the step number on the diagnostic table.

2: Any circuit faults on either APP sensor 1 or APP sensor 2 will set one of the DTCs listed. Refer to the appropriate table for diagnosis.

DTC P2138 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Observe the DTC information with a scan tool. Is DTC P1635, or P1639 also set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	1. Turn the ignition OFF. 2. Disconnect the accelerator pedal position (APP) sensor electrical connector. 3. Disconnect the engine control module (ECM). 4. Measure the resistance of the following circuits for each of the APP sensors with a DMM: • The low reference circuit • The signal circuit • The 5-volt reference circuit Did any of the circuits measure more than the specified value?	5 ohm	Go to **Step 7**	Go to **Step 4**
4	Test the signal circuit of the APP sensor 1 for a short to the signal circuit of the APP sensor 2. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 5**
5	Test for an intermittent and for a poor connection at the accelerator pedal harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 6**
6	Test for an intermittent and for a poor connection at the ECM harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems.	-		

	Did you find and correct the condition?		Go to **Step 9**	Go to **Step 8**
7	Repair the high resistance in the circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 9**	-
8	Replace the APP sensor. Refer to **Accelerator Pedal Position Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 7**	-
9	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 8**
10	**IMPORTANT:** **Be aware that repairing one individual condition may correct more than one DTC.** Observe the Capture Info with a scan tool.Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2176

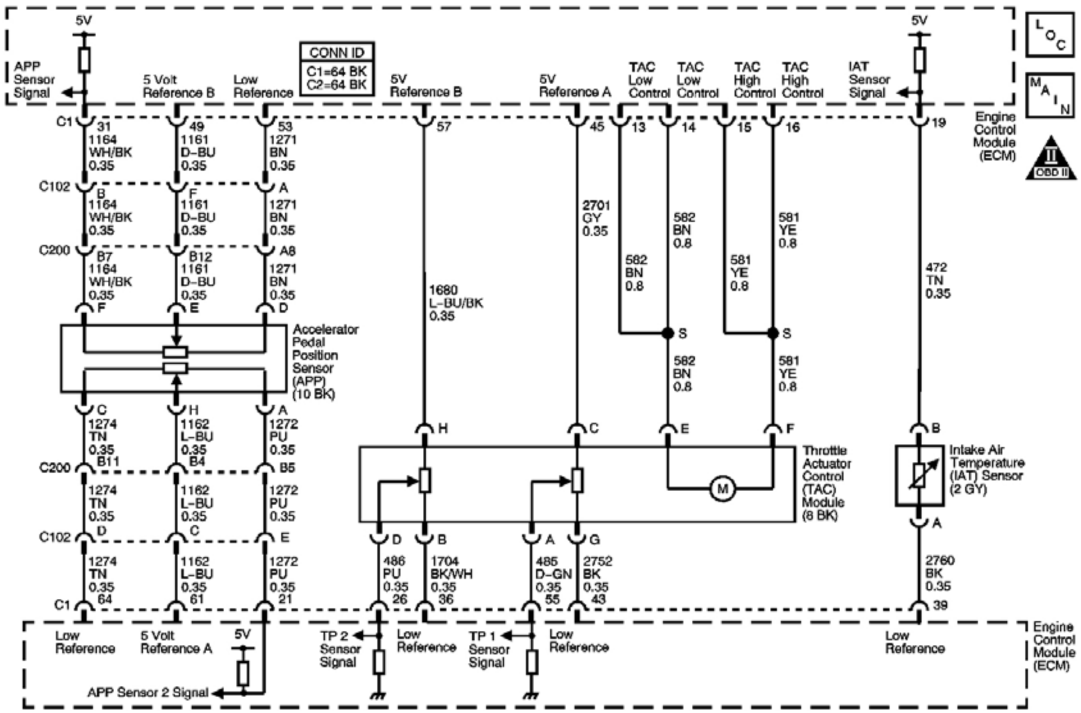


Fig. 9: DTC P2176 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The engine control module (ECM) determines the minimum throttle position each time the ignition is turned on. In order to learn this position, the ECM moves the throttle plate to the closed position. If the ECM determines the throttle plate is not moving to the fully closed position during this learn procedure, DTC P2176 will set.

Conditions for Running the DTC

- The ignition is ON.
- The ignition voltage is more than 5.25 volts.

Conditions for Setting the DTC

The ECM detects that the throttle plate did not return to the minimum position during learn procedure.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.

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

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

Inspect for mechanical conditions or binding that may be temperature related. Components may not move freely in extreme heat or cold due to the presence of contaminants or ice formation.

DTC P2176 Circuit

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Are DTCs P0120 and P0220 also set?	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 90 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Operate the vehicle within the conditions for running the DTC. You may also operate the vehicle within the conditions you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 4**	Go to **Intermittent Conditions**
4	Remove the throttle body assembly. Refer to **Throttle Body Assembly Replacement** . Did you find any obstructions preventing the throttle plate from returning to the minimum position?	Go to **Step 5**	Go to **Step 6**

5	Remove the obstruction. Did you find and correct the condition?	Go to **Step 7**	-
6	Replace the throttle body assembly. Refer to **Throttle Body Assembly Replacement** . Did you complete the replacement?	Go to **Step 7**	-
7	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Turn On the ignition, with the engine OFF 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 8**
8	**IMPORTANT:** **Be aware that repairing one individual condition may correct more than one DTC.** Observe the Capture Info with a scan tool.Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DIAGNOSTIC INFORMATION & PROCEDURES

DIAGNOSTIC STARTING POINT - ENGINE CONTROLS

Begin the system diagnosis with **Diagnostic System Check - Engine Controls** . The Diagnostic System Check-Engine Controls will provide the following information:

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the serial data circuit
- The identification of any stored diagnostic trouble codes (DTCs) and the codes' statuses

The use of the Diagnostic System Check-Engine Controls will identify the correct procedure for diagnosing the system and where the procedure is located.

DIAGNOSTIC SYSTEM CHECK - ENGINE CONTROLS

Description

The Diagnostic System Check-Engine Controls is an organized approach to identifying a condition that is created by a malfunction in the engine control system. The Diagnostic System Check must be the starting point for any driveability concern. The Diagnostic System Check directs the service technician to the next logical step in order to diagnose the concern. Understanding and correctly using the diagnostic table reduces diagnostic time and prevents the replacement of good parts.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

3: The Data Link References table is to identify which serial data protocol a particular control module is using. The powertrain control module (PCM) utilizes keyword serial data and controller area network (CAN) serial data.

11: This step is for areas that have inspection and maintenance testing procedures for emissions testing. Use this step if the testing facility found one or more I/M system statuses that did not set.

Diagnostic System Check - Engine Controls

Step	Action	Yes	No
	• Ensure the battery is fully charged. Refer to **Battery Inspection/Test (Side Terminal Battery)Battery Inspection/Test (Top Post Terminal Battery)** in Engine		

1	Electrical. • Ensure the battery cables are clean and tight. • Search for applicable service bulletins. • Inspect the easily accessible systems or the visible system components for obvious damage or conditions that could cause the symptom. Refer to **Strategy Based Diagnosis** in General Information. • Ensure that the engine and control module grounds are clean, tight, and in the correct location. • Inspect for aftermarket devices that could affect the operation of the system. Refer to **Checking Aftermarket Accessories** in Wiring Systems. Did you find and correct the condition?	System OK	Go to **Step 2**
2	1. Install a scan tool. 2. Turn ON the scan tool. Does the scan tool turn ON?	Go to **Step 3**	Go to **Scan Tool Does Not Power Up** in Data Link Communications
3	1. Turn ON the ignition, with the engine OFF. 2. Attempt to establish communication with the listed control modules: • Powertrain control module (PCM) • Body control module (BCM) • Electronic brake control module (EBCM) • Instrument panel cluster (IPC) Does the scan tool communicate with all the listed control modules?	Go to **Step 4**	Go to **Data Link References** in Data Link Communications
4	Attempt to start the engine. Does the engine crank?	Go to **Step 5**	Go to **Symptoms - Engine Electrical** in Engine Electrical
	Did the engine start and idle?		Go to **Engine Cranks**

5		Go to **Step 6**	**but Does Not Run**
6	**IMPORTANT:** **Do NOT clear the DTCs unless instructed by a diagnostic procedure.** 1. Select the DTC display function for the following control modules and record the DTCs: • Powertrain control module (PCM) • Body control module (BCM) • Electronic brake control module (EBCM) • Instrument panel cluster (IPC) 2. If multiple powertrain DTCs are stored, diagnose the DTCs in the following order: 1. Component level DTCs. For example, sensor DTCs, solenoid DTCs, and relay DTCs Begin with the lowest number DTC unless the diagnostic table directs you otherwise. 2. System level DTCs. For example, misfire DTCs, EVAP system DTCs and fuel trim DTCs. 3. If there are any powertrain DTCs, Select Capture Info in order to store the Powertrain DTC information with a scan tool. Does the scan tool display any DTCs?	Go to **Step 7**	Go to **Step 11**
7	Does the scan tool display DTCs which begin with a "U" other than U0107?	Go to **Data Link References** in Data Link Communications	Go to **Step 8**
8	Does the scan tool display DTC U0107?	**DTC U0107**	Go to **Step 9**
9	Does the scan tool display DTC P0602, DTC P1621, or DTC P2610?	Go to **DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610**	Go to **Step 10**
	Does the scan tool display DTCs P0562,		Go to **Diagnostic**

10	P0563, P0621, or P0622?	Go to **Diagnostic Trouble Code (DTC) List** in Engine Electrical	**Trouble Code (DTC) List**
11	Is the customer's concern with the automatic transmission - 5AT?	Go to **Diagnostic System Check - Automatic Transmission** in Automatic Transmission - 5AT	Go to **Step 12**
12	Is the customer's concern with Inspection/Maintenance (I/M) testing?	Go to **Inspection/Maintenance (I/M) System Check**	Go to **Step 13**
13	Are there any engine controls or driveability symptoms observed?	Go to **Symptoms - Engine Controls**	System OK

SCAN TOOL DATA LIST

The Engine Scan Tool Data List contains all engine related parameters that are available on the scan tool. The list is arranged in alphabetical order. A parameter may appear in any one of the data lists, and in some cases may appear more than once, or in more than one data list in order to group certain related parameters together.

Use the Engine Scan Tool Data List only after the following conditions are determined:

- The Diagnostic System Check-Engine Controls is completed.
- There are no diagnostic trouble codes (DTCs).
- The On-Board diagnostics are functioning properly.

Scan tool values from a properly running engine may be used for comparison with the engine you are diagnosing. The Engine Scan Tool Data List represents the values that would be seen on a normal running engine.

IMPORTANT: Do not use a scan tool that displays faulty data. The scan tool concern should be reported to the manufacturer. Use of a faulty scan tool can result in misdiagnosis and in unnecessary parts replacement.

Only the parameters listed below are referenced in this service manual for use in diagnosis. If all values are within the typical range described below, refer to the column labeled Data List indicates where a parameter is located on the scan tool. Review the scan tool operating manual for the exact locations of the data lists. The following is a description of each term listed:

All

The parameter is in all data lists indicated below.

Input

General Info-Inputs

Output

General Info-Outputs

FE

Fuel and Emissions

Ign

Ignition

MF

Misfire

Aux

Auxiliary Emissions

Idle

Idle/Speed Control

Eng

Engineering

FF

Freeze Frame Data List

FR

Failure Record Data List

Scan Tool Data List

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Engine Idling/Upper Radiator Hose Hot/Closed Throttle/Transmission in Park or Neutral/Closed Loop			
AC High Side Pressure	Input	kPa	Varies
AC Pressure Sensor	Input	Volts	Varies
AC Relay Command	Input, Output, Idle	On/Off	Off
AC Request	Input, Idle	Yes/No	No
Air Fuel Ratio	FE	XX :1	14.7:1
APP Angle	All	Percent	0%
APP at Idle	Idle	Yes/No	Yes

APP Sensor 1	Input, FE, Idle	Volts	0.9-1.0 Volts
APP Sensor 2	Input, FE, Idle	Volts	0.4-0.6 Volts
BARO	Input, FE	kPa	95-101 kPa
Brake Switch	Input, Idle	Applied/Released	Released
Calculated Converter Temperature	Eng	°C (°F)	Varies, typical 400-532°C (750-990°F)
Crankshaft Position Sensor A	Input	Counts	0-3 Counts
Crankshaft Position Sensor B	Input	Counts	0 Counts
Cruise Brake Switch	Input, Idle	Applied/Released	Released
Cruise Engaged	Input, Idle	Yes/No	No
Cruise Resume/Accelerate	Input, Idle	On/Off	Off
Cruise Set/Coast	Input, Idle	On/Off	Off
Cruise Switch	Input, Idle	On/Off	Off
Decel Fuel Cutoff	FE	Active/Inactive	Inactive
Desired Idle Speed	Idle	RPM	700 RPM
ECT Sensor	All	°C (°F)	80-90°C (176-194°F)
Engine at Operating Temperature	FE	Yes/No	Yes
Engine Load	All	Percent	9-30%
Engine Run Time	All	Hours/Minutes/Seconds	Varies
Engine Oil Life Left	Input	Percent	Varies
Engine Speed	All	RPM	700-800 RPM
EVAP Purge Solenoid DC	Output, FE, Aux	Percent	Varies
EVAP Vent Solenoid	Output, Aux	On/Off	Off
EGR Duty Cycle	Input, Output, Aux	Percent	0 %
EGR Sensor	Input, Aux	Volts	1.17 Volts
Fan Control 1 Command	Output	On/Off	Varies
Fan Control 2 Command	Output	On/Off	Varies
Fuel Level	Input, FE, Ign, MF	Liters/Gallons	Varies
Fuel Level Sensor	Input, FE, Ign, Aux	Volts	Varies
Fuel Level	FE, Ign, MF, Aux	Percent	Varies
Fuel Pump Relay Command	Output	On/Off	On
Fuel Tank Pressure Sensor	Input	Volts	Varies
Fuel Tank Pressure Sensor	Input, FE	mmHg (inH2O)	Varies
Generator F Terminal	Input	Percent	Varies
Generator L Terminal	Input	Active/Inactive	Inactive
HO2S Bank 1 Sensor 1	Input, FE	Lambda	Varies, 0.998-1.002 Lambda typical
HO2S Bank 1 Sensor 2	Input, FE	mV	Varies
HO2S Bank 2 Sensor 1	Input, FE	Lambda	Varies, 0.998-1.002 Lambda typical

HO2S Bank 2 Sensor 2	Input, FE	mV	Varies
HO2S Heater Bank 1 Sensor 1	Output, FE	On/Off	On
HO2S Heater Bank 1 Sensor 2	Output, FE	On/Off	Varies
HO2S Heater Bank 2 Sensor 1	Output, FE	On/Off	On
HO2S Heater Bank 2 Sensor 2	Output, FE	On/Off	Varies
Idle Increase Command (AC Request Only)	Idle	Yes/No	No
Ignition 1	All	Volts	10-14 Volts
Injector PWM Bank 1	FE	ms	2.4-2.8 ms
Injector PWM Bank 2	FE	ms	2.4-2.8 ms
IAT Sensor 1	Input, Aux	°C (°F)	Varies with underhood and ambient air temperatures
IAT Sensor 2	Input, FE, Ign, MF, Aux, Eng, Idle	°C (°F)	Varies with underhood and ambient air temperatures
Intake Rocker Arm Actuator Solenoid Command	Output	On/Off	Off
Intake Rocker Arm Actuator Oil Pressure Switch	Input, Output	On/Off	Off
Knock Sensor	Input, Output	Volts	0.0 Volts
Knock Control	Input, Output	Active/Inactive	Inactive
Long Term FT Bank 1	FE, Aux, FF, FR	Percent	-10% to +10%
Long Term FT Bank 2	FE, Aux, FF, FR	Percent	-10% to +10%
Loop Status Bank 1	FE, Eng, FF, FR	Open/Closed	Closed Loop
Loop Status Bank 2	FE, Eng, FF, FR	Open/Closed	Closed Loop
Low Oil Pressure Switch	Input	Open/Closed	Closed
Main Relay	Output	On/Off	On
MAP Sensor	Input	Volts	1.0-2.0 volts (varies w/ altitude)
MAP Sensor	Input, FE, Ign, MF, Aux, Eng, Idle, FF, FR	kPa	20-40 kPa (varies w/ altitude)
Misfire Current Cyl #1	MF	Counts	0 Counts
Misfire Current Cyl #2	MF	Counts	0 Counts
Misfire Current Cyl #3	MF	Counts	0 Counts
Misfire Current Cyl #4	MF	Counts	0 Counts
Misfire Current Cyl #5	MF	Counts	0 Counts
Misfire Current Cyl #6	MF	Counts	0 Counts
Misfire History Cyl #1	MF	Counts	0 Counts

Misfire History Cyl #2	MF	Counts	0 Counts
Misfire History Cyl #3	MF	Counts	0 Counts
Misfire History Cyl #4	MF	Counts	0 Counts
Misfire History Cyl #5	MF	Counts	0 Counts
Misfire History Cyl #6	MF	Counts	0 Counts
Power Enrichment	FE	Yes/No	No
Rough Road Detection	MF	Present/Not Present	Not Present
Short Term FT Bank 1	FE, Aux, FF, FR	Percent	-10% to +10%
Short Term FT Bank 2	FE, Aux, FF, FR	Percent	-10% to +10%
Spark Advance	Ign, FF, FR	Degrees	9° to 12°
Start Up ECT	FE	Degrees	Varies
TAC Limit Engine Power	Eng	Yes/No	No
TAC Module Power Inhibit Feedback	Output	Volts	0.67 Volts
Throttle Plate at Idle	Idle	Yes/No	Yes
Throttle Plate at WOT	Idle	Yes/No	No
TP Angle	All	Percent	9-14%
TPS Learned Value	FE, Idle	Percent	Varies
Vehicle Speed	All	km/h/mph	0 km/h / 0 mph

SCAN TOOL DATA DEFINITIONS

The Engine Scan Tool Data Definitions contains a brief description of all engine related parameters available on the scan tool.

AC High Side Pressure

This parameter displays the high side pressure of the air conditioning (A/C) system based on the signal from the A/C high side pressure sensor.

AC Pressure Sensor

This parameter displays the voltage from the A/C high side pressure sensor signal circuit to the control module.

AC Request

This parameter indicates the status of the A/C switch on the instrument panel (IP). The scan tool parameter is Yes when AC has been selected.

AC Relay Command

The parameter indicates On whenever the powertrain control module (PCM) energizes the A/C compressor clutch relay.

Air Fuel Ratio

This parameter indicates air to fuel ratio calculated from fuel control oxygen sensor input. The ideal air fuel ratio under normal engine power demand is 14.7:1.

APP Angle

The scan tool range is 0-100 percent. The scan tool displays the amount of throttle opening in percentage. At closed throttle the scan tool displays zero percent. At wide open throttle (WOT) the scan tool displays approximately 80 percent.

APP at Idle

This parameter displays what the control module has determined to be the engine status based on input from the APP sensor. The scan tool parameter indicates Yes when the engine is operating at idle speeds.

APP Sensor 1

The scan tool displays 0-5 volts. The scan tool displays the accelerator pedal position in volts. With the pedal at rest, APP sensor 1 displays about 0.5 volts. At wide open throttle (WOT) APP sensor 1 displays about 5.0 volts.

APP Sensor 2

The scan tool displays 0-5 volts. The scan tool displays the accelerator pedal position in volts. With the pedal at rest, APP sensor 2 displays about 0.25 volts. At wide open throttle (WOT) APP sensor 2 displays about 2.5 volts.

BARO

The scan tool range 0-125 kPa. The barometric pressure (BARO) sensor measures the changes in atmospheric pressure. This parameter will read approximately 95 to 105 kPa at sea level.

Brake Switch

The brake switch controls the operation of the brake lamp circuit and sends a signal to the powertrain control module (PCM). When the brake pedal is depressed, the brake switch is Applied, CLOSED, and the brake lamps illuminate. When the brake pedal is released, the brake switch OPENS and the scan tool indicates Released.

Calculated Converter Temperature

The scan tool range is 300-950°C (572-1,742°F). This parameter displays the catalytic converter temperature as calculated by the control module. Since this temperature is calculated, ignore any value when the engine is below normal operating temperature. The vehicle may need to be driven in order to provide enough information for the control module to calculate the temperature accurately.

Crankshaft Position Sensor A

The scan tool display is Counts-from 0 to 3. This parameter displays a rolling count, when the PCM is receiving and using the CKP sensor A position signal. Normal engine operation is for the PCM to use the sensor A signal for crankshaft position, and ignore the sensor B input. The scan tool displays only the signal the PCM is using to determine crankshaft position. Therefore sensor A counts will be changing and sensor B counts will be fixed at zero.

Crankshaft Position Sensor B

The scan tool display is Counts-from 0 to 3. This parameter displays a rolling count only when the PCM is calculating crankshaft position from the CKP sensor B signal. CKP sensor B is normally fixed at zero. The PCM software is designed to use the sensor A signal for crankshaft position, and ignore the sensor B signal. If the sensor A signal is missing or irregular, the PCM will use the sensor B signal and display a rolling count on the sensor B scan tool parameter.

Cruise Brake Switch

This parameter indicates the state of the cruise brake switch that is controlled by the position of the brake pedal. The normal state of the switch is CLOSED, when the brake pedal is not depressed and the scan tool will display Released. The cruise brake switch is OPEN, when the brake pedal is depressed and the scan tool display is Applied.

Cruise Engaged

This parameter displays the status of the cruise control system as determined by the control module.

Cruise Resume/Accel. Switch

This parameter displays the state of the cruise controls resume/accel switch input to the control module.

Cruise Set/Coast Switch

This parameter displays the state of the cruise controls set/coast switch input to the control module.

Decel Fuel Cutoff

The Decel Fuel Cutoff parameter indicates when the control module is operating the fuel injectors in the fuel cutoff mode. When the operating in the fuel cutoff mode, fuel injector output is stopped and the Decel Fuel Cutoff parameter should read Active. The Decel Fuel Cutoff parameter should read Inactive during all other fueling conditions.

Desired Idle Speed

The desired idle speed is a PCM internal parameter which indicates the PCM requested idle speed. If the engine is not running, this number indicated is not valid.

ECT Sensor

The scan tool range is -40 to +152°C (-40 to +419°F). The engine coolant temperature (ECT) sensor is a thermistor which changes internal resistance as the temperature changes. When the sensor is cold, internal resistance high, the powertrain control module (PCM) monitors a high signal voltage and interprets the voltage as a cold engine. As the sensor warms, internal resistance decreases, the voltage signal decreases and the PCM interprets the lower voltage as a warm engine.

Engine at Operating Temperature

This parameter will display Yes when the engine coolant temperature is 80°C (176°F) or more.

Engine Load

The scan tool range is 0-100 percent. This parameter indicates the engine load based upon the manifold absolute pressure. The higher the percentage, the more load the engine is under.

Engine Run Time

This parameter displays the time elapsed since the engine was started.

Engine Oil Life Left

This parameter displays the amount engine oil life remaining before requiring an oil change. This number is calculated by the control module based on inputs from various sensors.

Engine Speed

The scan tool range is 0-10,000 RPM. The powertrain control module (PCM) computes engine speed from the ignition reference pulses. The engine speed should remain close to the desired idle under various engine loads with the engine idling.

EVAP Purge Solenoid DC

The scan tool range is 0-100 percent. This parameter EVAP Purge Solenoid Duty Cycle (DC) indicates the percent of time the (EVAP) canister purge solenoid valve is ON.

EVAP Vent Solenoid

This parameter indicates when the PCM is turning ON the EVAP canister vent solenoid. The scan tool indicates ON when the solenoid is commanded ON.

EGR Duty Cycle

The scan tool range is 0-100 percent. The exhaust gas recirculation (EGR) duty cycle specifies the EGR valve on, valve open, time rate within a certain set cycle. Zero percent means that the valve is completely closed while a 100 percent is a fully open valve.

EGR Sensor

The scan tool range is 0.0-5.0 volts. The EGR valve pintle or plunger movement is monitored by a position sensor. When the EGR valve is closed, the sensor voltage is between 1.0-1.5 volts.

Fan Control 1 Command

This parameter indicates that the PCM is turning ON the fan 1 relay. When the fan 1 relay is ON, both engine cooling fans operate at LOW speed. The PCM will command the fan 1 relay on when AC is selected. The PCM will command the fan 1 relay on when the coolant temperature reaches 98°C (208°F). Once energized the fan 1 relay remains ON until the coolant temperature drops to below 95°C (203°F) or AC is switched Off.

Fan Control 2 Command

This parameter indicates that the PCM is turning ON the fan 2 relay. When the fan 2 relay is ON, both engine cooling fans operate at HIGH speed. The PCM will command the fan 2 relay on when AC system pressure is more than 2,100 kPa. The PCM will command the fan 2 relay on when the coolant temperature reaches 102°C (215°F). Once energized the fan 2 relay remains ON until the coolant temperature drops to below 99°C (210°F) or the AC pressure is below 1,400 kPa.

Fuel Level

The scan tool displays liters or gallons. This parameter indicates approximate of fuel in the fuel tank.

Fuel Level Sensor

The scan tool range is 0-100 percent. This parameter indicates approximate fuel level in the fuel tank. The detectable range of the fuel level sensor is set as 0 to 100 percent, however, with some models whose fuel tank capacity is smaller, the indicated fuel level may be only 70 percent even when the fuel tank is full.

Fuel Level Sensor

The scan tool range is 0- volts. This parameter indicates approximate fuel level in the fuel tank. The detectable range of the fuel level sensor is set as 0 to 100 percent, however, with some models whose fuel tank capacity is smaller, the indicated fuel level may be only 70 percent even when the fuel tank is full.

Fuel Pump Relay Command

This parameter indicates whether the powertrain control module (PCM) is requesting the fuel pump ON or OFF.

Fuel Tank Pressure Sensor

The scan tool range is 0-5 Volts/-32.0 mmHg to +16.8 mmHg (-17.1 inH2O to +9.0 inH2O). This parameter indicates the pressure in the fuel tank. High voltage indicates negative pressure. Low voltage indicates positive pressure.

Generator F Terminal

This parameter displays the amount of generator on-time as commanded by the control module. The higher the percentage the greater the generator output.

Generator L Terminal

This parameter displays the control module commanded state of the voltage regulator on the generator.

HO2S Bank 1 Sensor 1

The scan tool range is 0.0-2.0 Lambda. This parameter displays the lambda output from the heated oxygen sensor (HO2S) to the control module. A low lambda indicates a rich exhaust, while high lambda indicates a lean exhaust.

HO2S Bank 1 Sensor 2

The scan tool range is 0-1275 mV. The bank 1 rear heated oxygen sensor 2 represents the exhaust oxygen output voltage beyond the catalytic converter. This voltage will remain inactive or appear lazy within a range 100 mV, lean exhaust, and 900 mV, rich exhaust, when the system is operating in Closed Loop.

HO2S Bank 2 Sensor 1

The scan tool range is 0.0-2.0 Lambda. This parameter displays the lambda output from the heated oxygen sensor (HO2S) to the control module. A low lambda indicates a rich exhaust, while high lambda indicates a lean exhaust.

HO2S Bank 2 Sensor 2

The scan tool range is 0-1275 mV. The bank 2 rear heated oxygen sensor represents the exhaust oxygen output voltage beyond the catalytic converter. This voltage will remain inactive or appear lazy within a range 100 mV, lean exhaust, and 900 mV, rich exhaust, when the system is operating in Closed Loop.

HO2S Heater Bank 1 Sensor 1

This parameter indicates when the heater of the bank 1 oxygen sensor 1 is switched On.

HO2S Heater Bank 1 Sensor 2

This parameter indicates when the heater of the bank 1 oxygen sensor 2 is switched On.

HO2S Heater Bank 2 Sensor 1

This parameter indicates when the heater of the bank 2 oxygen sensor 1 is switched On.

HO2S Heater Bank 2 Sensor 2

This parameter indicates when the heater of the bank 2 oxygen sensor 2 is switched On.

Idle Increase Command (AC Request Only)

This parameter indicates when the engine idle speed is being increased because of increased engine load from the AC compressor operation.

Ignition 1

This parameter indicates the ignition switched system voltage.

Injector PWM Bank 1

The scan tool range is 0 to 32.64 ms. This parameter indicates the amount of time a bank 1 fuel injector solenoid valve is open.

Injector PWM Bank 2

The scan tool range is 0 to 32.64 ms. This parameter indicates the amount of time a bank 2 fuel injector solenoid valve is open.

IAT Sensor 1

The scan tool range is -40 to +152°C (-40 to +419°F). The powertrain control module (PCM) converts the resistance of the intake air temperature (IAT) sensor to degrees. The PCM uses the intake air temperature (IAT) in order to adjust fuel delivery and spark timing according to incoming air density.

IAT Sensor 2

The scan tool range is -40 to +152°C (-40 to +419°F). The powertrain control module (PCM) converts the resistance of the intake air temperature (IAT) sensor to degrees. The PCM uses the intake air temperature (IAT) in order to adjust fuel delivery and spark timing according to incoming air density.

Intake Rocker Arm Actuator Solenoid Command

This parameter displays the commanded state of the intake rocker arm actuator solenoid.

Intake Rocker Arm Actuator Oil Pressure Switch

When the intake rocker arm actuator solenoid is On, engine oil should flow to the intake rocker arms and the rocker arm oil pressure switch. Oil pressure will turn On the intake rocker arm actuator oil pressure switch.

Knock Control

This parameters indicates when the control module is actively modifying ignition timing in response to knock sensor input.

Knock Sensor

The scan tool range is 0.0-3.9 volts. This parameters displays the voltage input to the control module from the knock sensor (KS). Voltage that is more than 0.0 is indicated only when knock is detected.

Long Term FT Bank 1

The scan tool displays a positive or a negative percentage. The powertrain control module (PCM) derives the Long Term fuel trim (FT) from the Short Term fuel trim value. The Long Term fuel trim represents a long-term correction of fuel delivery. A value of 0 percent indicates that the fuel delivery requires no compensation in order to maintain the PCM commanded air/fuel ratio. A negative value significantly less than 0 percent indicates that the fuel system is rich and the PCM is reducing the fuel delivery, decreasing the fuel injector pulse width. A positive value significantly more than 0 percent indicates that a lean condition exists and the PCM compensates by adding fuel, increasing fuel injector pulse width. Fuel trim values at maximum authority may indicate an excessively rich or lean system.

Long Term FT Bank 2

The scan tool displays a positive or a negative percentage. The powertrain control module (PCM) derives the Long Term fuel trim (FT) from the Short Term fuel trim value. The Long Term fuel trim represents a long-term correction of fuel delivery. A value of 0 percent indicates that the fuel delivery requires no compensation in order to maintain the PCM commanded air/fuel ratio. A negative value significantly less than 0 percent indicates that the fuel system is rich and the PCM is reducing the fuel delivery, decreasing the fuel injector pulse width. A positive value significantly more than 0 percent indicates that a lean condition exists and the PCM compensates by adding fuel, increasing fuel injector pulse width. Fuel trim values at maximum authority may indicate an excessively rich or lean system.

Loop Status Bank 1

The Loop Status parameter will display one of the following conditions:
OPEN LOOP: The HO2S Bank 1 Sensor 1 has not met all of the conditions necessary for Closed Loop operation.
CLOSED LOOP: The powertrain control module (PCM) is using HO2S Bank 1 Sensor 1 as feedback for fuel control.

Loop Status Bank 2

The Loop Status parameter will display one of the following conditions:
OPEN LOOP: The HO2S Bank 2 Sensor 1 has not met all of the conditions necessary for Closed Loop operation.
CLOSED LOOP: The powertrain control module (PCM) is using HO2S Bank 2 Sensor 1 as feedback for fuel control.

Low Oil Pressure Switch

This parameter displays the status of the low engine oil pressure switch.

MAP Sensor

The scan tool range is 0-125 kPa/0.0-5.0 volts. The manifold absolute pressure (MAP) sensor measures the change in the intake manifold pressure from engine load, and speed changes. As intake manifold pressure increases, the intake vacuum decreases resulting in a higher kPa reading.

Misfire Current Cyl #1, #2, #3, #4, #5, #6

Indicates a count of the abnormal engine revolutions (misfire) for each cylinder.

Misfire History Cyl #1, #2, #3, #4, #5, #6

Indicates the stored or history count of the abnormal engine revolutions (misfire) for each cylinder.

Power Enrichment

This parameter displays the status of the operating mode of the control module used to increase fuel delivery during certain acceleration conditions.

Rough Road Detection

This parameter indicates Yes when the misfire diagnostic has determined that a rough road surface condition exists. Input from the CKP and CMP sensors indicates that the road surface may cause false engine misfire counts. During rough road detection the PCM uses certain filters in order to monitor engine misfire accurately.

Short Term FT Bank 1

The scan tool displays a positive or a negative percentage. The Short Term fuel trim (FT) represents a short-term correction to fuel delivery by the powertrain control module (PCM). The Short Term FT correction is driven by the fuel control oxygen sensor voltage. When the oxygen sensor (O2S) voltage remains less than 450 mV the PCM adds fuel and the Short Term FT parameter displays a positive percentage. When the oxygen sensor voltage stays at more than 450 mV the PCM subtracts fuel and the Short Term FT parameter displays a negative percentage. During an extended idle in high ambient temperatures the evaporative emission (EVAP) canister may purge, causing the Short Term FT to read in the negative range. This is a normal condition. Fuel trim values at maximum authority may indicate an excessively rich or lean system.

Short Term FT Bank 2

The scan tool displays a positive or a negative percentage. The Short Term fuel trim (FT) represents a short-term correction to fuel delivery by the powertrain control module (PCM). The Short Term FT correction is driven by the fuel control oxygen sensor voltage. When the oxygen sensor (O2S) voltage remains less than 450 mV the PCM adds fuel and the Short Term FT parameter displays a positive percentage. When the oxygen sensor voltage stays at more than 450 mV the PCM subtracts fuel and the Short Term FT parameter displays a negative percentage. During an extended idle in high ambient temperatures the evaporative emission (EVAP) canister may purge, causing the Short Term FT to read in the negative range. This is a normal condition. Fuel trim values at maximum authority may indicate an excessively rich or lean system.

Spark Advance

The scan tool range is -1 to +63 degrees. The scan tool displays the powertrain control module (PCM) controlled value that is being used to control the spark timing.

Start Up ECT

The scan tool range is -40 to +140°C (-40 to +284°F). This parameter displays what the ECT sensor temperature was when the engine was first started this ignition cycle.

TAC Limit Engine Power

The scan tool will indicate Yes when the throttle actuator control (TAC) system has fixed the engine speed below 1,500 RPM. A fault in the accelerator pedal position (APP) sensor circuit will cause the TAC Limit Engine Power

TAC Module Power Inhibit Feedback

This scan tool parameter displays the internal voltage of the TAC motor inhibit circuit. Normal circuit operation voltage is approximately 0.67 volts. Most DTC setting TAC system failures cause the inhibit circuit voltage to default to 0.0 volts. An open in the TAC module ground circuit can cause an inhibit circuit voltage of 0.96 volts.

Throttle Plate at Idle

This parameter indicates Yes when the position of throttle body throttle plate is at idle or the default closed position.

Throttle Plate at WOT

This parameter indicates Yes when the throttle body throttle plate is at the wide open throttle (WOT) position.

TP Angle

The scan tool range is 0-100 percent. The scan tool displays the amount of throttle opening in percentage. At closed throttle the scan tool displays zero percent. At wide open throttle (WOT) the scan tool displays approximately 80 percent. At normal engine idle speeds the TP angle is between 9-14 percent.

TPS Learned Value

The scan tool range is 0-100 percent. The TPS learned value is an assigned value by the PCM. The PCM calculates the value using the original TP position, plus any increase in angle as a result of a greater throttle plate opening to compensate for the buildup of carbon deposits. The typical TPS learned value is zero percent after reset. The value will increase as carbon deposits build up on the throttle plate.

Vehicle Speed

The scan tool range is 0-255 km/h (0-158 mph). This parameter displays the vehicle speed. The powertrain control module (PCM) receives reference pulses from the vehicle speed sensor (VSS) and converts the pulses into km/h and mph for display.

SCAN TOOL OUTPUT CONTROLS

Scan Tool Output Controls

Scan Tool Output Control	Additional Menu Selection (s)	Description
A/C Relay	Engine Output Controls	Activates the A/C compressor relay. The normal commanded state of the A/C relay is NONE. The relay status can also be monitored on the scan tool data parameter A/C Relay Command. The powertrain control module (PCM) will inhibit the operation of the A/C relay when the ambient air temperature is low enough to cause icing of the evaporator core.
EGR Solenoid	Engine Output Controls	Activates the EGR valve. The normal commanded state is NONE. When commanded ON, the EGR valve position is commanded in 10 percent duty cycle increments. • The transmission must be in Park or Neutral. • The engine coolant temperature is 85°C (185°F) or more. • No vehicle speed is detected The valve remains in the commanded state until cancelled by the scan tool or until vehicle speed is detected.
Engine Speed Control	Throttle Control System	Activates the throttle actuator control (TAC) motor in order to change engine speed. The normal commanded state is a 9-14 percent throttle plate opening. The PCM allows engine speed control when the following conditions are met: • The transmission must be in Park or Neutral. • The throttle position (TP) sensor is indicating the throttle is at idle. • The engine coolant temperature is 85°C (185°F) or more. • No vehicle speed is detected

		The system will INCREASE or DECREASE the engine speed from 500-2,000 RPM. The system remains in the commanded state until cancelled by the scan tool or when vehicle speed is detected.
EVAP Purge Solenoid	Engine Output Controls / EVAP System	Activates the EVAP canister purge valve. The normal commanded state is NONE. The solenoid is commanded ON in 10 percent increments, with a maximum scan tool command of 20 percent duty cycle. The solenoid remains in the commanded state until cancelled by the scan tool or until vehicle speed is detected.
EVAP Vent Solenoid	Engine Output Controls / EVAP System	Activates the EVAP vent solenoid. The normal commanded state is NONE. When commanded ON, the vent valve switches to non-venting. The solenoid remains in the commanded state until cancelled by the tool or until vehicle speed is detected.
EVAP Purge/Seal	Engine Output Controls / EVAP System	Activates the EVAP purge and vent solenoids. The normal commanded state is NONE. When INCREASE is selected the following commands are executed: • The purge solenoid is commanded ON, open, at 10 or 20 percent duty cycle. • The vent solenoid is commanded ON, closed. The purge solenoid will remain ON until cancelled or the FTP sensor detects a negative pressure greater than -23.45 mm Hg (-12.50 in H2O). When SEAL is selected the following commands are executed: • The purge solenoid is commanded OFF, closed. • The vent solenoid is commanded ON, closed. The system remains in the commanded state until cancelled by the scan tool or until vehicle speed is detected.
Fan Relay 1	Engine Output Controls / Fan Relays	Operates both engine cooling fans at low speed by enabling fan relay 1. The normal commanded state of the relay is NONE. The PCM allows relay control when the following conditions are met: • The ignition is ON, with the engine OFF. • The transmission must be in Park or Neutral. • The A/C request is OFF. • The engine coolant temperature is less than 100°C (212°F).
	Engine Output	Operate both engine cooling fans at high speed by enabling fan relay 2. The normal commanded state of the relay is NONE. The PCM allows relay control when the following conditions are met:

Fan Relay 2	Controls / Fan Relays	• The ignition is ON, with the engine OFF. • The transmission must be in Park or Neutral. • The A/C request is OFF. • The engine coolant temperature is less than 100°C (212°F).
Fuel Injector Flow Test	Fuel System	This function activates the selected fuel injector in order to verify the correct fuel injector flow. The ECM commands the fuel pump ON when the test is initiated and pulses the selected fuel injector on the second prompt. The normal commanded state is None. The scan tool initiates the test when the following conditions are met: • The ignition is ON, with the engine OFF. • The vehicle speed is 0 km/h (0 mph). If any fuel injector needs to be tested again, the engine must be started and idled for 30 seconds.
Fuel Pump	Fuel System	This function controls the fuel pump relay. The normal commanded state is NONE. • Condition 1-Engine is running When the engine is running the fuel pump relay can be commanded OFF if engine speed is less than 1,200 RPM and TP is at idle. The relay remains in the commanded state for 5 minutes or until cancelled by the scan tool. • Condition 2-Engine is not running When the engine is not running the fuel pump relay can be commanded ON. The relay remains in the commanded state until cancelled by the scan tool or until engine speed is detected.
HO2S Bank 1 Sensor 1 Heater	Engine Output Controls / HO2S Heater Controls	This function controls the selected HO2S heater control circuit. The normal commanded state is NONE. The system will command ON the heater for 1 second. In order to repeat the test, the ignition switch must be cycled On to Off, wait 5 seconds, then back to On. The PCM allows heater control when the following conditions are met: • The transmission must be in Park or Neutral. • The engine is not running. • The engine coolant temperature is less than 100°C (212°F). • No vehicle speed is detected
		This function controls the selected HO2S heater control circuit. The normal commanded state is NONE. The system will command ON the heater for 1 second. In order to repeat the test, the ignition switch must

HO2S Bank 1 Sensor 2 Heater	Engine Output Controls / HO2S Heater Controls	be cycled On to Off, wait 5 seconds, then back to On. The PCM allows heater control when the following conditions are met: • The transmission must be in Park or Neutral. • The engine is not running. • The engine coolant temperature is less than 100°C (212°F). • No vehicle speed is detected
HO2S Bank 2 Sensor 1 Heater	Engine Output Controls / HO2S Heater Controls	This function controls the selected HO2S heater control circuit. The normal commanded state is NONE. The system will command ON the heater for 1 second. In order to repeat the test, the ignition switch must be cycled On to Off, wait 5 seconds, then back to On. The PCM allows heater control when the following conditions are met: • The transmission must be in Park or Neutral. • The engine is not running. • The engine coolant temperature is less than 100°C (212°F). • No vehicle speed is detected
HO2S Bank 2 Sensor 2 Heater	Engine Output Controls / HO2S Heater Controls	This function controls the selected HO2S heater control circuit. The normal commanded state is NONE. The system will command ON the heater for 1 second. In order to repeat the test, the ignition switch must be cycled On to Off, wait 5 seconds, then back to On. The PCM allows heater control when the following conditions are met: • The transmission must be in Park or Neutral. • The engine is not running. • The engine coolant temperature is less than 100°C (212°F). • No vehicle speed is detected
Intake Rocker Arm Actuator Solenoid	Engine Output Controls	Activates the rocker arm oil control solenoid valve. The normal commanded state of the rocker arm oil control solenoid is NONE. When commanded ON, the rocker arm oil control solenoid opens the oil passage to the rocker arm assemblies. The PCM allows solenoid control when the following conditions are met: • DTC P2646, P2647, P2648, or P2649 are not set. • The engine is running and engine speed is more than 2,500 RPM. • The engine coolant temperature is 85°C (185°F) or more. • No vehicle speed is detected The solenoid remains in the commanded state until any of the following conditions occur:

		• Cancelled by the scan tool • Engine speed drops below 2,500 RPM • Vehicle speed is detected
Reset TPS Learn Value	Throttle Control System	This function commands the PCM to set the TPS Learned Value in the control module to zero percent. The PCM accepts a TPS learned value reset command when the following conditions are met: • The engine is not running. • The APP sensors indicate there is no driver input.
Throttle Actuator Control	Throttle Control System	This function controls the throttle plate position in 1 percent increments. The PCM allows TAC motor control when the following conditions are met: • There are no TAC system or accelerator position (APP) system DTCs set. • The transmission must be in Park or Neutral. • The engine coolant temperature is 85°C (185°F) or more. • No vehicle speed is detected
TAC Module Power Inhibit	Throttle Control System	This function commands the throttle plate to the power inhibit position for approximately 2 seconds. The PCM sets the TAC motor to the power inhibit position when the following conditions are met: • There are no TAC system or accelerator position (APP) system DTCs set. • The engine is not running.

DIAGNOSTIC TROUBLE CODE (DTC) LIST

Diagnostic Trouble Code (DTC) List

DTC	Diagnostic Procedure	Module (s)
P0030	**DTC P0030, P0036, P0050, or P0056**	PCM
P0036	**DTC P0030, P0036, P0050, or P0056**	PCM
P0050	**DTC P0030, P0036, P0050, or P0056**	PCM
P0056	**DTC P0030, P0036, P0050, or P0056**	PCM
P0097	**DTC P0097**	PCM
P0098	**DTC P0098**	PCM
P0107	**DTC P0107**	PCM
P0108	**DTC P0108**	PCM
P0112	**DTC P0112**	PCM
P0113	**DTC P0113**	PCM
P0116	**DTC P0116**	PCM

P0117	**DTC P0117**	PCM
P0118	**DTC P0118**	PCM
P0122	**DTC P0122**	PCM
P0123	**DTC P0123**	PCM
P0125	**DTC P0125**	PCM
P0128	**DTC P0128**	PCM
P0133	**DTC P0133 or P0153**	PCM
P0135	**DTC P0135 or P0155**	PCM
P0137	**DTC P0137 or P0157**	PCM
P0138	**DTC P0138 or P0158**	PCM
P0139	**DTC P0139 or P0159**	PCM
P0141	**DTC P0141 or P0161**	PCM
P0153	**DTC P0133 or P0153**	PCM
P0155	**DTC P0135 or P0155**	PCM
P0157	**DTC P0137 or P0157**	PCM
P0158	**DTC P0138 or P0158**	PCM
P0159	**DTC P0139 or P0159**	PCM
P0161	**DTC P0141 or P0161**	PCM
P0171	**DTC P0171 or P0174**	PCM
P0172	**DTC P0172 or P0175**	PCM
P0174	**DTC P0171 or P0174**	PCM
P0175	**DTC P0172 or P0175**	PCM
P0201-P0206	**DTC P0201-P0206**	PCM
P0218	**DTC P0218**	PCM
P0222	**DTC P0222**	PCM
P0223	**DTC P0223**	PCM
P0300	**DTC P0300**	PCM
P0301-P0306	**DTC P0301-P0306**	PCM
P0325	**DTC P0325**	PCM
P0335	**DTC P0335**	PCM
P0340	**DTC P0340**	PCM
P0341	**DTC P0341**	PCM
P0385	**DTC P0385**	PCM
P0386	**DTC P0386**	PCM
P0401	**DTC P0401**	PCM
P0403	**DTC P0403**	PCM
P0404	**DTC P0404**	PCM
P0406	**DTC P0406**	PCM
P0420	**DTC P0420 or P0430**	PCM

P0430	**DTC P0420 or P0430**	PCM
P0442	**DTC P0442**	PCM
P0443	**DTC P0443**	PCM
P0446	**DTC P0446**	PCM
P0452	**DTC P0452**	PCM
P0453	**DTC P0453**	PCM
P0455	**DTC P0455**	PCM
P0461	**DTC P0461** In Instrument Panel, Gages, and Console	PCM
P0462	**DTC P0462** In Instrument Panel, Gages, and Console	PCM
P0463	**DTC P0463** In Instrument Panel, Gages, and Console	PCM
P0496	**DTC P0496**	PCM
P0498	**DTC P0498**	PCM
P0499	**DTC P0499**	PCM
P0501	**DTC P0501** in Automatic Transaxle - 5AT	PCM
P0502	**DTC P0502** in Automatic Transaxle - 5AT	PCM
P0503	**DTC P0503** in Automatic Transaxle - 5AT	PCM
P0506	**DTC P0506**	PCM
P0507	**DTC P0507**	PCM
P0520	**DTC P0520** In Instrument Panel, Gages, and Console	PCM
P0530	**DTC P0530, P0532, or P0533** in HVAC Systems - Manual	PCM
P0562	**DTC P0562** in Engine Electrical	PCM, IPC
P0563	**DTC P0563** in Engine Electrical	PCM, IPC
P0567	**DTC P0567 (2.2L)DTC P0567 (3.5L)** in Cruise Control	PCM
P0568	**DTC P0568 (2.2L)DTC P0568 (3.5L)** in Cruise Control	PCM
P0571	**DTC P0571 (2.2L)DTC P0571 (3.5L)** in Cruise Control	PCM
P0602	**DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610**	PCM
P0621	**DTC P0621** in Engine Electrical	PCM
P0622	**DTC P0622** in Engine Electrical	PCM
P0628	**DTC P0628**	PCM
P0629	**DTC P0629**	PCM
P0641	**DTC P0641**	PCM
P0646	**DTC P0645, P0646, or P0647** in HVAC Systems - Manual	PCM
P0647	**DTC P0645, P0646, or P0647** in HVAC Systems - Manual	PCM
P0651	**DTC P0651**	PCM
P0685	**DTC P0685**	PCM
P0688	**DTC P0688**	PCM
P0691	**DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L61)DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L66)** in Engine Cooling	PCM
P0692	**DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L61)DTC P0480,**	PCM

	P0481, P0691, P0692, P0693, P0694, or P1650 (L66) in Engine Cooling	
P0693	**DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L61)DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L66)** in Engine Cooling	PCM
P0694	**DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L61)DTC P0480, P0481, P0691, P0692, P0693, P0694, or P1650 (L66)** in Engine Cooling	PCM
P0705	**DTC P0705** in Automatic Transaxle - 5AT	PCM
P0706	**DTC P0706** in Automatic Transaxle - 5AT	PCM
P0711	**DTC P0711** in Automatic Transaxle - 5AT	PCM
P0712	**DTC P0712** in Automatic Transaxle - 5AT	PCM
P0713	**DTC P0713** in Automatic Transaxle - 5AT	PCM
P0716	**DTC P0716** in Automatic Transaxle - 5AT	PCM
P0717	**DTC P0717** in Automatic Transaxle - 5AT	PCM
P0718	**DTC P0718** in Automatic Transaxle - 5AT	PCM
P0731	**DTC P0731** in Automatic Transaxle - 5AT	PCM
P0732	**DTC P0732** in Automatic Transaxle - 5AT	PCM
P0733	**DTC P0733** in Automatic Transaxle - 5AT	PCM
P0734	**DTC P0734** in Automatic Transaxle - 5AT	PCM
P0735	**DTC P0735** in Automatic Transaxle - 5AT	PCM
P0741	**DTC P0741** in Automatic Transaxle - 5AT	PCM
P0746	**DTC P0746** in Automatic Transaxle - 5AT	PCM
P0747	**DTC P0747** in Automatic Transaxle - 5AT	PCM
P0751	**DTC P0751** in Automatic Transaxle - 5AT	PCM
P0752	**DTC P0752** in Automatic Transaxle - 5AT	PCM
P0756	**DTC P0756** in Automatic Transaxle - 5AT	PCM
P0757	**DTC P0757** in Automatic Transaxle - 5AT	PCM
P0761	**DTC P0761** in Automatic Transaxle - 5AT	PCM
P0762	**DTC P0762** in Automatic Transaxle - 5AT	PCM
P0776	**DTC P0776** in Automatic Transaxle - 5AT	PCM
P0777	**DTC P0777** in Automatic Transaxle - 5AT	PCM
P0780	**DTC P0780** in Automatic Transaxle - 5AT	PCM
P0847	**DTC P0847** in Automatic Transaxle - 5AT	PCM
P0848	**DTC P0848** in Automatic Transaxle - 5AT	PCM
P0872	**DTC P0872** in Automatic Transaxle - 5AT	PCM
P0873	**DTC P0873** in Automatic Transaxle - 5AT	PCM
P0962	**DTC P0962** in Automatic Transaxle - 5AT	PCM
P0963	**DTC P0963** in Automatic Transaxle - 5AT	PCM
P0966	**DTC P0966** in Automatic Transaxle - 5AT	PCM
P0967	**DTC P0967** in Automatic Transaxle - 5AT	PCM
P0973	**DTC P0973** in Automatic Transaxle - 5AT	PCM
P0974	**DTC P0974** in Automatic Transaxle - 5AT	PCM
P0976	**DTC P0976** in Automatic Transaxle - 5AT	PCM

P0977	**DTC P0977** in Automatic Transaxle - 5AT	PCM
P0979	**DTC P0979** in Automatic Transaxle - 5AT	PCM
P0980	**DTC P0980** in Automatic Transaxle - 5AT	PCM
P1128	**DTC P1128**	PCM
P1129	**DTC P1129**	PCM
P1574	**DTC P1574 (2.2L)DTC P1574 (3.5L)** in Cruise Control	PCM
P1621	**DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610**	PCM
P1630	**DTC P1630** in Theft Deterrent	PCM
P1631	**DTC P1631** in Theft Deterrent	PCM
P2100	**DTC P2100**	PCM
P2101	**DTC P2101**	PCM
P2108	**DTC P2108**	PCM
P2111	**DTC P2111**	PCM
P2112	**DTC P2112**	PCM
P2122	**DTC P2122**	PCM
P2123	**DTC P2123**	PCM
P2127	**DTC P2127**	PCM
P2128	**DTC P2128**	PCM
P2135	**DTC P2135**	PCM
P2138	**DTC P2138**	PCM
P2176	**DTC P2176**	PCM
P2199	**DTC P2199**	PCM
P2227	**DTC P2227**	PCM
P2228	**DTC P2228**	PCM
P2229	**DTC P2229**	PCM
P2238	**DTC P2238 or P2241**	PCM
P2239	**DTC P2239 or P2242**	PCM
P2241	**DTC P2238 or P2241**	PCM
P2242	**DTC P2239 or P2242**	PCM
P2243	**DTC P2243 or P2247**	PCM
P2245	**DTC P2245 or P2249**	PCM
P2247	**DTC P2243 or P2247**	PCM
P2249	**DTC P2245 or P2249**	PCM
P2252	**DTC P2252 or P2255**	PCM
P2253	**DTC P2253 or P2256**	PCM
P2255	**DTC P2252 or P2255**	PCM
P2256	**DTC P2253 or P2256**	PCM
P2282	**DTC P2282**	PCM
P2297	**DTC P2297 or P2298**	PCM
P2298	**DTC P2297 or P2298**	PCM
P2413	**DTC P2413**	PCM

P2414	**DTC P2414**	PCM
P2415	**DTC P2415**	PCM
P2553	**DTC P2553**	PCM
P2554	**DTC P2554**	PCM
P2555	**DTC P2555**	PCM
P2627	**DTC P2627 or P2630**	PCM
P2628	**DTC P2628 or P2631**	PCM
P2630	**DTC P2627 or P2630**	PCM
P2631	**DTC P2628 or P2631**	PCM
P2646	**DTC P2646**	PCM
P2647	**DTC P2647**	PCM
P2648	**DTC P2648**	PCM
P2649	**DTC P2649**	PCM
P2763	**DTC P2763** in Automatic Transaxle - 5AT	PCM
P2764	**DTC P2764** in Automatic Transaxle - 5AT	PCM
P2769	**DTC P2769** in Automatic Transaxle - 5AT	PCM
P2770	**DTC P2770** in Automatic Transaxle - 5AT	PCM
U0107	**DTC U0107**	PCM

DIAGNOSTIC INFORMATION & PROCEDURES

DTC P0030, P0036, P0050, OR P0056

Circuit Description

The heated oxygen sensor (HO2S) heater reduces the time required for the oxygen sensor to reach operating temperature and maintains the operating temperature during extended idle periods. When the ignition is turned to the ON position, ignition voltage is supplied directly to the sensor heater. The PCM controls the heater by grounding the control circuit with a solid state device called a driver. If the PCM detects the control circuit voltage is not within a predetermined range when the circuit is commanded ON or OFF, this DTC sets.

DTC Descriptors

This diagnostic procedure supports the following DTCs.

- DTC P0030 Heater Control Circuit Bank 1 Sensor 1
- DTC P0036 Heater Control Circuit Bank 1 Sensor 2
- DTC P0050 Heater Control Circuit Bank 2 Sensor 1
- DTC P0056 Heater Control Circuit Bank 2 Sensor 2

Conditions for Running the DTC

- Conditions for running DTCs P0030 and P0050
  - The engine is operating.
  - DTCs P0133, P0153, P2238, P2241, P2242, P2243, P2245, P2247, P2249, P2252, P2255, P2256, P2297, P2298, P2414, P2415, P2627, P2628, P2630, and P2631 are not set.
  - The heater control circuit is being commanded ON and OFF.
- Conditions for running DTCs P0036 and P0056
  - The ignition is ON.
  - The heater control circuit is being commanded ON and OFF.
- DTCs P0030, P0036, P0050, and P0056 run continuously once the above conditions are met for more than 1 second.

Conditions for Setting the DTC

- The PCM detects the heater control circuit voltage is less than a predetermined range when the circuit is commanded OFF.
- The PCM detects the heater control circuit voltage is more than a predetermined range when the circuit is commanded ON.

- The condition exists for more than 1 second.

Action Taken When the DTC Sets

- The powertrain control module (PCM) illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

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

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4: If all DTCs are set for either the front sensors or the rear sensors, the ignition voltage circuit to the heaters may be open. The front sensors and rear sensors share the same fuse.

Heated Oxygen Sensor (HO2S) Open Circuit

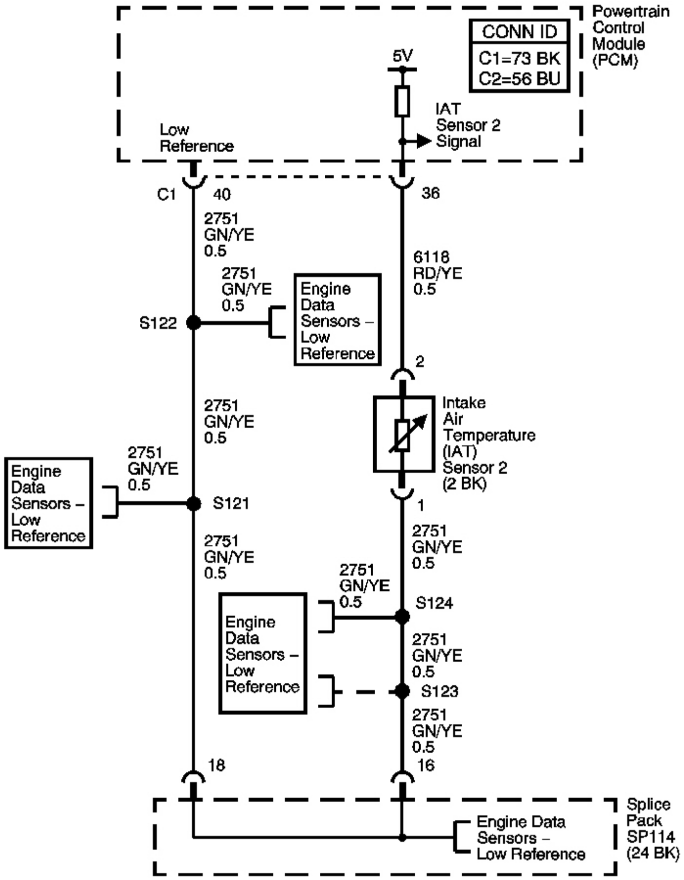
Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	1. Start the engine. 2. Allow the engine to idle for at least 30 seconds.			

2	3. Observe the DTC information with a scan tool. Does DTC P0030, DTC P0036, DTC P0050, or DTC P0056 set?	-	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to Diagnostic Aids
4	Are DTCs P0030, P0036, P0050, and P0056 set at the same time?	-	Go to **Step 12**	Go to **Step 5**
5	1. Turn OFF the ignition. **IMPORTANT:** **The ignition must be OFF when disconnecting or connecting the HO2S electrical connector.** 2. Disconnect the appropriate HO2S. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the ignition voltage circuit of the HO2S and the PCM housing. Does the test lamp illuminate?	-	Go to **Step 6**	Go to **Step 12**
6	Connect a test lamp between the ignition voltage circuit of the HO2S and the heater control circuit. Does the test lamp illuminate?	-	Go to **Step 8**	Go to **Step 7**
7	1. Connect a test lamp between the ignition voltage circuit of the HO2S and the heater control circuit. 2. With a scan tool command the HO2S heater ON and OFF. Does the test lamp flash ON and OFF?	-	Go to **Step 10**	Go to **Step 9**
	1. Turn OFF the ignition. 2. Disconnect the PCM.			

8	3. Test the heater control circuit between the HO2S and the PCM for a short to ground. Refer to in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 11**
9	1. Turn OFF the ignition. 2. Disconnect the PCM. 3. Test the heater control circuit between the HO2S and the PCM for an open, a short to voltage or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 11**
10	Test for an intermittent and for a poor connection at the HO2S. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 13**
11	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 14**
12	**IMPORTANT:** **The ignition voltage circuit supplies voltage to other components. Make sure you test all circuits for a short to ground or test all components for being shorted that share the ignition voltage circuit.** 1. Repair the open or the grounded ignition voltage circuit of the HO2S. Refer to **Wiring Repairs** in Wiring Systems. 2. Replace the fuse if necessary. Did you complete the repair?	-	Go to **Step 15**	-
13	Replace the HO2S. Refer to the appropriate procedure: • **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** • **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 2**	-		

	- **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1** - **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1** Did you complete the replacement?		Go to **Step 15**	-
14	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 15**	-
15	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 16**
16	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0097



<u>Fig. 1: DTC P0097 Circuit</u>
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0097 Intake Air Temperature (IAT) Sensor 2 Circuit Low Voltage diagnostic monitors the signal circuit value. The IAT sensor is a variable resistor that measures the temperature of the intake air. The powertrain control module (PCM) supplies 5 volts to the IAT signal circuit and supplies a ground to the low reference circuit. If the PCM detects a low IAT signal voltage, which is a high temperature indication, this DTC sets.

The following table illustrates the difference between temperature, resistance, and voltage:

DTC P0097 Circuit

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

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P0097 Intake Air Temperature (IAT) Sensor 2 Circuit Low Voltage

Conditions for Running the DTC

- The ignition is ON.
- DTC P0098 is not set.
- DTC P0097 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The PCM detects that the intake air temperature (IAT) sensor signal voltage is 0.08 volts or less.
- The above condition is present for at least 5 seconds.

Action Taken When the DTC Sets

- The powertrain control module (PCM) illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

- Use the Temperature vs Resistance table in order to test the IAT sensor at various temperature levels in order to evaluate the possibility of a skewed sensor. A skewed sensor could result in a driveability condition. If the engine has sat overnight, the engine coolant temperature and the intake air temperature values should display within a few degrees. If the temperatures are not within 3°C (5°F), refer to **Temperature vs Resistance - Intake Air Temperature (IAT) Sensor** .
- An intermittent malfunction may be caused by a fault in the IAT sensor electrical circuit. Inspect the wiring harness and the components for an intermittent condition. Refer to **Intermittent Conditions** .

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step determines if a condition is present.

5: Disconnecting the PCM allows using the DMM in order to check continuity of the circuits. This aids in locating an open or a shorted circuit.

7: After replacing the PCM a new minimum throttle position and idle speed must also be established.

DTC P0097 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the IAT sensor 2 parameter with a scan tool. Does the scan tool indicate that the IAT sensor 2 is more than specified value?	168°C (334°F)	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame and/or the Failure records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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 and/or the Failure Records data. Does the DTC fail this ignition cycle?	-	Go to **Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the electrical connector of the IAT sensor 2. Refer to **Intake Air Temperature (IAT) Sensor 1 Replacement** . 3. Turn ON the ignition, with the engine OFF. Does the scan tool indicate that the IAT sensor 2 is at the specified value?	-40°C (-40°F)	Go to **Step 6**	Go to **Step 5**
	1. Turn OFF the ignition. 2. Disconnect the PCM. Refer to **Powertrain Control Module (PCM) Replacement** .			

5	3. Test the IAT signal circuit for a short to a ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 8**	Go to **Step 7**
6	Replace the IAT sensor 2. Refer to **Intake Air Temperature (IAT) Sensor 2 Replacement** . Did you complete the replacement?	-	Go to **Step 8**	-
7	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 8**	-
8	1. Use the scan tool in order to clear the DTCs. 2. Turn the ignition OFF for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. Does the DTC run and pass?	-	Go to **Step 9**	Go to **Step 2**
9	With a scan tool, select Capture Info in order to observe the stored information. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0098

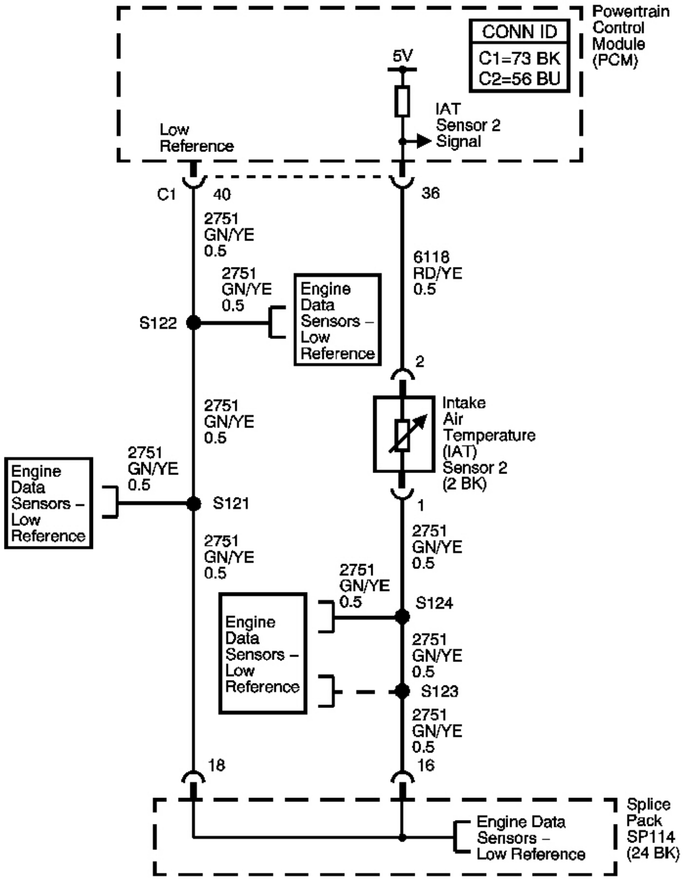


Fig. 2: DTC P0098 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0098 Intake Air Temperature (IAT) Sensor 2 Circuit High Voltage diagnostic monitors the signal circuit value. The IAT sensor is a variable resistor that measures the temperature of the intake air. The powertrain control module (PCM) supplies 5 volts to the IAT signal circuit and supplies a ground to the low reference circuit. If the PCM detects a high IAT signal voltage, which is a low temperature indication, this DTC sets.

The following table illustrates the difference between temperature, resistance, and voltage:

DTC P0098 Circuit

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

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P0098 Intake Air Temperature (IAT) Sensor 2 Circuit High Voltage

Conditions for Running the DTC

- The ignition is ON.
- DTC P0097 is not set.
- DTC P0098 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The PCM detects that the intake air temperature (IAT) sensor 2 voltage is 4.95 volts or more.
- The above condition is present for at least 5 seconds.

Action Taken When the DTC Sets

- The powertrain control module (PCM) illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

- Use the Temperature vs Resistance table in order to test the IAT sensor at various temperature levels in order to evaluate the possibility of a skewed sensor. A skewed sensor could result in a driveability condition. If the engine has sat overnight, the engine coolant temperature and the intake air temperature values should display within a few degrees. If the temperatures are not within 3°C (5°F), refer to **Temperature vs Resistance - Intake Air Temperature (IAT) Sensor** .
- An intermittent malfunction may be caused by a fault in the IAT sensor electrical circuit. Inspect the wiring harness and the components for an intermittent condition. Refer to **Intermittent Conditions** .

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step will determine if a fault is present.

3: Review the Freeze Frame data to determine when the DTC set. Always record this information.

4: This step determines if there is a fault in the IAT circuit wiring.

11: After replacing the PCM a new minimum throttle position and idle speed must also be established.

DTC P0098 Circuit

Step	Action	Value (s)	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, leaving the engine OFF. 2. Install a scan tool. 3. Observe the intake air temperature (IAT) parameter on the scan tool. Is the IAT less than or equal to the specified value?	-40°C (-40°F)	Go to **Step 4**	Go to **Step 3**
3	1. Use the scan tool clear information function. 2. Operate the vehicle within the Freeze Frame conditions as noted. Does DTC P0113 set?	-	Go to **Step 4**	Go to Diagnostic Aids
4	1. Disconnect the IAT sensor 2 electrical connector. 2. Jump the IAT signal circuit and the sensor ground circuit together at the IAT sensor harness connector. 3. Observe the IAT parameter on the scan tool. Is the IAT equal to or more than the specified value?	168°C (334°F)	Go to **Step 6**	Go to **Step 5**
	1. Jumper the IAT signal circuit at the sensor			

5	harness connector to chassis ground. 2. Observe the IAT parameter on the scan tool. Is the IAT equal to or more than the specified value?	168°C (334°F)	Go to **Step 7**	Go to **Step 8**
6	1. Check for a faulty electrical connection at the IAT sensor 2. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 10**
7	1. Turn OFF the ignition. 2. Disconnect the PCM. 3. Check the IAT sensor 2 ground circuit for an open circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
8	1. Turn OFF the ignition. 2. Disconnect the PCM. 3. Check the IAT sensor 2 signal circuit for an open. 4. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
9	1. Check for a faulty connection at the PCM. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
10	Replace the IAT sensor 2. Refer to **Intake Air Temperature (IAT) Sensor 2 Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
11	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 12**	-

12	1. Use the scan tool in order to clear the DTCs. 2. Turn the ignition OFF for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. Does the DTC run and pass?	-	Go to **Step 13**	Go to **Step 2**
13	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0107

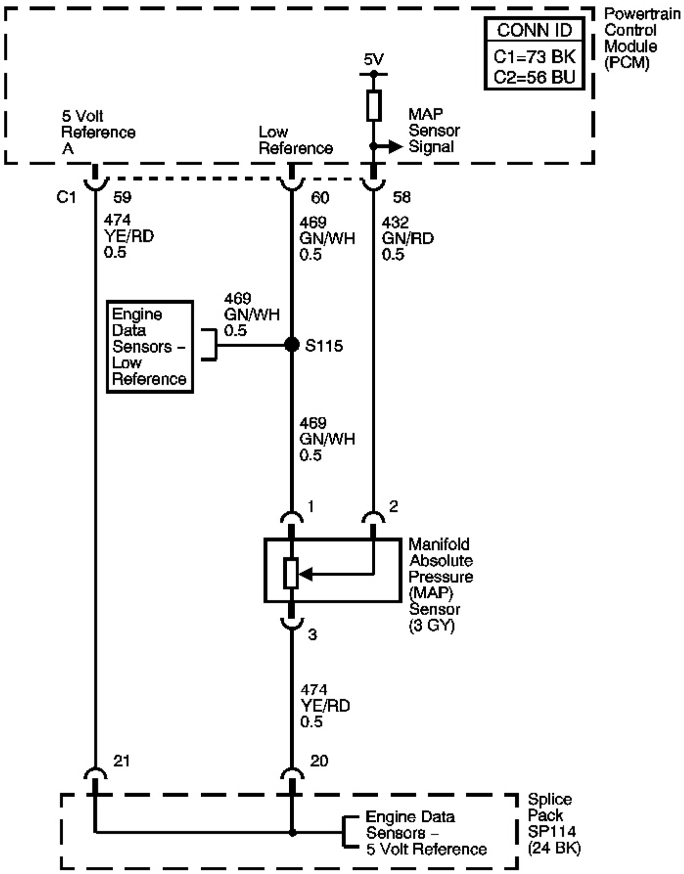


Fig. 3: DTC P0107 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0107 Manifold Absolute Pressure (MAP) Sensor Circuit Low Voltage diagnostic monitors the MAP sensor response to pressure changes in the intake manifold. The pressure changes occur based on engine load and the throttle valve opening. The MAP sensor has the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The powertrain control module (PCM) supplies 5 volts to the MAP sensor on the 5-volt reference circuit. The PCM also provides a ground on the low reference circuit. The PCM receives a low voltage on the signal circuit when manifold vacuum is high at idle or deceleration. The PCM receives a high voltage when manifold vacuum is low at wide open throttle (WOT) or when the ignition is ON and the engine is OFF. The PCM monitors the MAP sensor signal for voltage outside of the normal range and sets a DTC P0107 when the voltage is unusually low.

The following table illustrates the difference between MAP kPa, signal voltage, and engine vacuum.

DTC P0107 Circuit

Engine Condition	MAP kPa	MAP Signal Voltage	Manifold Vacuum
Idle	Low	Low	High
Deceleration	Low	Low	High
Ignition ON, Engine OFF	High	High	Zero
Wide-Open Throttle	High	High	Low

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P0107 Manifold Absolute Pressure (MAP) Sensor Circuit Low Voltage

Conditions for Running the DTC

- The engine is operating.
- DTC P0108 is not set.
- DTC P0107 runs continuously once the above conditions are met.

Conditions for Setting the DTC

The MAP sensor signal is 0.23 volts or less for at least 2 seconds.

Action Taken When the DTC Sets

- The powertrain control module (PCM) illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame/Failure Records.
- The PCM enters the Fail Safe Function and uses default MAP values based on throttle position, while the fuel control system operates in OPEN LOOP.

Conditions for Clearing the MIL/DTC

- The MIL turns OFF after 3 consecutively passing trips without a fault present.
- A history DTC clears after 40 consecutive warm-up cycles without a fault.
- Perform the scan tool Clear DTC Information function.

Diagnostic Aids

- Inspect for a restriction or blockage in the vacuum passage to the MAP sensor orifice.
- An intermittent malfunction may be caused by a fault in the MAP sensor circuit. Inspect the wiring harness and the components for an intermittent condition. Refer to **Intermittent Conditions** .
- If the DTC P0107 cannot be duplicated, the information included in the Freeze Frame data can be useful in determining the vehicle operating conditions when the DTC was first set.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

1: The Diagnostic System Check- Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step determines if a MAP sensor malfunction is present. The input signal of the MAP sensor should indicate atmospheric pressure with the ignition ON, engine OFF. The MAP sensor will vary with atmospheric pressure. A typical pressure at sea level is 100 kPa (29-30 in Hg).

5: This step checks for an open in the MAP sensor reference voltage circuit.

6: The MAP sensor signal circuit carries a 5 volt bias that can be measured with the DMM. If the measured voltage is near zero there is a short to ground or a faulty PCM.

DTC P0107 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check- Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	1. Turn ON the ignition, with the engine OFF. 2. Observe the manifold absolute pressure (MAP) sensor parameter on the scan tool.	95-100		

2	Is the MAP sensor value within the specified range?	kPa	Go to **Step 3**	Go to **Step 4**
3	1. Use the scan tool in order to clear the DTCs. 2. Start the engine. 3. Operate the vehicle within the Freeze Frame conditions as specified or within the Conditions for Running the DTC. Review the supporting text. Did DTC P0107 set?	-	Go to **Step 4**	Go to Diagnostic Aids
4	Was DTC P0502 also set?	-	Go to **Step 9**	Go to **Step 5**
5	1. Turn OFF the ignition. 2. Disconnect the MAP sensor electrical connector. 3. Turn ON the ignition, with the engine OFF. 4. Measure the 5-volt reference circuit of the MAP sensor with a DMM. Is the voltage near the specified value?	5.0 V	Go to **Step 6**	Go to **Step 8**
6	Measure the voltage of the MAP sensor signal circuit with a DMM. Is the voltage near the specified value?	4.9 V	Go to **Step 10**	Go to **Step 7**
7	1. Test the MAP sensor signal circuit for a short to ground. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 12**	Go to **Step 11**
8	Repair the open in the 5-volt reference sensor circuit between the MAP sensor and SP114. Refer to **Wiring Repairs** in Wiring Systems. Is the action complete?	-	Go to **Step 12**	-
9	Repair the open in the 5-volt reference sensor circuit between the PCM and SP114. Refer to **Wiring Repairs** in Wiring Systems. Is the action complete?	-	Go to **Step 12**	-
10	Replace the MAP sensor. Refer to **Manifold Absolute Pressure (MAP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
	1. Replace the PCM. Refer to **Powertrain**			

11	**Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Use the scan tool in order to clear the DTCs. 2. Turn the ignition OFF for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC or until the DTC P0107 diagnostic has passed. Does the DTC run and pass?	-	Go to **Step 13**	Go to **Step 2**
13	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0108

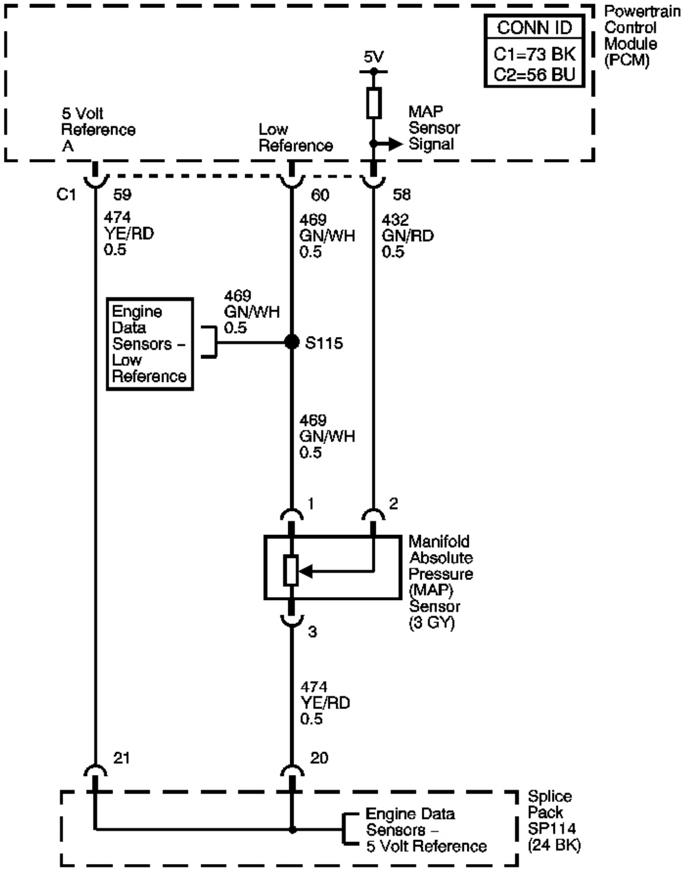


Fig. 4: DTC P0108 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0108 Manifold Absolute Pressure (MAP) Sensor Circuit High Voltage diagnostic monitors the MAP sensor response to pressure changes in the intake manifold. The pressure changes occur based on engine load and the throttle valve opening. The MAP sensor has the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The powertrain control module (PCM) supplies 5 volts to the MAP sensor on the 5-volt reference circuit. The PCM also provides a ground on the low reference circuit. The PCM receives a low voltage on the signal circuit when manifold vacuum is high at idle or deceleration. The PCM receives a high voltage when manifold vacuum is low at wide open throttle (WOT) or when the ignition is ON and the engine is OFF. The PCM monitors the MAP sensor signal for voltage outside of the normal range and sets a DTC P0108 when the voltage is unusually high.

The following table illustrates the difference between MAP kPa, signal voltage, and engine vacuum.

DTC P0108 Circuit

Engine Condition	MAP kPa	MAP Signal Voltage	Manifold Vacuum
Idle	Low	Low	High
Deceleration	Low	Low	High
Ignition ON, Engine OFF	High	High	Zero
Wide-Open Throttle	High	High	Low

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P0108 Manifold Absolute Pressure (MAP) Sensor Circuit High Voltage

Conditions for Running the DTC

- The engine is operating.
- DTCs P0107 is not set.
- DTC P0108 runs continuously once the above conditions are met.

Conditions for Setting the DTC

The MAP sensor signal is 4.49 volts or more for at least 2 seconds.

Action Taken When the DTC Sets

- The powertrain control module (PCM) illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame/Failure Records.
- The PCM enters the Fail Safe Function and uses default MAP values based on throttle position, while the fuel control system operates in OPEN LOOP.

Conditions for Clearing the MIL/DTC

- The MIL turns OFF after 3 consecutively passing trips without a fault present.
- A history DTC clears after 40 consecutive warm-up cycles without a fault.
- Perform the scan tool Clear DTC Information function.

Diagnostic Aids

- Inspect for the following conditions:

- Inspect for an exhaust gas recirculation (EGR) valve that is stuck open.
- Inspect for a restricted exhaust system. Refer to **Restricted Exhaust** in Engine Exhaust.

- An intermittent malfunction may be caused by a fault in the MAP sensor circuit. Inspect the wiring harness and the components for an intermittent condition. Refer to **Intermittent Conditions** .
- If the DTC P0108 cannot be duplicated, the information included in the Freeze Frame data can be useful in determining the vehicle operating conditions when the DTC was first set.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

1: The Diagnostic System Check- Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step determines if a MAP sensor malfunction is present. The input signal of the MAP sensor should indicate atmospheric pressure with the ignition ON, engine OFF. The MAP sensor will vary with atmospheric pressure. A typical pressure at sea level is 100 kPa (29-30 in Hg).

5: The MAP sensor signal circuit carries a 5 volt bias that can be measured with the DMM. If the measured voltage is near zero there is an open or a faulty PCM.

7: This step checks for an open in the MAP sensor ground circuit. This step checks for an open in the MAP sensor ground circuit.

DTC P0108 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check- Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the manifold absolute pressure (MAP) sensor parameter on the scan tool. Is the MAP sensor value within the specified range?	95-100 kPa	Go to **Step 3**	Go to **Step 4**
3	1. Use the scan tool in order to clear the DTCs. 2. Start the engine. 3. Operate the vehicle within the Freeze Frame conditions as specified or within the Conditions for Running the DTC. Review the supporting text.	-		Go to Diagnostic

	Did DTC P0108 set?		Go to **Step 4**	Aids
4	Was DTC P0502 also set?	-	Go to **Step 9**	Go to **Step 5**
5	1. Turn OFF the ignition. 2. Disconnect the MAP sensor electrical connector. 3. Turn ON the ignition, with the engine OFF. 4. Measure the MAP sensor signal circuit voltage with a DMM. Is the voltage near the specified value?	4.9 V	Go to **Step 7**	Go to **Step 6**
6	1. Test the MAP sensor signal circuit for an open or a short to voltage. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Was a repair necessary?	-	Go to **Step 12**	Go to **Step 11**
7	Probe the MAP sensor ground circuit on the harness side with a test lamp connected to B+. Does the test lamp illuminate?	-	Go to **Step 10**	Go to **Step 8**
8	Repair the open in the sensor ground circuit between the MAP sensor and S115. Refer to **Wiring Repairs** in Wiring Systems. Is the action complete?	-	Go to **Step 12**	-
9	Repair the open in the sensor ground circuit between the PCM and S115. Refer to **Wiring Repairs** in Wiring Systems. Is the action complete?	-	Go to **Step 12**	-
10	Replace the MAP sensor. Refer to **Manifold Absolute Pressure (MAP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
11	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Use the scan tool in order to clear the DTCs. 2. Turn the ignition OFF for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions	-		

	for Running the DTC or until the DTC P0108 diagnostic has passed. Does the DTC run and pass?		Go to **Step 13**	Go to **Step 2**
13	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0112

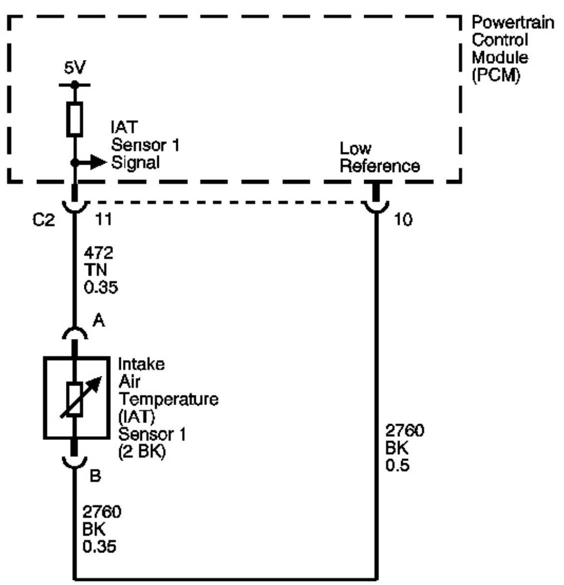


Fig. 5: DTC P0112 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0112 Intake Air Temperature (IAT) Sensor Circuit Low Voltage diagnostic monitors the signal circuit value. The IAT sensor is a variable resistor that measures the temperature of the intake air. The powertrain control module (PCM) supplies 5 volts to the IAT signal circuit and supplies a ground to the low reference circuit. If the PCM detects a low IAT signal voltage, which is a high temperature indication, this DTC sets.

The following table illustrates the difference between temperature, resistance, and voltage:

DTC P0112 Circuit

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

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P0112 Intake Air Temperature (IAT) Sensor 1 Circuit Low Voltage

Conditions for Running the DTC

- The ignition is ON.
- DTC P0113 is not set.
- DTC P0112 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The PCM detects that the intake air temperature (IAT) sensor signal voltage is 0.08 volts or less.
- The above condition is present for at least 5 seconds.

Action Taken When the DTC Sets

- The powertrain control module (PCM) illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

- Use the Temperature vs Resistance table in order to test the IAT sensor at various temperature levels in order to evaluate the possibility of a skewed sensor. A skewed sensor could result in a driveability condition. If the engine has sat overnight, the engine coolant temperature and the intake air temperature values should display within a few degrees. If the temperatures are not within 3°C (5°F), refer to **Temperature vs Resistance - Intake Air Temperature (IAT) Sensor** .
- For an intermittent condition, refer to **Intermittent Conditions** .

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step determines if a condition is present.

4: An intake air temperature below -30°C (-22°F) indicates the PCM and the IAT wiring are OK.

5: Disconnecting the PCM allows using the DMM in order to check continuity of the circuits. This aids in locating an open or a shorted circuit.

7: After replacing the PCM a new minimum throttle position and idle speed must also be established.

DTC P0112 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the IAT sensor parameter with a scan tool. Does the scan tool indicate that the IAT sensor is more than specified value?	168°C (334°F)	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame and/or the Failure records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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 and/or the Failure Records data. Does the DTC fail this ignition cycle?	-	Go to **Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the electrical connector of the IAT sensor. Refer to **Intake Air Temperature (IAT) Sensor 1 Replacement** . 3. Turn ON the ignition, with the engine OFF. Does the scan tool indicate that the IAT sensor is at the specified value?	-40°C (-40°F)	Go to **Step 6**	Go to **Step 5**

5	1. Turn OFF the ignition. 2. Disconnect the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 3. Test the IAT signal circuit for a short to a ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 8**	Go to **Step 7**
6	Replace the IAT sensor. Refer to **Intake Air Temperature (IAT) Sensor 1 Replacement** Did you complete the replacement?	-	Go to **Step 8**	-
7	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 8**	-
8	1. Use the scan tool in order to clear the DTCs. 2. Turn the ignition OFF for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. Does the DTC run and pass?	-	Go to **Step 9**	Go to **Step 2**
9	With a scan tool, select Capture Info in order to observe the stored information. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0113

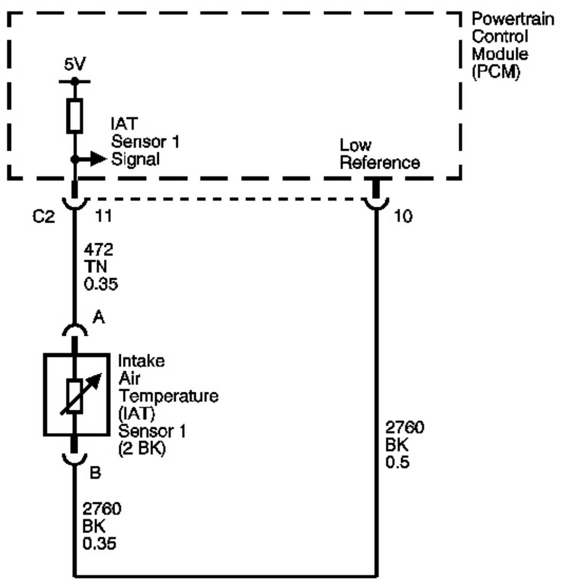


Fig. 6: DTC P0113 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0113 Intake Air Temperature (IAT) Sensor 1 Circuit High Voltage diagnostic monitors the signal circuit value. The IAT sensor is a variable resistor that measures the temperature of the intake air. The powertrain control module (PCM) supplies 5 volts to the IAT signal circuit and supplies a ground to the low reference circuit. If the PCM detects a high IAT signal voltage, which is a low temperature indication, this DTC sets.

The following table illustrates the difference between temperature, resistance, and voltage:

DTC P0113 Circuit

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

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P0113 Intake Air Temperature (IAT) Sensor 1 Circuit High Voltage

Conditions for Running the DTC

- The ignition is ON.
- DTC P0112 is not set.
- DTC P0113 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The PCM detects that the intake air temperature (IAT) sensor 1 signal voltage is 4.95 volts or more.
- The above condition is present for at least 5 seconds.

Action Taken When the DTC Sets

- The powertrain control module (PCM) illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

- Use the Temperature vs Resistance table in order to test the IAT sensor at various temperature levels in order to evaluate the possibility of a skewed sensor. A skewed sensor could result in a driveability condition. If the engine has sat overnight, the engine coolant temperature and the intake air temperature values should display within a few degrees. If the temperatures are not within 3°C (5°F), refer to **Temperature vs Resistance - Intake Air Temperature (IAT) Sensor** .
- For an intermittent condition, refer to **Intermittent Conditions** .

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step will determine if a fault is present.

3: Review the Freeze Frame data to determine when the DTC set. Always record this information.

4: This step determines if there is a fault in the IAT circuit wiring.

11: After replacing the PCM a new minimum throttle position and idle speed must also be established.

DTC P0113 Circuit

Step	Action	Value (s)	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, leaving the engine OFF. 2. Install a scan tool. 3. Observe the intake air temperature (IAT) parameter on the scan tool. Is the IAT less than or equal to the specified value?	-40°C (-40°F)	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame and/or the Failure records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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 and/or the Failure Records data. Does the DTC fail this ignition cycle?	-	Go to **Step 4**	Go to Diagnostic Aids
4	1. Disconnect the IAT sensor 1 electrical connector. 2. Jump the IAT signal circuit and the sensor 1 ground circuit together at the IAT sensor 1 harness connector. 3. Observe the IAT parameter on the scan tool. Is the IAT equal to or more than the specified value?	168°C (334°F)	Go to **Step 6**	Go to **Step 5**
5	1. Jumper the IAT signal circuit at the sensor 1 harness connector to chassis ground. 2. Observe the IAT parameter on the scan tool. Is the IAT equal to or more than the specified value?	168°C (334°F)	Go to **Step 7**	Go to **Step 8**
	1. Check for a faulty electrical connection at the IAT sensor 1. Refer to **Testing for**			

6	**Intermittent Conditions and Poor Connections** in Wiring Systems. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 10**
7	1. Turn OFF the ignition. 2. Disconnect the PCM. 3. Check the IAT sensor 1 ground circuit for an open circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
8	1. Turn OFF the ignition. 2. Disconnect the PCM. 3. Check the IAT sensor 1 signal circuit for an open. 4. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
9	1. Check for a faulty connection at the PCM. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
10	Replace the IAT sensor 1. Refer to **Intake Air Temperature (IAT) Sensor 1 Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
11	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Use the scan tool in order to clear the DTCs. 2. Turn the ignition OFF for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC.	-		

	Does the DTC run and pass?		Go to **Step 13**	Go to **Step 2**
13	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0116

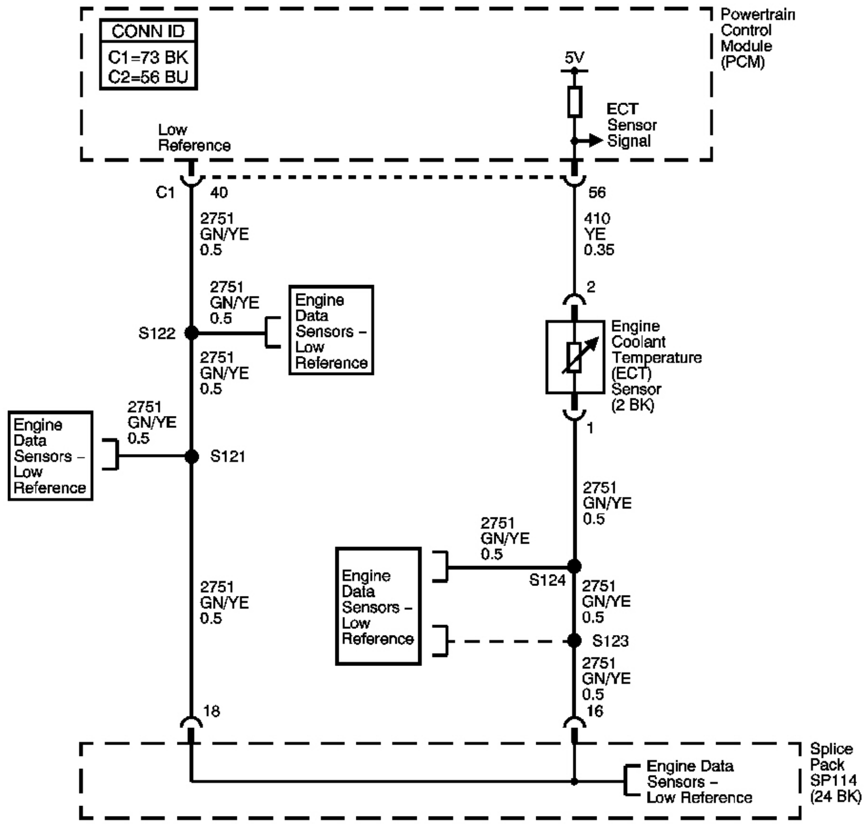


Fig. 7: DTC P0116 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0116 Engine Coolant Temperature (ECT) Sensor Performance diagnostic monitors the sensor activity. The ECT sensor is a thermistor. A thermistor is a resistor whose value varies with temperature. The ECT sensors resistance is high when the coolant temperature is cold, and the ECT sensors resistance is low when the coolant temperature is warm. The ECT sensor is wired in series with a fixed resistor in the powertrain control module (PCM). The PCM applies 5 volts to the ECT sensor. The PCM monitors the voltage across the ECT sensor and converts the voltage into a temperature reading. The PCM will receive a high voltage signal when the coolant temperature is cold. The PCM will receive a low voltage signal when the coolant temperature is warm. If the ECT sensor voltage does not indicate that the engine coolant temperature has increased sufficiently during engine operation, this DTC sets.

The following table illustrates the difference between temperature, resistance, and voltage:

DTC P0116 Circuit

Temperature	ECT Resistance	ECT Signal Voltage
Cold	High	High
Warm	Low	Low

DTC Descriptors

This diagnostic procedure supports the following DTC.

DTC P0116 Engine Coolant Temperature (ECT) Sensor Performance

Conditions for Running the DTC

- The engine speed is between 1000-1500 RPM.
- DTCs P0030, P0050, P0107, P0108, P0112, P0113, P0117, P0118, P0125, P0135, P0155, P0171, P0172, P0174, P0175, P0201- P0206, P0300-P0306, P0335, P0401, P0403, P0404, P0443, P0496, P0506, P0507, P0641, P1128, P1129, P2227, P2228, P2229, P2413, P2414, P2415, P2646, P2647, P2648, and P2649 are not set.
- The engine coolant temperature is between -7 and +38°C (20-100°F) at engine start up.
- The intake air temperature is at least -7°C (20°F).
- Manifold absolute pressure is between 48-32 kPa.
- Fuel cut-off is not active.
- DTC P0116 runs once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

The ECT does not reach at least 30°C (86°F) in 20 minutes.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the PCM stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the PCM records the operating conditions at the time of the failure. The PCM writes the conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

Check for the following conditions:

- Check for the proper operation of the engines cooling system, including the correct coolant level.
- A faulty thermostat that stays open slightly can cause DTC P0116 to set in cold weather when the vehicle is started and let sit while warming up. Replace any suspect thermostat.
- Use the Temperature vs Resistance table in order to evaluate the possibility of a shifted ECT sensor. A shifted sensor could result in DTC P0116. Refer to **Temperature vs Resistance - Engine Coolant Temperature (ECT) Sensor** .
- Check for a faulty electrical connection to the PCM.

An intermittent malfunction may be caused by a fault in the ECT sensor electrical circuit. Inspect the wiring harness and components for an intermittent condition. Refer to **Intermittent Conditions** .

Repair any electrical circuit faults that were found. Refer to **Wiring Repairs** in Wiring Systems.

If DTC P0116 cannot be duplicated, the information included in the Freeze Frame data can be useful in determining the vehicle operating conditions when the DTC was first set.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

3: This step checks for a faulty ECT sensor or ECT sensor circuit.

4: This step checks the integrity of the ECT sensor signal circuit.

5: This step checks the integrity of the ECT sensor signal and ground circuits.

6: This step checks the integrity of the ECT sensor ground circuit.

10: After replacing the PCM a new minimum throttle position and idle speed must also be established.

12: This step determines if DTC P0116 is the result of a hard failure or an intermittent condition.

DTC P0116 Circuit

Step	Action	Values	Yes	No

Connector End View Reference: **Powertrain Control Module (PCM) Connector End Views** or **Engine Controls Connector End Views**

1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Check for DTC P0117 or DTC P0118 with a scan tool. Is DTC P0117 or DTC P0118 set?	-	Go to **DTC P0117** or **DTC P0118**	Go to **Step 3**
3	1. Measure the actual coolant temperature. 2. Turn ON the ignition, with the engine OFF. 3. Observe the ECT sensor parameter on the scan tool. Is the ECT sensor value displayed near the actual coolant temperature?	-	Go to **Step 11**	Go to **Step 4**
4	1. Disconnect the ECT sensor electrical connector. 2. Observe the ECT sensor parameter on the scan tool. Does the engine coolant temperature equal the specified value?	-40°C (-40°F)	Go to **Step 5**	Go to **Step 8**
5	1. Jump the ECT sensor signal circuit and the ground circuit together at the ECT sensor harness connector. 2. Observe the ECT sensor parameter on the scan tool. Is the engine coolant temperature more than the specified value?	168°C (334°F)	Go to **Step 11**	Go to **Step 6**
6	1. Jump the ECT sensor signal circuit to chassis ground. 2. Observe the ECT sensor parameter on the scan tool. Is the engine coolant temperature more than the specified value?	168°C (334°F)	Go to **Step 7**	Go to **Step 9**
7	Repair the open or high resistance in the ECT sensor ground circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 15**	Go to **Step 9**
	1. Turn OFF the ignition.			

8	2. Test the ECT sensor signal circuit for a short. 3. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 10**
9	1. Check for a faulty connection at the PCM and the ECT electrical connectors. 2. Repair as necessary. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 10**
10	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 15**	-
11	Observe the ECT sensor parameter on the scan tool. Is the temperature more than 80°C (176°F)?	-	Go to **Step 12**	Go to **Step 13**
12	1. Let the engine cool for 1 hour. 2. Observe the ECT sensor parameter on the scan tool. Did the ECT sensor parameter indicate that the coolant temperature has decreased more than the specified value?	2°C (3.6°F)	Go to Diagnostic Aids	Go to **Step 14**
13	1. Let the engine run at 3,000 RPM until the engine cooling fan turns ON. 2. Observe the ECT sensor parameter on the scan tool. Did the ECT sensor parameter indicate that the coolant temperature has increased more than the specified value?	2°C (3.6°F)	Go to Diagnostic Aids	Go to **Step 14**
14	Replace the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
	1. Use the scan tool in order to clear the DTCs. 2. Turn OFF the ignition for 30 seconds.			

15	3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text or until the DTC P0116 diagnostic test has run. Does the DTC run and pass?	-	Go to **Step 16**	Go to **Step 2**
16	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0117

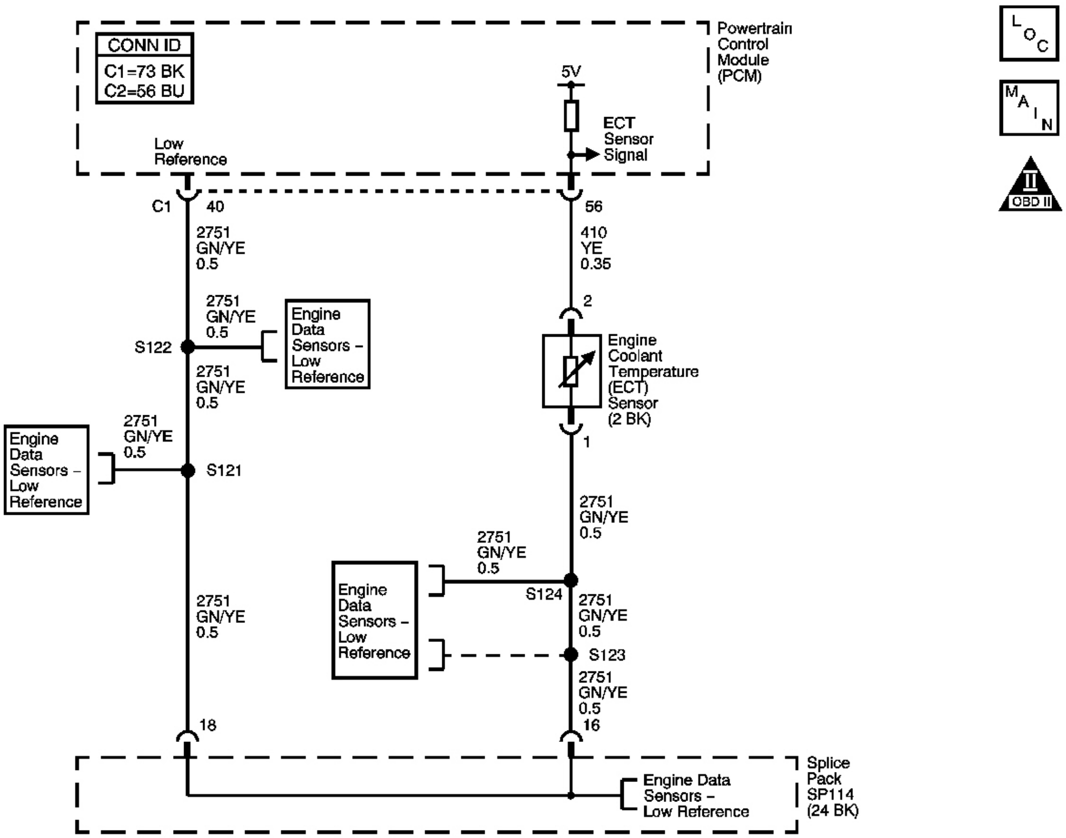


Fig. 8: DTC P0117 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0117 Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage diagnostic monitors the signal circuit value. The ECT sensor is a variable resistor that measures the temperature of the engine coolant. The powertrain control module (PCM) supplies 5 volts to the ECT signal circuit and supplies a ground to the low reference circuit. If the PCM detects a low ECT signal voltage, which is a high temperature indication, this DTC sets.

The following table illustrates the difference between temperature, resistance, and voltage:

DTC P0117 Circuit

ECT	ECT Resistance	ECT Signal Voltage
Cold	High	High
Warm	Low	Low

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P0117 Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage

Conditions for Running the DTC

- The ignition is ON.
- DTC P0118, is not set.
- DTC P0117 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The PCM detects that the ECT sensor signal voltage is 0.08 volts or less.
- The above condition is present for at least 2 seconds.

Action Taken When the DTC Sets

- The powertrain control module (PCM) illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame/Failure Records.
- The PCM enters the Fail Safe Function in which the coolant temperature will use default values and the fuel control system will operate in OPEN LOOP.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other

emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

- An overheating condition may cause this DTC to set.
- After starting the engine, the ECT should rise steadily to about 90°C (194°F) then stabilize when the thermostat opens.
- Use the Temperature vs Resistance table in order to test the ECT sensor at various temperature levels in order to evaluate the possibility of a skewed sensor. A skewed sensor could result in a driveability condition. If the engine has sat overnight, the engine coolant temperature and the intake air temperature values should display within a few degrees. If the temperatures are not within 3°C (5°F), refer to **Temperature vs Resistance - Intake Air Temperature (IAT) Sensor** .
- For an intermittent condition, refer to **Intermittent Conditions** .

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step determines if a condition is present.

7: After replacing the PCM a new minimum throttle position and idle speed must also be established.

DTC P0117 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the ECT parameter with a scan tool. Does the scan tool indicate that the ECT is near the specified value?	168°C (334°F)	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame and/or the Failure records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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 and/or the Failure records data.	-		

	Does the DTC fail this ignition cycle?		Go to **Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . 3. Turn ON the ignition, with the engine OFF. 4. Observe the ECT parameter with a scan tool. Does the scan tool indicate that the ECT sensor temperature is less than the specified value?	-40°C (-40°F)	Go to **Step 6**	Go to **Step 5**
5	1. Turn OFF the ignition. 2. Disconnect the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 3. Test the signal circuit of the ECT sensor for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 8**	Go to **Step 7**
6	Replace the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 8**	-
7	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 8**	-
8	1. Use the scan tool in order to clear the DTCs. 2. Turn the ignition OFF for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. Does the DTC run and pass?	-	Go to **Step 9**	Go to **Step 2**
9	With a scan tool, select Capture Info in order to observe the stored information. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0118

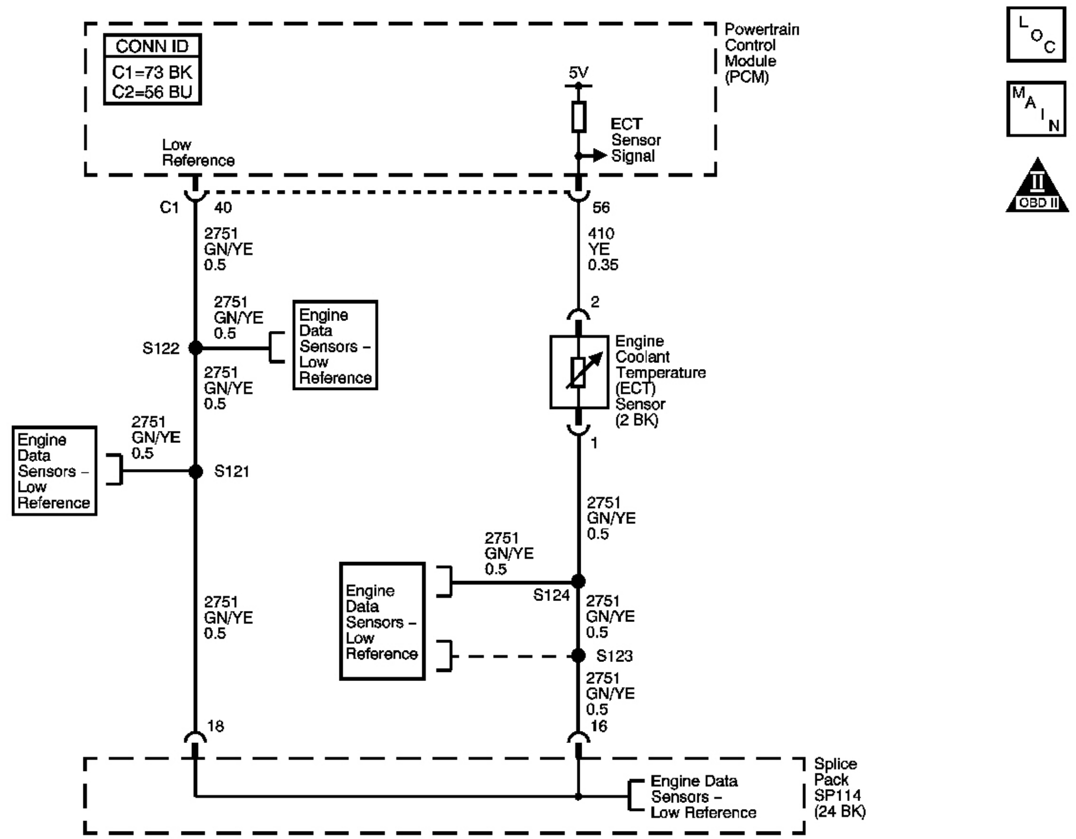


Fig. 9: DTC P0118 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0118 Engine Coolant Temperature (ECT) Sensor Circuit High Voltage diagnostic monitors the signal circuit value. The ECT sensor is a variable resistor that measures the temperature of the engine coolant. The powertrain control module (PCM) supplies 5 volts to the ECT signal circuit and supplies a ground to the low reference circuit. If the PCM detects a high ECT signal voltage, which is a low temperature indication, this DTC sets.

The following table illustrates the difference between temperature, resistance, and voltage:

DTC P0118 Circuit

ECT	ECT Resistance	ECT Signal Voltage
Cold	High	High
Warm	Low	Low

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P0118 Engine Coolant Temperature (ECT) Sensor Circuit High Voltage

Conditions for Running the DTC

- The ignition is ON.
- DTC P0117, is not set.
- DTC P0118 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The PCM detects that the ECT sensor signal voltage is 4.92 volts or more.
- The above condition is present for at least 2 seconds.

Action Taken When the DTC Sets

- The powertrain control module (PCM) illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame/Failure Records.
- The PCM enters the Fail Safe Function in which the coolant temperature will use default values and the fuel control system will operate in OPEN LOOP.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

- If a short to a separate 5-volt source occurs this DTC may set, if this is found to be the condition a continuity test to all other PCM circuits will be necessary to diagnose the specific circuit.
- Use the Temperature vs Resistance table in order to test the ECT sensor at various temperature levels in order to evaluate the possibility of a skewed sensor. A skewed sensor could result in a driveability condition. If the engine has sat overnight, the engine coolant temperature and the intake air temperature values should display within a few degrees. If the temperatures are not within 3°C (5°F), refer to **Temperature vs Resistance - Intake Air Temperature (IAT) Sensor** .
- After starting the engine, the ECT should rise steadily to about 90°C (194°F) then stabilize when the thermostat opens.

- For an intermittent condition, refer to **Intermittent Conditions** .

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4: Tests for the proper operation of the circuit in the low voltage range. If the fuse in the jumper opens when you perform this test, the signal circuit is shorted to voltage.

9: This step tests the signal circuit of the ECT sensor for a short to another 5.0 volt reference circuit.

15: After replacing the PCM a new minimum throttle position and idle speed must also be established.

DTC P0118 Circuit

Step -	Action	Values	Yes	No
Connector End View Reference:Powertrain Control Module (PCM) Connector End Views or **Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the ECT sensor parameter with a scan tool. Does the scan tool indicate that the ECT is at the specified value?	-40°C (-40°F)	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame and/or the Failure records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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 and/or the Failure records data. Does the DTC fail this ignition cycle?	-	Go to **Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . 3. Connect a 3-amp fused jumper wire between the signal circuit of the ECT sensor and the low reference circuit of the ECT sensor.	168°C (334°F)		

	4. Turn ON the ignition, with the engine OFF. 5. Observe the ECT parameter with a scan tool. Does the scan tool indicate that the ECT is more than the specified value?		Go to **Step 9**	Go to **Step 5**
5	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the signal circuit of the ECT sensor and a good ground. 3. Turn ON the ignition, with the engine OFF. 4. Observe the ECT parameter with a scan tool. Does the scan tool indicate that the ECT is more than the specified value?	168°C (334°F)	Go to **Step 8**	Go to **Step 6**
6	Did the fuse in the jumper wire open?	-	Go to **Step 11**	Go to **Step 7**
7	Test the signal circuit of the ECT sensor for an open circuit or for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 12**
8	Test the low reference circuit of the ECT sensor for a high resistance or an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 12**
9	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the signal circuit of the ECT sensor and a good ground. 3. Start the engine. Do any additional DTCs set?	-	Go to **Step 13**	Go to **Step 10**
10	Test for an intermittent and for a poor connection at the ECT sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and**Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 14**
11	**IMPORTANT:** **A short to voltage in signal circuit of the ECT sensor will cause ECT sensor failure. Replace the ECT sensor after you repair the short to voltage.** Test the signal circuit of the ECT sensor for short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct	-		

	the condition?		Go to **Step 16**	Go to **Step 15**
12	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 15**
13	Repair the short between the signal circuit of the ECT sensor and the circuit for which the DTC set. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 16**	-
14	Replace the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 16**	-
15	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 16**	-
16	1. Use the scan tool in order to clear the DTCs. 2. Turn the ignition OFF for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. Does the DTC run and pass?	-	Go to **Step 17**	Go to **Step 2**
17	With a scan tool, select Capture Info in order to observe the stored information. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0122

Circuit Description

This diagnostic monitors the TP sensor 1 signal. There are two TP sensors located on the throttle body inside of the throttle actuator control (TAC) module. All throttle control is performed by the throttle actuator control (TAC) system. The TP sensors, along with the accelerator pedal position (APP) sensors and the TAC module are mandatory components of the TAC system. The TP sensors are used to determine the throttle plate angle. The TP sensor is a potentiometer with a resistance value that changes along with the throttle valve position. The sensor uses a 5-volt reference supply, a low reference and a signal circuit. The TAC module uses the signal circuit voltage to calculate the actual throttle valve opening. The TP sensor is an integral part of the TAC module and is not serviced separately. Installing a new TP sensor requires the replacement of the throttle body assembly. For additional information on the operation of the TP sensor and the TAC system refer to **Throttle**

Actuator Control (TAC) System Description . If the TAC module detects that the TP sensor 1 signal voltage is too low it reports the malfunction to the PCM and the PCM sets this DTC.

DTC Descriptors

This diagnostic procedure supports the following DTC.

DTC P0122 Throttle Position (TP) Sensor 1 Circuit Low Voltage

Conditions for Running the DTC

- DTC P0123 is not set.
- DTC P0122 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The TP sensor 1 voltage is 0.28 volts or less.
- The above condition is present for less than 1 second.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

> **1:** The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool, if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.
>
> **2:** This step determines if a fault is present. The normal TP angle at engine speeds above idle is more than 0 percent.

DTC P0122 Circuit

Step	Action	Value (s)	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Increase the engine speed to 3,500 RPM while observing the TP sensor 1 angle with a scan tool. Did the TP sensor 1 angle remain fixed at the specified value at all engine speeds?	0%	Go to **Step 4**	Go to **Step 3**
3	1. Use the scan tool in order to clear the DTCs. 2. Start the engine. 3. Operate the vehicle within the Freeze Frame conditions as specified or until the DTC P0122 diagnostic test has run. Refer to the Test Description. Is DTC P0122 set?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	Replace the throttle body. Refer to **Throttle Body Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 5**	-
5	1. Use the scan tool in order to clear the DTCs. 2. Start the engine. 3. Operate the vehicle within the Freeze Frame conditions as specified or until the DTC P0122 diagnostic test has run. Refer to the Test Description. Does the DTC run and pass?	-	Go to **Step 6**	Go to **Step 2**
6	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0123

Description

This diagnostic monitors the TP sensor 1 signal. There are two TP sensors located on the throttle body inside of the throttle actuator control (TAC) module. All throttle control is performed by the throttle actuator control (TAC) system. The TP sensors, along with the accelerator pedal position (APP) sensors and the TAC module are mandatory components of the TAC system. The TP sensors are used to determine the throttle plate angle. The TP sensor is a potentiometer whose resistance value changes along with the throttle valve position. The sensor uses a 5-volt reference supply, a low reference and a signal circuit. The TAC module the signal circuit voltage to calculate the actual throttle valve opening. The TP sensor is an integral part of the TAC module is not serviced separately. Installing a new TP sensor requires the replacement of the throttle body assembly. For additional information on the operation of the TP sensor and the TAC system refer to **Throttle Actuator Control (TAC) System Description** . If the TAC module detects that the TP sensor 1 signal voltage is too high it reports the malfunction to the PCM and the PCM sets this DTC.

DTC Descriptors

This diagnostic procedure supports the following DTC.

DTC P0123 Throttle Position (TP) Sensor 1 Circuit High Voltage

Conditions for Running the DTC

- DTC P0122 is not set.
- DTC P0123 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The TP sensor 1 voltage is 4.75 volts or more.
- The above condition is present for less than 1 second.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool, if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step determines if a fault is present. The normal TP angle at idle is between 11-15 percent.

DTC P0123 Circuit

Step	Action	Value (s)	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Observe the TP sensor 1 angle with a scan tool. Is the TP sensor 1 angle more than the specified value?	90%	Go to **Step 4**	Go to **Step 3**
3	1. Use the scan tool in order to clear the DTCs. 2. Start the engine. 3. Operate the vehicle within the Freeze Frame conditions as specified or until the DTC P0123 diagnostic test has run. Refer to the Test Description. Is DTC P0123 set?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	Replace the throttle body. Refer to **Throttle Body Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 5**	-
5	1. Use the scan tool in order to clear the DTCs. 2. Start the engine. 3. Operate the vehicle within the Freeze Frame conditions as specified or until the DTC P0123 diagnostic test has run. Refer to the Test Description. Does the DTC run and pass?	-	Go to **Step 6**	Go to **Step 2**
6	With a scan tool, observe the stored information, Capture Info.	-	Go to **Diagnostic**	

	Does the scan tool display any DTCs that you have not diagnosed?		**Trouble Code (DTC) List**	System OK

DTC P0125

Circuit Description

The DTC P0125 Engine Coolant Temperature (ECT) Excessive Time To Closed Loop Fuel Control diagnostic monitors the time passed before Closed Loop fuel control occurs. The engine operates in Open Loop when first started. In Open Loop the powertrain control module (PCM) ignores the oxygen sensor signal and calculates the air/fuel ratio based on inputs from the engine coolant temperature (ECT) sensor, the accelerator pedal position (APP) sensor, and the manifold absolute pressure (MAP) sensor. The PCM will begin Closed Loop fuel control when the oxygen sensor signal is active enough and the ECT sensor reaches a predetermined coolant temperature. The PCM expects to begin Closed Loop fuel control within a specified amount of time.

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P0125 Engine Coolant Temperature (ECT) Excessive Time to Closed Loop Fuel Control

Conditions for Running the DTC

- DTCs P0030, P0050, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0135, P0155, P0171, P0172, P0174, P0175, P0300-P0306, P0335, P0401, P0404, P0443, P0496, P0506, P0507, P1128, P1129, P2227, P2228, P2229, P2413, P2414, and P2415 are not set.
- The engine coolant temperature is less than 38°C (100°F) at engine start up.
- Fuel Cut-Off is not active.
- DTC P0125 runs once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

The engine coolant temperature does vary more than 2°C (3.6°F) within 20 minutes from engine start.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the PCM stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the PCM records the operating conditions at the time of the failure. The PCM writes the conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.

- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

- Check for any of the following conditions:
  - A DTC P0125 can indicate a skewed ECT sensor. Comparing the coolant temperature displayed on a scan tool with the actual engine coolant temperature measured with a thermometer may isolate the fault. If the displayed engine coolant temperature is not close to the actual engine coolant temperature, replace the ECT sensor. Refer to **Temperature vs Resistance - Engine Coolant Temperature (ECT) Sensor** .
  - Check for the proper operation of the thermostat. Refer to **Thermostat Diagnosis** in Engine Cooling.
- An intermittent malfunction may be caused by a fault in the ECT sensor electrical circuit. Inspect the wiring harness and the components for an intermittent condition. Refer to **Intermittent Conditions** .
- If the DTC P0125 cannot be duplicated, the information included in the Freeze Frame data can be useful in determining vehicle operating conditions when the DTC was first set.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step determines if there is a cooling system malfunction.

3: This step compares the engine coolant temperature (ECT) temperature to the intake air temperature (IAT). This inspection is to be performed when the vehicle has reached the ambient room temperature. At that time both the surrounding air temperature and the engine coolant temperature are nearly equal. If the ECT sensor and circuit are OK, both sensors should indicate the same temperature.

5: The fault not present indicates the condition that caused DTC P0125 to set is intermittent and not currently present. If no other DTCs are stored, refer to Diagnostic Aids for additional information on diagnosing an intermittent DTC P0125.

10: After replacing the PCM the relationship between the CKP sensor and the crankshaft must re-established. A new minimum throttle position and idle speed must also be established.

DTC P0125 Circuit

Step	Action	Value (s)	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or**				

Engine Controls Connector End Views

1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Review the list below for any of the following customer concerns: • Insufficient heat from the climate control system • Instrument panel (IP) temperature gauge indicates a lower than normal engine temperature after driving the vehicle • Compare the engine coolant temperature (ECT) sensor reading to the intake air temperature (IAT) sensor reading on a scan tool. Did you identify a customer concern from the list above?	-	Go to **Step 8**	Go to **Step 3**
3	1. Allow the engine to cool to the ambient air temperature. 2. Turn ON the ignition, leaving the engine OFF. 3. Compare the engine coolant temperature (ECT) sensor reading to the intake air temperature (IAT) sensor reading on a scan tool. Are the ECT and the IAT readings within 2 or 3 degrees of each other?	-	Go to **Step 4**	Go to **Step 6**
4	1. Start the engine and immediately observe the ECT on the scan tool. 2. Continue to observe the ECT while idling the engine for 10 minutes. Does the ECT increase by more than the specified value within the 10 minutes?	20°C (68°F)	Go to **Step 5**	Go to **Step 8**
5	The fault is not present. Are there any DTCs stored that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to Diagnostic Aids
6	1. Measure the resistance of the ECT sensor with a DMM. 2. Compare the measured resistance of the ECT sensor with the resistance values in the Temperature vs Resistance table. Refer to	-		

	Temperature vs Resistance - Engine Coolant Temperature (ECT) Sensor . Is the resistance of the ECT sensor within specifications?		Go to **Step 7**	Go to **Step 9**
7	1. Check for any of the following conditions: • A high resistance in the ECT sensor signal and low reference ground circuits • A faulty connection at the ECT sensor • A faulty connection at the PCM 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 10**
8	1. Inspect the engine cooling system for all of the following: • The correct coolant level-Refer to **Draining and Filling Cooling System** in Engine Cooling. • The correct operation of the cooling system-Refer to **Engine Fails To Reach Normal Operating Temperature** in Engine Cooling. • The correct operation of the thermostat-Refer to **Thermostat Diagnosis** in Engine Cooling. • The correct operation of the engine cooling fan- **Cooling Fan Always On (L61)** or **Cooling Fan Always On (L66)** in Engine Cooling 2. Repair as necessary. Did you complete the action?	-	Go to **Step 11**	-
9	Replace the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 11**	Go to **Step 10**
10	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 11**	-

11	1. Use the scan tool in order to clear the DTCs. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text or until the DTC P0125 diagnostic test has run. Does the DTC run and pass?	-	Go to **Step 12**	Go to **Step 2**
12	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0128

Circuit Description

The DTC P0128 Engine Coolant Temperature (ECT) Below Thermostat Regulating Temperature diagnostic monitors the relationship between engine temperature and engine running time. The ECT sensor signal is used to monitor the performance of the engine cooling system thermostat. A DTC P0128 may set if the ECT sensor voltage does not indicate that the engine coolant temperature has increased sufficiently during running of the diagnostic. When the ambient air temperature and engine operating conditions are right, the powertrain control module (PCM) starts the diagnostic using a water temperature counter. The water temperature counter times how long the cooling system takes to reach 75°C (167°F). Failure to reach 75°C (167°F) within the diagnostic window can indicate a malfunctioning thermostat.

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P0128 Engine Coolant Temperature (ECT) is Below Thermostat Regulating Temperature

Conditions for Running the DTC

- DTCs P0030, P0050, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0122, P0123, P0125, P0135, P0155, P0171, P0172, P0174, P0175, P0222, P0223, P0300-P0306, P0335, P0401, P0404, P0443, P0496, P0506, P0507, P1128, P1129, P2100, P2101, P2108, P2122, P2123, P2127, P2128, P2135, P2138, P2176, P2227, P2228, P2229, P2413, P2414, P2415, and U0107 are not set.
- The engine speed is less than 5,000 RPM.
- The engine coolant temperature (ECT) is between -7 and +35°C (20-95°F) at start-up.
- The intake air temperature (IAT) is between -7 and +35°C (20-95°F) at start-up.
- The difference between IAT temperature and ECT temperature at engine startup is less than 6°C (10°F).
- DTC P0128 runs once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

- The engine coolant temperature failed to reach at least 70°C (159°F).

  OR

- The difference between the actual ECT temperature and the estimated coolant temperature is 10°C (18°F) or more.
- The above conditions exist when the engine has been operating for 20 minutes or less depending on the engine load.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the PCM stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the PCM records the operating conditions at the time of the failure. The PCM writes the conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

Check for the following conditions:

- A faulty thermostat that stays open slightly can cause DTC P0128 to set in cold weather when the vehicle is started and allowed to sit while warming up. Replace any suspect thermostat. Refer to **Thermostat Diagnosis** in Engine Cooling.
- An incorrect thermostat can cause the engine to warm up slowly. Replace any thermostat that does not meet OEM specifications. Refer to **Thermostat Replacement (L61)** or **Thermostat Replacement (L66)** in Engine Cooling.
- Use the Temperature vs Resistance table in order to evaluate the possibility of a shifted ECT sensor. A shifted sensor could result in DTC P0128. Refer to **Temperature vs Resistance - Engine Coolant Temperature (ECT) Sensor** .
- Check for the proper operation of the engine cooling system, including the correct coolant level.

If DTC P0128 cannot be duplicated, the information included in the Freeze Frame data can be useful in determining the vehicle operating conditions when the DTC was first set.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

1: The Diagnostic System Check - Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step compares the ECT temperature to the IAT temperature. This inspection is to be performed when the vehicle has reached ambient room temperature. At that time both the surrounding air temperature and the engine coolant temperature are nearly equal. If the ECT sensor and circuit are OK, both sensors should indicate the same temperature.

3: This step checks that the temperature of the engine coolant increases at least 60°C (140°F) within 20 minutes. If the temperature does not increase to the specified value there is a fault with the ECT sensor or the engine cooling system.

4: This step checks for a correctly operating engine cooling fan. A cooling fan that comes ON too soon or stays ON all the time, can cause a DTC P0128 to set.

5: Fault not present indicates the condition that caused DTC P0128 to set is intermittent and not currently present. If no other DTCs are stored, refer to Diagnostic Aids for additional information on diagnosing an intermittent DTC P0128.

16: After replacing the PCM the relationship between the CKP sensor and the crankshaft must re-established. A new minimum throttle position and idle speed must also be established.

DTC P0128 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Allow the engine to cool to the ambient air temperature. 2. Turn ON the ignition, with the engine OFF. 3. Compare the ECT sensor temperature reading to the IAT sensor temperature reading on a scan tool. Are the ECT and the IAT readings within 2 or 3 degrees of each other?	-	Go to **Step 3**	Go to **Step 6**
	1. Start the engine and immediately observe the ECT on the scan tool. 2. Continue to observe the ECT while idling the			

3	engine for 10 minutes. Does the ECT indicated on the scan tool increase to at least the specified value within the 20 minutes?	60°C (140°F)	Go to **Step 5**	Go to **Step 4**
4	Test for the correct operation of the engine cooling fan. Refer to **Cooling Fan Always On (L61)** or **Cooling Fan Always On (L66)** in Engine Cooling. Did you find and repair a condition with engine cooling fan operation?	-	Go to **Step 17**	Go to **Step 6**
5	The fault is not present. Are there any DTCs stored that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to Diagnostic Aids
6	1. Disconnect the ECT sensor electrical connector. 2. Measure the resistance of the ECT sensor with a DMM. 3. Compare the measured resistance of the ECT sensor with the resistance values in the Temperature vs Resistance table. Refer to **Temperature vs Resistance - Engine Coolant Temperature (ECT) Sensor** . Is the resistance of the ECT sensor within specifications?	-	Go to **Step 7**	Go to **Step 14**
7	1. Disconnect the ECT sensor electrical connector. 2. Turn ON the ignition, with the engine OFF. 3. Observe the ECT sensor temperature with a scan tool. Does the scan tool indicate that the ECT sensor temperature is at the specified value?	-40°C (-40°F)	Go to **Step 8**	Go to **Step 12**
8	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the signal circuit and the sensor ground circuit of the ECT sensor. 3. Turn ON the ignition, with the engine OFF. 4. Observe the ECT sensor temperature with a scan tool. Does the scan tool indicate that the ECT sensor temperature is at the specified value?	215°C (419°F)	Go to **Step 13**	Go to **Step 9**
	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the			

9	signal circuit and a known good ground. 3. Turn ON the ignition, with the engine OFF. 4. Observe the ECT sensor temperature with a scan tool. Does the scan tool indicate that the ECT sensor temperature is at the specified value?	215°C (419°F)	Go to **Step 10**	Go to **Step 11**
10	1. Test the ECT sensor ground circuit for high resistance. Refer to **Circuit Testing** in Wiring Systems. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 15**
11	1. Test the ECT sensor signal circuit for high resistance. Refer to **Circuit Testing** in Wiring Systems. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 15**
12	1. Test the ECT sensor signal circuit for a short to ground. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 15**
13	1. Inspect the engine cooling system for all of the following: • The correct coolant level - Refer to **Draining and Filling Cooling System** in Engine Cooling. • The correct operation of the cooling system - Refer to **Engine Fails To Reach Normal Operating Temperature** in Engine Cooling. • The correct operation of the thermostat - Refer to **Thermostat Diagnosis** in Engine Cooling. • The correct operation of the engine cooling fan- Refer to **Cooling Fan Always On (L61)** or **Cooling Fan Always On (L66)** in Engine Cooling.	-		

	2. Repair as necessary. Did you complete the action?		Go to **Step 17**	-
14	Replace the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 17**	-
15	1. Inspect the PCM and the ECT sensor electrical connectors for poor connections. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 16**
16	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 17**	-
17	1. Use the scan tool in order to clear the DTCs. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text or until the DTC P0128 diagnostic test has run. Does the DTC run and pass?	-	Go to **Step 18**	Go to **Step 2**
18	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0133 OR P0153

Circuit Description

The wide band heated oxygen sensor (HO2S) measures the amount of oxygen in the exhaust system and provides more information than the switching style HO2S. The wide band sensor consists of an oxygen sensing cell, an oxygen pumping cell, and a heater. The exhaust gas sample passes through a diffusion gap between the sensing cell and the pumping cell. The powertrain control module (PCM) supplies a voltage to the HO2S and uses this voltage as a reference to the amount of oxygen in the exhaust system. An electronic circuit within the PCM controls the pump current through the oxygen pumping cell in order to maintain a constant voltage in the oxygen sensing cell. The PCM monitors the voltage variation in the sensing cell and attempts to keep the voltage constant by increasing or decreasing the amount of current flow, or oxygen ion flow, to the pumping cell. By measuring the amount of current required to maintain the voltage in the sensing cell, the PCM can determine the concentration of oxygen in the exhaust. The HO2S voltage is displayed as a lambda value. A lambda value of 1 is equal to a stoichiometric air fuel ratio of 14.7:1. Under normal operating conditions, the lambda value will remain around 1. When the fuel system is lean, the oxygen level will be high and the lambda signal will be high or more than 1. When the fuel system is rich, the oxygen level will be low, and the lambda signal will be low or less than 1. The PCM uses this information to maintain the correct air/fuel ratio. The PCM monitors the HO2S for a transition from high to low and back to high. If the PCM determines the HO2S transition cycles take more than a predetermined amount of time, this DTC sets.

DTC Descriptor

This diagnostic procedure supports the following DTCs.

- DTC P0133 HO2S Slow Response Bank 1 Sensor 1
- DTC P0153 HO2S Slow Response Bank 2 Sensor 1

Conditions for Running the DTC

- Before the PCM can report that DTC P0133 or P0153 failed, DTC P0442 must run and pass.
- DTCs P0030, P0050, P0107, P0108, P0112, P0113, P0117, P0118, P0135, P0155, P0171, P0172, P0300, P0301-P0306, P0335, P0401, P0403, P0404, P0443, P0496, P0501, P0641, P1128, P1129, P2227, P2228, P2229, P2297, P2413, P2414, P2415, P2646-P2649 are not set.
- The engine coolant temperature (ECT) is more than 69°C (156°F).
- The intake air temperature (IAT) is more than 0°C (0°F).
- The engine speed is more than 1,000 RPM.
- The manifold absolute pressure (MAP) is between 27-68 kPa.
- The vehicle speed is more than 48 km/h (30 mph).
- The HO2S lambda is between 0.73-1.47.
- The engine is in closed loop.
- The evaporative emission (EVAP) monitor is not running.
- DTC P0133 and P0153 run once per drive cycle when the above conditions exist for more than 5 minutes.

Conditions for Setting the DTC

The average transition time of the last six HO2S samples is more than 2.6 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the PCM stores this information in the Failure Records. If the diagnostic reports a failure on the

second consecutive ignition cycle, the PCM records the operating conditions at the time of the failure. The PCM writes the conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

- Use the **J-35616** Connector Test Adapter Kit for any test that requires probing the ECM harness connector or a component harness connector.
- The Loop Status for the respective bank will default to Open when the DTC is current.
- The wide band sensors do not toggle or switch like a switching HO2S. The HO2S signals will be relatively stable for an idling engine.
- For an intermittent condition, refer to **Intermittent Conditions** .
- The following table illustrates the typical voltages for the HO2S circuits:

HO2S Voltages

• Ignition On, Engine Off • HO2S Disconnected	
HO2S Circuit	**Voltage**
Heater Control	Less than 0.5 V
Heater Supply Voltage	B+
Reference Voltage	3.3-3.8 V
Low Reference	5.9-6.4 V
Pump Current	4.8-5.3 V
Input Pump Current	3.3-3.8 V

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step determines whether a condition currently exists. If the Lambda value fluctuates near 1.00 and Loop Status is Closed, the HO2S is operating correctly.

4: This step determines if the fuel system is contaminated.

DTC P0133 or P0153 Circuit

Step	Action	Yes	No

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views

1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** • **DTC P0133 is for bank 1 sensor 1 (Rear) and DTC P0153 is for bank 2 sensor 1 (Front)** • **Inspect the HO2S for being secure before proceeding with this DTC. A sensor that is loose could cause this DTC to set.** 1. Allow the engine to reach operating temperature. 2. Operate the vehicle within the parameters specified in Conditions for Running the DTC. 3. Observe the diagnostic trouble code (DTC) information with a scan tool. Did DTC P0133 and/or DTC P0153 fail this ignition?	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 4**	Go to Diagnostic Aids
4	Did DTC P0133 and DTC P0153 fail this ignition cycle?	Go to **Step 7**	Go to **Step 5**
5	Inspect for an exhaust leak near the HO2S. Refer to **Exhaust Leakage** in Engine Exhaust. After you inspect the exhaust system, return to this diagnostic. Did you find and correct the condition?	Go to **Step 8**	Go to **Step 6**
6	Inspect or test for the following conditions: • Inspect for corrosion on the HO2S terminals. • Inspect the terminal tension at the HO2S and at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. • Inspect the HO2S wiring for damage.		

	Did you find and correct the condition?	Go to **Step 8**	Go to **Step 7**
7	**IMPORTANT:** **If both DTCs are set, determine and correct the cause of the contamination before replacing a sensor. Inspect for the following conditions:** • **Inspect for fuel contamination. Refer to Alcohol/Contaminants-in-Fuel Diagnosis .** • **Inspect for the correct RTV sealant.** • **Inspect for engine oil consumption. Refer to Oil Consumption Diagnosis in Engine Mechanical - 3.5L (L66).** • **Inspect for engine coolant consumption. Refer to Loss of Coolant in Engine Cooling.** Replace the HO2S. Refer to the appropriate procedure: • **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** • **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1** Did you complete the replacement?	Go to **Step 8**	-
8	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 9**
9	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0135 OR P0155

Circuit Description

Heating elements inside the heated oxygen sensor (HO2S) minimize the time required for the sensors to reach operating temperature, and to provide an accurate voltage signal. A low side driver within the powertrain control module (PCM) is pulse width controlled to provide current to the heater elements. During warm-up the PCM will pulse the heaters ON-OFF to prevent thermal shock to the sensor components from moisture in the exhaust system. The PCM will not allow continuous HO2S heating until calibrated limits of time, temperature, and intake airflow have been reached. The PCM continuously monitors the HO2S heater current draw and operating state by briefly turning OFF the heater low side driver at regular intervals. The PCM calculates the HO2S heater element resistance based on the actual heater current. If the PCM detects that the HO2S heater element resistance is too high, this DTC will set.

Each HO2S heater has the following circuits:

- HO2S heater ignition 1 voltage
- HO2S heater low control

DTC Descriptor

This diagnostic procedure supports the following DTCs.

- DTC P0135 HO2S Heater Performance Bank 1 Sensor 1
- DTC P0155 HO2S Heater Performance Bank 2 Sensor 1

Conditions for Running the DTC

- DTCs P0030, P0036, P0050, P0056, P0117, P0118, P2414, and P2415 are not set.
- The engine is operating for more than 90 seconds.
- The ignition 1 voltage is between 10.5-16 volts.
- The engine coolant temperature (ECT) is more than -20°C (-4°F).
- The system is not in fuel cut-off mode for at least 15 seconds.
- DTCs P0135 and P0155 run continuously once the above conditions are met.

Conditions for Setting the DTC

- The calculated internal resistance of the HO2S is more than 110 ohms for more than 90 seconds after an engine start.

  OR

  The calculated internal resistance of the HO2S is more than 110 ohms for more than 15 seconds.

- The A/F sensor heater internal output voltage is 0.76 V or more.
- The A/F sensor heater internal output voltage is 0.24 V or less.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

- Use the **J-35616** Connector Test Adapter Kit for any test that requires probing the PCM harness connector or a component harness connector.
- The Loop Status for the respective bank will default to Open when the DTC is current.
- The wide band sensors do not toggle or switch like a switching HO2S. The HO2S signals will be relatively stable for an idling engine.
- For an intermittent condition, refer to **Intermittent Conditions** .
- The following table illustrates the typical voltages for the HO2S circuits:

HO2S Voltages

• Ignition On, Engine Off • HO2S Disconnected	
HO2S Circuit	**Voltage**
Heater Control	Less than 0.5 V
Heater Supply Voltage	B+
Reference Voltage	3.3-3.8 V
Low Reference	5.9-6.4 V
Pump Current	4.8-5.3 V
Input Pump Current	3.3-3.8 V

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4: This step tests for high resistance in the ignition 1 voltage circuit of the HO2S. If the DMM does not display near battery voltage, repair the high resistance in the ignition 1 voltage circuit.

5: This step tests the HO2S heater control circuit for a high resistance. 6 amps threw the DMM is normal when the HO2S heater control circuit is commanded ON with a scan tool. A high resistance in the circuit will cause the amperage to be less than 1 amp. Test the HO2S heater control circuit for a high resistance if the DMM displays a reading of less than 1 amp.

9: This step tests the HO2S input pump current circuit for a wire to wire short to the reference voltage circuit or a condition internal to the PCM. If the resistance measured between the circuits is more than 110,000 ohms, the PCM and the circuits are OK.

10: This step isolates the condition. Test for a wire to wire short between the HO2S input pump current and reference voltage circuits, if any continuity exists between the circuits.

15: Inspect the HO2S connector for water intrusion, corrosion, and bent or damaged terminals.

16: Inspect the PCM connectors for water intrusion, corrosion, and bent or damaged terminals.

DTC P0135 or P0155 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **DTC P0135 is for bank 1 sensor 1 - Rear and DTC P0155 is for bank 2 sensor 1 - Front.** 1. Start the engine. 2. Allow the engine to reach operating temperature. 3. Observe the DTC info with a scan tool for at least 90 seconds. Does the DTC fail this ignition?	-	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text or as close to the Freeze Frame/Failure Records that you observed. Does the DTC fail this ignition?	-	Go to **Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the affected HO2S 1 connector. 3. Turn ON the ignition. 4. Connect a test lamp between the ignition 1 voltage circuit of the HO2S and a good ground. 5. Connect a DMM to the probe of the test lamp and a good ground. Refer to **Measuring**	B+		

	Voltage Drop in Wiring Systems. Does the voltage measure at the specified value?		Go to **Step 5**	Go to **Step 17**
5	1. Set-up a DMM to test amperage on the 10 amp scale. 2. Connect the DMM between the ignition 1 circuit and the heater control circuit of the HO2S. 3. Observe the amperage on the DMM while the HO2S heater is being commanded ON with a scan tool. Is the amperage more than the specified value?	1 A	Go to **Step 6**	Go to **Step 11**
6	Measure the voltage between the HO2S reference voltage circuit and a good ground with a DMM. Is the voltage within the specified range?	3.3-3.8 V	Go to **Step 7**	Go to **Step 12**
7	Measure the voltage between the HO2S low reference circuit and a good ground with a DMM. Is the voltage within the specified range?	5.9-6.4 V	Go to **Step 8**	Go to **Step 13**
8	Measure the voltage between the HO2S input pump current circuit and a good ground with a DMM. Is the voltage within the specified range?	3.3-3.8 V	Go to **Step 9**	Go to **Step 14**
9	1. Turn the ignition OFF for 1 minute. 2. Measure the resistance between the HO2S input pump current circuit and the HO2S reference voltage circuit. Is the resistance less than the specified value?	110 Kohm	Go to **Step 10**	Go to **Step 15**
10	1. Disconnect the appropriate PCM connector. 2. Measure the resistance between the HO2S input pump current circuit and the HO2S reference voltage circuit. Is the resistance at the specified value?	OL	Go to **Step 16**	Go to **Step 18**
11	Test the HO2S heater control circuit for a high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 16**
12	Test the HO2S reference voltage circuit for an open, a high resistance, or a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 16**
	Test the HO2S low reference circuit for one of the			

13	following conditions: • An open • A high resistance • A short to voltage • A short to the HO2S pump current circuit • A short to the HO2S reference voltage circuit, refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 16**
14	Test the HO2S input pump current circuit for an open, a high resistance, or a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 16**
15	Test for shorted terminals and for poor connections at the HO2S. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 19**
16	Test for shorted terminals and for poor connections at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 20**
17	Repair the open or high resistance in the HO2S heater ignition 1 circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 21**	-
18	Repair the short between the HO2S input pump current circuit and the HO2S reference voltage circuit. Did you complete the repair?	-	Go to **Step 21**	-
19	Replace the HO2S. Refer to the appropriate procedure: • **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** • **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1** Did you complete the replacement?	-	Go to **Step 21**	-

20	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 21**	-
21	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 22**
22	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0137 OR P0157

Circuit Description

The secondary heated oxygen sensor (HO2S) measures the oxygen content of the exhaust downstream of the three-way catalyst (TWC), so that the TWC efficiency is optimized. The powertrain control module (PCM) supplies a voltage near 450 mV between the HO2S signal circuit and the low reference circuit. The HO2S varies the voltage over a range from about 1,000 mV when the exhaust is rich, down through about 10 mV when the exhaust is lean.

The PCM monitors and stores the HO2S voltage information. The PCM evaluates the HO2S voltage samples in order to determine the amount of time that the HO2S voltage was out of range. The PCM compares the stored HO2S voltage samples taken within each sample period and determines if the majority of the samples are out of the operating range.

The PCM monitors the HO2S voltage for being fixed below a predetermined voltage. If the PCM detects the voltage is too low, this DTC sets.

DTC Descriptor

This diagnostic procedure supports the following DTCs.

- DTC P0137 HO2S Circuit Low Voltage Bank 1 Sensor 2
- DTC P0157 HO2S Circuit Low Voltage Bank 2 Sensor 2

Conditions for Running the DTC

- DTCs P0030, P0050, P0107, P0108, P0112, P0113, P0117, P0118, P0133, P0135, P0138, P0141, P0153, P0155, P0158, P0161, P0171, P0172, P0174, P0175, P0300, P0301-P0306, P0335, P0401, P0404, P0442, P0443, P0496, P1128, P1129, P2413, P2414, and P2415 are not set.
- The engine is operating for more than 2 minutes.
- The engine speed is less than 2,350 RPM.
- The engine coolant temperature (ECT) is more than 69°C (156°F).
- The intake air temperature (IAT) is more than -18°C (0°F).
- The HO2S 1 same bank lambda is between 0.73-1.47.
- The fuel system is in closed loop.
- DTCs P0137 and P0157 run once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

- The PCM detects that the affected HO2S 2 signal voltage is less than 290 mV.
- The condition exists for less than 30 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the PCM stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the PCM records the operating conditions at the time of the failure. The PCM writes the conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

DTC P0137 or P0157 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**

2	**IMPORTANT:** • **DTC P0137 is for bank 1 sensor 2 and DTC P0157 is for bank 2 sensor 2** • **Inspect the HO2S for being secure before proceeding with this DTC. A sensor that is loose could cause this DTC to set.** 1. Allow the engine to reach operating temperature. 2. Operate the engine above 1,200 RPM for 2 minutes. 3. Observe the appropriate HO2S 2 voltage parameter with a scan tool. Is the voltage less than the specified value?	290 mV	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the appropriate HO2S 2. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage between the HO2S 2 signal circuit and a good ground with a DMM. Is the voltage more than the specified value?	100 mV	Go to **Step 6**	Go to **Step 5**
5	1. Turn OFF the ignition. 2. Disconnect the PCM connector. 3. Test the appropriate HO2S 2 signal circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** . Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 7**
	Test shorted terminals and for poor connections at			

6	the HO2S. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 8**
7	Test shorted terminals and for poor connections at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 9**
8	Replace the appropriate HO2S. Refer to the appropriate procedure: • **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 2** • **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 2** Did you complete the replacement?	-	Go to **Step 10**	-
9	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 10**	-
10	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 11**
11	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0138 OR P0158

Circuit Description

The secondary heated oxygen sensor (HO2S) measures the oxygen content of the exhaust downstream of the three-way catalyst (TWC), so that the TWC efficiency is optimized. The powertrain control module (PCM) supplies a voltage near 450 mV between the HO2S high signal circuit and the low reference circuit. The HO2S varies the voltage over a range from about 1,000 mV when the exhaust is rich, down through about 10 mV when the exhaust is lean.

The PCM monitors and stores the HO2S voltage information. The PCM evaluates the HO2S voltage samples in order to determine the amount of time that the HO2S voltage was out of range. The PCM compares the stored HO2S voltage samples taken within each sample period and determines if the majority of the samples are out of the operating range.

The PCM monitors the HO2S voltage for being fixed above a predetermined voltage. If the PCM detects the voltage is too high, this DTC sets.

DTC Descriptor

This diagnostic procedure supports the following DTCs.

- DTC P0138 HO2S Circuit High Voltage Bank 1 Sensor 2
- DTC P0158 HO2S Circuit High Voltage Bank 2 Sensor 2

Conditions for Running the DTC

- DTCs P0030, P0050, P0107, P0108, P0112, P0113, P0117, P0118, P0133, P0135, P0137, P0141, P0153, P0155, P0157, P0161, P0171, P0172, P0174, P0175, P0300, P0301-P0306, P0335, P0401, P0404, P0442, P0443, P0496, P1128, P1129, P2413, P2414, and P2415 are not set.
- The engine is operating for more than 2 minutes.
- The engine speed is less than 2,350 RPM.
- The engine coolant temperature (ECT) is more than 69°C (156°F).
- The intake air temperature (IAT) is more than -13°C (8°F).
- The HO2S 1 same bank lambda is between 0.73-1.47.
- The fuel system is in closed loop.
- DTCs P0138 and P0158 run once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

- The PCM detects that the HO2S signal voltage is more than 1250 mV.
- The condition exists for more than 2.5 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the PCM stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the PCM records the operating conditions at the time of the failure.

The PCM writes the conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step verifies that a condition exists.

4: This step tests the signal circuit of the HO2S 2. Test the signal circuit for a short to voltage, if the voltage on the signal circuit is more than the specified value.

5: This step isolates the condition. If the voltage on the signal circuit is more than the specified value after the PCM is disconnected, test the signal circuit for a wire to wire short to a voltage.

6: This step isolates the condition. If the test lamp illuminates when the HO2S 2 heater is commanded ON, test the signal circuit for a short to the heater control circuit.

DTC P0138 or P0158 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference:Powertrain Control Module (PCM) Connector End Views** or **Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **DTC P0138 is for bank 1 sensor 2 and DTC P0158 is for bank 2 sensor 2.** 1. Allow the engine to reach operating temperature. 2. Operate the engine speed above 1,200 RPM for 2 minutes. 3. Observe the appropriate HO2S 2 voltage parameter with a scan tool.	1,200 mV		

	Is the voltage more than the specified value?		Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the appropriate HO2S 2. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage between the signal circuit of the HO2S 2 and a good ground with a DMM. Is the voltage more than the specified value?	750 mV	Go to **Step 5**	Go to **Step 6**
5	1. Turn OFF the ignition. 2. Disconnect the PCM. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage between the signal circuit of the HO2S 2 and a good ground with a DMM. Is the voltage less than the specified value?	750 mV	Go to **Step 9**	Go to **Step 10**
6	1. Connect a test lamp between the signal circuit of the HO2S 2 and B+. 2. Command the appropriate HO2S 2 Heater Control ON with a scan tool. Does the test lamp illuminate?	-	Go to **Step 7**	Go to **Step 8**
7	Test the signal circuit of the HO2S 2 for a short to the heater control circuit of the HO2S 2. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 9**
8	Test for shorted terminals and for poor connections at the HO2S. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Wiring**	-		

	Repairs in Wiring Systems. Did you find and correct the condition?		Go to **Step 13**	Go to **Step 11**
9	Test shorted terminals and for poor connections at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
10	Repair the short to voltage in the signal circuit of the HO2S 2. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 13**	-
11	Replace the appropriate HO2S. Refer to the appropriate procedure: • **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 2** • **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 2** Did you complete the replacement?	-	Go to **Step 13**	-
12	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 13**	-
13	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 14**
14	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0139 OR P0159

Circuit Description

The secondary heated oxygen sensor (HO2S) measures the oxygen content of the exhaust downstream of the three-way catalyst (TWC), so that the TWC efficiency is optimized. The powertrain control module (PCM) supplies a voltage near 450 mV between the HO2S high signal circuit and the low reference circuit. The HO2S varies the voltage over a range from about 1,000 mV when the exhaust is rich, down through about 10 mV when the exhaust is lean.

The PCM monitors and stores the HO2S voltage information. The PCM evaluates the HO2S voltage samples in order to determine the amount of time that the HO2S voltage was out of range. The PCM compares the stored HO2S voltage samples taken within each sample period and determines if the majority of the samples are out of the operating range.

The PCM monitors the HO2S voltage and detects if the voltage goes out of the bias range. If the PCM does not detect the voltage went out of the bias range, this DTC sets.

DTC Descriptor

This diagnostic procedure supports the following DTCs.

- DTC P0139 HO2S Slow Response Bank 1 Sensor 2
- DTC P0159 HO2S Slow Response Bank 2 Sensor 2

Conditions for Running the DTC

- DTCs P0030, P0107, P0108, P0112, P0113, P0117, P0118, P0133, P0135, P0137, P0138, P0141, P0153, P0155, P0157, P0158, P0161, P0171, P0172, P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0335, P0401, P0404, P0443, P0496, P1128, P1129, P2413, and P2414, are not set.
- The engine has been running for at least 2 minutes.
- The engine speed is less than 2,350 RPM.
- The engine coolant (ECT) temperature is at least 69°C (156°F).
- The intake air (IAT) temperature is at least -18°C (0°F).
- The HO2S 1 same bank lambda is between 0.73-1.47.
- The engine is in closed loop.
- DTCs P0139 and P0159 run once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

The HO2S 2 output voltage is between 0.29 volts and 0.75 volts for 30 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the PCM stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the PCM records the operating conditions at the time of the failure.

The PCM writes the conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

- An oxygen supply inside the HO2S is necessary for proper operation. The HO2S wires provide the supply of oxygen. Inspect the HO2S wires and connections for breaks or contamination. Refer to **Wiring Repairs** in Wiring Systems.
- For an intermittent condition, refer to **Intermittent Conditions** .

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: The engine must be at the normal operating temperature before performing this test.

4: If the scan tool indicates the HO2S voltage goes below 100 mV, this indicates the HO2S circuits and the PCM are OK.

5: This step isolates the condition. Test the HO2S low reference circuit for an open or a high resistance, if the observed voltage is less than 100 mV.

DTC P0139 or P0159 Circuit

Step	Action	Values	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Powertrain Control Module (PCM) Connector End Views** or **Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** • **DTC P0139 is for bank 1 sensor 2 and DTC P0159 is for bank 2 sensor 2.** • **Ensure the HO2S is secure before proceeding with this DTC. A loose sensor could cause this DTC to set.** 1. Allow the engine to reach operating	1,200 mV		

	temperature. 2. Operate the engine above 1,200 RPM for 2 minutes. 3. Observe the appropriate HO2S 2 voltage parameter with a scan tool. Is the voltage at the specified value?		Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame and/or the Failure records data for this DTC. 2. Turn the ignition OFF for 30 seconds. 3. Start the engine. 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 and/or the Failure records data. Does the DTC fail this ignition cycle?	-	Go to **Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the appropriate HO2S 2. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3 amp fused jumper wire between the HO2S signal circuit and the low reference circuit. 5. Observe the HO2S 2 voltage parameter with a scan tool. Is the HO2S voltage less than specified value?	100 mV	Go to **Step 8**	Go to **Step 5**
5	1. Connect the fused jumper wire between the HO2S signal circuit and a good ground. 2. Observe the HO2S voltage parameter with a scan tool. Is the voltage less than the specified value?	100 mV	Go to **Step 7**	Go to **Step 6**
6	Test the signal circuit of the HO2S for an open or a high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
7	Test the low reference circuit of the HO2S for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**

8	Test for an intermittent and for a poor connection at the HO2S. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 10**
9	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
10	Replace the appropriate HO2S. Refer to the appropriate procedure: • **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 2** • **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 2** Did you complete the replacement?	-	Go to **Step 12**	-
11	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Use the scan tool in order to clear the DTCs. 2. Turn the ignition OFF for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. Does the DTC run and pass?	-	Go to **Step 13**	Go to **Step 2**
13	With a scan tool, select Capture Info in order to observe the stored information. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0141 OR P0161

Circuit Description

The DTC P0141 Heated Oxygen Sensor (HO2S) Heater Performance Bank 1 Sensor 2 diagnostic monitors the operation of the HO2S 2 heater circuit. The DTC P0161 HO2S Heater Performance Bank 2 Sensor 2 diagnostic monitors the operation of the HO2S 2 heater circuit. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature, and to provide an accurate voltage signal. A low side driver within the powertrain control module (PCM) is pulse width controlled to provide current to the heater elements. During warm-up the PCM will pulse the heaters ON-OFF to prevent thermal shock to the sensor components from moisture in the exhaust system. The PCM will not allow continuous HO2S heating until calibrated limits of time, temperature, and intake airflow have been reached. The PCM continuously monitors the HO2S heater current draw and operating state by briefly turning OFF the heater low side driver at regular intervals. A small reference voltage is present at the heater low control circuit. When the low side driver is commanded ON, the reference voltage is low, 2.6-4.6 volts. When the low side driver is commanded OFF, the reference voltage is high, close to battery voltage. The PCM calculates the HO2S heater element resistance based on the actual heater current. If the PCM detects that the HO2S heater element resistance is too high, this DTC will set.

Each HO2S has the following circuits:

- HO2S high signal
- HO2S low signal
- HO2S heater ignition 1 voltage
- HO2S heater low control

DTC Descriptor

This diagnostic procedure supports the following DTCs.

- DTC P0141 HO2S Heater Performance Bank 1 Sensor 2
- DTC P0161 HO2S Heater Performance Bank 2 Sensor 2

Conditions for Running the DTC

- The engine is operating.
- The ignition 1 voltage is more than 10.5 volts.
- The HO2S 2 heaters are commanded ON.
- DTCs P0141 and P0161 run continuously once the above conditions are met.

Conditions for Setting the DTC

- The PCM detects that the affected HO2S 2 Heater Current is not within the expected range.
- The condition exists for more than 5 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Test Description

The number below refers to the step number on the diagnostic table.

> **4:** This test must not be performed until the HO2S heater has cooled and stabilized for at least 15 minutes. Heater resistance is typically about 10 ohms at room temperature.
>
> **5:** This step tests for high resistance in the ignition 1 voltage circuit of the HO2S 2. If the DMM does not display near battery voltage, repair the high resistance in the ignition 1 voltage circuit.

DTC P0141 or P0161 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **DTC P0141 is for bank 1 sensor 2 and DTC P0161 is for bank 2 sensor 2** 1. Clear the DTCs with a scan tool. 2. Start the engine. 3. Observe the DTC info parameter with a scan tool for at least 30 seconds. Does the DTC fail this ignition?	-	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?		Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Allow the HO2S 2 to cool for at least 15 minutes. 3. Disconnect the affected HO2S 2 connector. 4. Measure the resistance from the heater control circuit of the HO2S 2, to the ignition 1 voltage circuit of the HO2S 2. Is the resistance within the specified range?	2-20 ohm	Go to **Step 5**	Go to **Step 11**
5	1. Turn ON the ignition. 2. Connect a test lamp between the ignition 1 circuit of the HO2S and the PCM housing. 3. Connect a DMM to the probe of the test lamp and the PCM housing. Refer to **Measuring Voltage Drop** in Wiring Systems. Does the voltage measure near the specified value?	B+	Go to **Step 6**	Go to **Step 8**
6	1. Disconnect the PCM connector containing the affected HO2S 2 heater control circuit. 2. Measure the resistance between heater control circuit of the HO2S 2 and a good ground, with a DMM. Is the resistance within the specified range?	0-5 ohm	Go to **Step 9**	Go to **Step 7**
7	Repair the open or high resistance in the HO2S 2 heater control circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 12**	-
8	Repair the open or high resistance in the HO2S 2 heater ignition 1 voltage circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 12**	-
9	Test for intermittent and for a poor connection at the HO2S 2. Refer to **Testing for Intermittent Conditions and Poor Connections** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 10**
10	Test for intermittent and for poor a connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Wiring Repairs** in Wiring Systems.	-	Go to	

	Did you find and correct the condition?		**Step 12**	Go to **Step 11**
11	Replace the HO2S. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 2** or **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 2** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 13**
13	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Scan Tool Data List**	System OK

DTC P0171 OR P0174

Description

This diagnostic monitors the operation of the air/fuel ratio feedback controls. In order to provide the best possible combination of driveability, fuel economy, and emission control, the powertrain control module (PCM) uses a Closed Loop air/fuel metering system. The PCM monitors the heated oxygen sensor (HO2S) input and when in Closed Loop adjusts fuel delivery based on the HO2S information. Changes in fuel delivery will be indicated by the long term and the short term fuel trim values that are displayed on the scan tool. The ideal fuel trim value is around 0 percent. The PCM will add fuel when the heated oxygen sensor signal is indicating a lean condition. Additional fuel is indicated by fuel trim values that are above 0 percent. The PCM will reduce the amount of fuel delivered when a rich condition is indicated by the HO2S. Fuel trim values below 0 percent indicate a reduction in fuel. If the PCM detects that the long term fuel trim is more than a predetermined value, this DTC sets.

DTC Descriptors

This diagnostic procedure supports the following DTCs.

- DTC P0171 HO2S Fuel Trim System Lean Bank 1
- DTC P0174 HO2S Fuel Trim System Lean Bank 2

DTC P0171 or P0174 Circuit

HO2S Indication	Short Term FT Action	Long Term FT Action	Short Term FT Response

Lean Condition	Quick Increase of 1% or More	Slow Increase of 1% or More	Return to 0%
Desired Condition	Stays Near 0%	Stays at Learned +/- Value	Stays Near 0%
Rich Condition	Quick Decrease of -1% or Less	Slow Decrease of -1% or Less	Return to 0%

Conditions for Running the DTC

- Before the PCM can report that DTC P0171 or P0174 failed, DTC P0442 must run and pass.
- DTCs P0030, P0050, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0135, P0155, P0300-P0306, P0335, P0339, P0401, P0404, P0442, P0443, P0496, P1128, P1129, P2227, P2228, P2229, P2413, P2414, and P2415 are not set.
- Engine coolant temperature (ECT) is more than 69°C (156°F).
- Intake air temperature (IAT) is at least 0°C (32°F).
- Manifold absolute pressure (MAP) is at least 24 kPa.
- Engine speed is between 630-4,000 RPM.
- The engine is operating in CLOSED LOOP.
- The evaporative emission (EVAP) monitor is not running.
- DTC P0171 and DTC P0174 run once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

The long term fuel trim of bank 1 or bank 2 is more than 18 percent.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the PCM stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the PCM records the operating conditions at the time of the failure. The PCM writes the conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

Check for any of the following conditions:

- Inspect for a contaminated oxygen sensor. If contamination is found, determine the cause and correct the condition before replacing the HO2S.
- Inspect for a damaged wiring harness-Inspect the wiring harness for damage. If the harness appears to be OK, observe the heated oxygen sensor (HO2S) bank 1 sensor 1 display on the scan tool while moving the connectors and the wiring harnesses related to the sensor. A change in the display will indicate the location of the fault.
- Inspect for fuel contamination-Small amounts of water can be delivered to the fuel injectors and cause a lean exhaust indication. A lean exhaust indication can also be caused by too much alcohol in the fuel. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis** .
- Test for the correct fuel pressure-The fuel system will be lean if the fuel pressure is too low or the fuel filter is restricted. In order to determine the cause of DTC P0171 or DTC P0174 monitoring the fuel pressure while driving the vehicle at various road speeds may be necessary. Refer to **Fuel System Diagnosis** .
- For an intermittent condition, refer to **Intermittent Conditions** .

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step determines whether the fault is present.

4: If DTC P0171 and P0174 are set at the same time, this indicates both banks of the engine are operating lean. Inspect the items that would cause both banks to operate lean.

5: A vacuum leak causes DTC P0171 and P0174 to set at the same time. Inspect all areas of the engine for a vacuum leak. Also inspect the PCV valve for being the correct one for this application. Make sure that the engine oil fill cap is in place and that it is tight. Verify that the engine oil dip stick is fully seated.

8: This step tests for inadequate fuel delivery from a fuel injector. The fault may be a fuel injector or the fuel injector electrical circuit.

DTC P0171 or P0174 Circuit

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	IMPORTANT: **If any DTCs are set, except P0171 and P0174, refer to those DTCs before proceeding with this diagnostic.** 1. Start the engine.			

2	2. Idle the engine at the normal operating temperature. 3. Operate the vehicle until the scan tool indicates Closed Loop. 4. Observe the Long Term FT parameter for bank 1 or bank 2 with a scan tool. Does the scan tool display less than the specified value?	18%	Go to **Step 3**	Go to **Step 4**
3	1. Turn ON the ignition, leaving the engine OFF. 2. Observe the Freeze Frame and/or the Failure records data for this DTC. 3. Perform the scan tool Clear DTC Information function. 4. Turn the ignition OFF for 90 seconds. 5. Start the engine. 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 and/or the Failure records data. Does the DTC fail this ignition cycle?	-	Go to **Step 4**	Go to Diagnostic Aids
4	Are both banks of the engine operating lean?	-	Go to **Step 5**	Go to **Step 6**
5	Visually and physically inspect for any of the following conditions: • Inspect the vacuum hoses for splits, kinks, and proper connection. Refer to **Emission Hose Routing Diagram** . • Inspect the crankcase ventilation valve and system for leaks. • Inspect for contaminated fuel. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis** . • Inspect the engine control grounds for being clean, tight, and in the correct locations. • Inspect for an engine mechanical condition. Refer to **Symptoms - Engine Mechanical** in Engine Mechanical - 3.5L (L66). Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 7**
	Visually and physically inspect for any of the following conditions:			

6	• Inspect for exhaust leaks, missing or loose exhaust hardware. Refer to **Exhaust Leakage** in Engine Exhaust. • Inspect that the HO2S is installed securely and the electrical connector is not contacting the exhaust system. • Inspect for an engine mechanical condition. Refer to **Symptoms - Engine Mechanical** in Engine Mechanical - 3.5L (L66). • Inspect for vacuum leaks that only affect one bank of the engine. For example, the intake manifold, the injector O-rings. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 7**
7	**IMPORTANT:** **When you have completed the fuel system diagnosis, return to this diagnostic.** Test fuel system for operating lean. Refer to **Fuel System Diagnosis** .Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 8**
8	Test the fuel injectors for any of the following conditions: • The discharge of fuel is regular and even. Refer to **Fuel Injector Balance Test with Tech 2** and **Fuel Injector Balance Test with Special Tool** . • The electrical resistance of the injector coils are all within specifications. Refer to **Fuel Injector Coil Test** . Did you find and correct a condition?	-	Go to **Step 11**	Go to **Step 9**
9	Test for an intermittent and for a poor connection at the appropriate HO2S. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 10**
10	Replace the HO2S. Refer to the appropriate procedure: • **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** • **Heated Oxygen Sensor (HO2S) Replacement**	-		

	Bank 2 Sensor 1 Did you complete the replacement?		Go to **Step 11**	-
11	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 4. Reset the fuel trim system with a scan tool. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 12**
12	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0172 OR P0175

Description

This diagnostic monitors the operation of the air/fuel ratio feedback controls. In order to provide the best possible combination of driveability, fuel economy, and emission control, the powertrain control module (PCM) uses a Closed Loop air/fuel metering system. The PCM monitors the heated oxygen sensor (HO2S) input and, when in Closed Loop, adjusts the fuel delivery based on the HO2S information. Changes in fuel delivery will be indicated by the long term and the short term fuel trim values that are displayed on the scan tool. The ideal fuel trim value is around 0 percent. The PCM will add fuel when the heated oxygen sensor signal is indicating a lean condition. Additional fuel is indicated by fuel trim values that are more than 0 percent. The PCM will reduce the amount of fuel delivered when a rich condition is indicated by the HO2S. Fuel trim values less than 0 percent indicate a reduction in fuel. If the PCM detects that the long term fuel trim is below a predetermined value, this DTC sets.

DTC Descriptors

This diagnostic procedure supports the following DTCs.

- DTC P0172 HO2S Fuel Trim System Rich Bank 1
- DTC P0175 HO2S Fuel Trim System Rich Bank 2

DTC P0172 or P0175 Circuit

HO2S Indication	Short Term FT Action	Long Term FT Action	Short Term FT Response

Lean Condition	Quick Increase of 1% or More	Slow Increase of 1% or More	Return to 0%
Desired Condition	Stays Near 0%	Stays at Learned +/- Value	Stays Near 0%
Rich Condition	Quick Decrease of -1% or Less	Slow Decrease of -1% or Less	Return to 0%

Conditions for Running the DTC

- Before the PCM can report that DTC P0172 or P0175 failed, DTC P0442 must run and pass.
- DTCs P0030, P0050, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0135, P0155, P0300-P0306, P0335, P0339, P0401, P0404, P0442, P0443, P0496, P1128, P1129, P2227, P2228, P2229, P2413, P2414, and P2415 are not set.
- Engine coolant temperature (ECT) at least 69°C (156°F).
- Intake air temperature (IAT) is at least 0°C (32°F).
- Manifold absolute pressure (MAP) is at least 24 kPa.
- Engine speed is between 630-4,000 RPM.
- The engine is operating in CLOSED LOOP.
- The evaporative emission (EVAP) monitor is not running.
- DTC P0172 and DTC P0175 run once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

The long term fuel trim of bank 1 or bank 2 is less than -16 percent.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the PCM stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the PCM records the operating conditions at the time of the failure. The PCM writes the conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

Check for any of the following conditions:

- Inspect for a restriction in the inlet air passage-A duct or inlet hose that collapses when hot or that is blocked by debris.
- Test for the correct fuel pressure-The fuel system will be rich if the fuel pressure is too high. In order to determine the cause of DTC P0172 or DTC P0175 monitoring the fuel pressure while driving the vehicle at various road speeds may be necessary. Refer to **Fuel System Diagnosis** .
- Inspect for a damaged wiring harness-Inspect the wiring harness for damage. If the harness appears to be OK, observe the heated oxygen sensor (HO2S) bank 1 or bank 2 sensor 1 display on the scan tool while moving the connectors and the wiring harnesses related to the sensor. A change in the display will indicate the location of the fault.
- Inspect for a contaminated oxygen sensor. readings. If contamination is found, determine the cause and correct the condition before replacing the HO2S.
- Inspect the HO2S bank 1 or bank 2 sensor 1 for water intrusion into the wiring harness and the sensor housing. Water can create a short to voltage in the HO2S signal circuit causing a false rich indication.
- For an intermittent condition, refer to **Intermittent Conditions** .

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step determines whether a condition exists.

4: If DTC P0172 and P0175 are set at the same time, this indicates both banks of the engine are operating rich. Inspect the items that would cause both banks to operate rich.

6: This step tests for excess fuel from a fuel injector. The fault may be a fuel injector or the fuel injector electrical circuit.

DTC P0172 or P0175 Circuit

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **If any DTCs are set, except P0172 and P0175, refer to those DTCs before proceeding with this diagnostic.** 1. Start the engine. 2. Idle the engine at the normal operating temperature. 3. Operate the vehicle until the scan tool indicates	-16%		

	Closed Loop. 4. Observe the Long Term FT parameter for bank 1 or bank 2 with a scan tool. Does the scan tool display more than the specified value?		Go to **Step 3**	Go to **Step 4**
3	1. Turn ON the ignition, leaving the engine OFF. 2. Observe the Freeze Frame and/or the Failure records data for this DTC. 3. Perform the scan tool Clear DTC Information function. 4. Turn the ignition OFF for 90 seconds. 5. Start the engine. 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 and/or the Failure records data. Does the DTC fail this ignition cycle?	-	Go to **Step 4**	Go to Diagnostic Aids
4	Are both banks of the engine operating rich?		Go to **Step 5**	Go to **Step 6**
5	Visually and physically inspect for any of the following conditions: • Inspect for a collapsed air intake duct. • Inspect for a restricted air filter element. Refer to **Air Cleaner Element Replacement** . • Inspect for excessive fuel in the crankcase. Change the oil as necessary. • Test the fuel system for operating rich. Refer to **Fuel System Diagnosis** . • Inspect for contaminated fuel. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis** . • Inspect the evaporative emission (EVAP) control system for the correct operation. Refer to **Evaporative Emission (EVAP) Control System Description** . • Inspect the exhaust gas recirculation (EGR) value for the correct operation. Refer to **Exhaust Gas Recirculation (EGR) System Description** . • Inspect the engine control grounds for being clean, tight, and in the correct locations.	-		

	• Inspect for an engine mechanical condition. Refer to **Symptoms - Engine Mechanical** in Engine Mechanical - 3.5L (L66). Did you find and correct the condition?		Go to **Step 9**	Go to **Step 7**
6	Visually and physically inspect for any of the following conditions: • Verify that the discharge of fuel is regular and even. Refer to **Fuel Injector Balance Test with Tech 2** or **Fuel Injector Balance Test with Special Tool** . • Verify that the electrical resistance of the injector coils are all within specifications. Refer to **Fuel Injector Coil Test** . • Inspect for a restricted exhaust. Refer to **Restricted Exhaust** in Engine Exhaust. • Inspect for an engine mechanical condition. Refer to **Symptoms - Engine Mechanical** in Engine Mechanical - 3.5L (L66). Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 7**
7	Test for an intermittent and for a poor connection at the appropriate HO2S. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 8**
8	Replace the HO2S. Refer to the appropriate procedure: • **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** • **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1** Did you complete the replacement?	-	Go to **Step 9**	-
9	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 4. Reset the fuel trim system with a scan tool. 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. Did the DTC fail this ignition?		Go to **Step 2**	Go to **Step 10**
10	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0201-P0206

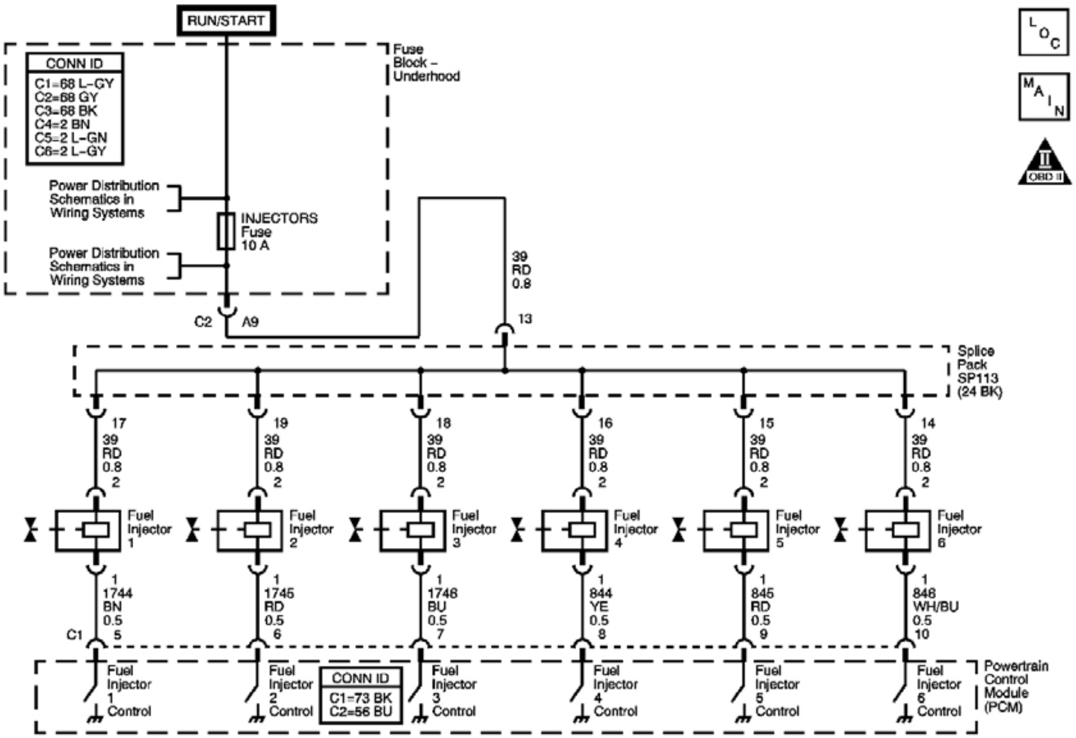


Fig. 10: DTC P0201-P0206 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

DTCs P0201-P0206 are cylinder specific fuel injector fault codes. Each fuel injector is monitored individually by the powertrain control module (PCM) and can set an injector specific DTC. The PCM enables the appropriate fuel injector on the intake stroke for each cylinder. An ignition voltage is supplied to the fuel injectors. The PCM controls each fuel injector by grounding the control circuit via a solid state device called a driver. The PCM monitors the status of each driver. If the PCM detects an incorrect voltage for the commanded state of the driver, a fuel injector control DTC sets.

DTC Descriptors

This diagnostic procedure supports the following DTCs.

- DTC P0201 Injector 1 Control Circuit
- DTC P0202 Injector 2 Control Circuit
- DTC P0203 Injector 3 Control Circuit
- DTC P0204 Injector 4 Control Circuit
- DTC P0205 Injector 5 Control Circuit
- DTC P0206 Injector 6 Control Circuit

Conditions for Running the DTC

The engine is cranking or running.

Conditions for Setting the DTC

The PCM 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

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Performing the Fuel Injector Coil test may help isolate an intermittent condition. Refer to **Fuel Injector Coil Test** .
- For an intermittent condition, refer to **Intermittent Conditions** .

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step verifies that the condition is present.

3: This step tests for voltage at the fuel injector harness connector.

4: This step verifies that the PCM is able to control the fuel injector. If the test lamp blinks, then the PCM and wiring are OK.

5: This step tests for a ground constantly being applied to the fuel injector control circuit.

12: After replacing the PCM the relationship between the CKP sensor and the crankshaft must be re-established. A new minimum throttle position and idle speed must also be established.

DTC P0201-P0206 Circuit

Step	Action	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. With a scan tool, clear the DTCs. 2. Crank the engine or start the engine. Does an injector DTC set?	Go to **Step 3**	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the appropriate harness connector of the fuel injector. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition voltage circuit of the fuel injector harness with a test lamp connected to a good ground. Does the test lamp illuminate?	Go to **Step 4**	Go to **Step 10**
4	1. Connect the **SA9194E** Fuel Injector Test Lamp between the control circuit and the ignition voltage circuit of the fuel injector harness connector. 2. Crank the engine or start the engine. Does the test lamp blink?	Go to **Step 8**	Go to **Step 5**
5	Does the test lamp remain illuminated at all times?	Go to **Step 7**	Go to **Step 6**
6	1. Turn OFF the ignition. 2. Disconnect the PCM. 3. Turn ON the ignition, with the engine OFF. 4. Test the control circuit of the fuel injector for a short to voltage or an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.		

	Did you find and correct the condition?	Go to **Step 13**	Go to **Step 9**
7	1. Turn OFF the ignition. 2. Disconnect the PCM. 3. Turn ON the ignition, with the engine OFF. 4. Test the control circuit of the fuel injector for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 13**	Go to **Step 12**
8	Test for an intermittent and for a poor connections at the fuel injector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 13**	Go to **Step 11**
9	Test for an intermittent and for a poor connections at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 13**	Go to **Step 12**
10	1. Repair the ignition voltage circuit of the fuel injector for an open or a short to ground. Refer to **Wiring Repairs** in Wiring Systems. 2. Replace the fuse as necessary. Did you complete the repair?	Go to **Step 13**	-
11	Replace the fuel injector. Refer to **Fuel Injector Replacement** . Did you complete the replacement?	Go to **Step 13**	-
12	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	Go to **Step 13**	-
13	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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.		

	Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 14**
14	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0222

Description

This diagnostic monitors the TP sensor 2 signal. There are two TP sensors located on the throttle body inside of the throttle actuator control (TAC) module. All throttle control is performed by the throttle actuator control (TAC) system. The TP sensors, along with the accelerator pedal position (APP) sensors and the TAC module are mandatory components of the TAC system. The TP sensors are used to determine the throttle plate angle. The TP sensor is a potentiometer whose resistance value changes along with the throttle valve position. The sensor uses a 5-volt reference supply, a low reference and a signal circuit. The TAC module the signal circuit voltage to calculate the actual throttle valve opening. The TP sensor is an integral part of the TAC module is not serviced separately. Installing a new TP sensor requires the replacement of the throttle body assembly. For additional information on the operation of the TP sensor and the TAC system refer to **Throttle Actuator Control (TAC) System Description** .

DTC Descriptors

This diagnostic procedure supports the following DTC.

DTC P0222 Throttle Position (TP) Sensor 2 Circuit Low Voltage

Conditions for Running the DTC

- DTC P0223 is not set.
- DTC P0222 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The TP sensor 2 voltage is 0.18 volts or less.
- The above condition is present for less than 1 second.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.

- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

> **1:** The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool, if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.
>
> **2:** This step determines if a fault is present. The normal TP angle at engine speeds above idle is more than 0 percent.

DTC P0222 Circuit

Step	Action	Value (s)	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Increase the engine speed to 3,500 RPM while observing the TP sensor 2 angle with a scan tool. Did the TP sensor 2 angle remain fixed at the specified value at all engine speeds?	0%	Go to **Step 4**	Go to **Step 3**
3	1. Use the scan tool in order to clear the DTCs. 2. Start the engine. 3. Operate the vehicle within the Freeze Frame conditions as specified or until the DTC P0222 diagnostic test has run. Refer to the Test Description. Is DTC P0222 set?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	The TP sensor 2 is faulty. Replace the TAC module. Refer to **Throttle Body Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 5**	-

5	1. Use the scan tool in order to clear the DTCs. 2. Start the engine. 3. Operate the vehicle within the Freeze Frame conditions as specified or until the DTC P0222 diagnostic test has run. Refer to the Test Description. Does the DTC run and pass?	-	Go to **Step 6**	Go to **Step 2**
6	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0223

Description

This diagnostic monitors the TP sensor 2 signal. There are two TP sensors located on the throttle body inside of the throttle actuator control (TAC) module. All throttle control is performed by the throttle actuator control (TAC) system. The TP sensors, along with the accelerator pedal position (APP) sensors and the TAC module are mandatory components of the TAC system. The TP sensors are used to determine the throttle plate angle. The TP sensor is a potentiometer whose resistance value changes along with the throttle valve position. The sensor uses a 5-volt reference supply, a low reference and a signal circuit. The TAC module the signal circuit voltage to calculate the actual throttle valve opening. The TP sensor is an integral part of the TAC module is not serviced separately. Installing a new TP sensor requires the replacement of the throttle body assembly. For additional information on the operation of the TP sensor and the TAC system refer to **Throttle Actuator Control (TAC) System Description** .

DTC Descriptors

This diagnostic procedure supports the following DTC.

DTC P0223 Throttle Position (TP) Sensor 2 Circuit High Voltage

Conditions for Running the DTC

- DTC P0222 is not set.
- DTC P0223 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The TP sensor 2 voltage is 4.85 volts or more.
- The above condition is present for less than 1 second.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool, if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step determines if a fault is present. The normal TP angle at idle is between 11-15 percent.

DTC P0223 Circuit

Step	Action	Value (s)	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, leaving the engine OFF. 2. Observe the TP sensor 2 angle with a scan tool. Is the TP sensor 2 angle within the specified range?	10-20%	Go to **Step 3**	Go to **Step 4**
3	1. Use the scan tool in order to clear the DTCs. 2. Start the engine. 3. Operate the vehicle within the Freeze Frame conditions as specified or until the	-		

	DTC P0223 diagnostic test has run. Refer to the Test Description. Is DTC P0223 set?		Go to **Step 4**	Go to **Intermittent Conditions**
4	Replace the throttle body. Refer to **Throttle Body Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 5**	-
5	1. Use the scan tool in order to clear the DTCs. 2. Start the engine. 3. Operate the vehicle within the Freeze Frame conditions as specified or until the DTC P0223 diagnostic test has run. Refer to the Test Description. Does the DTC run and pass?	-	Go to **Step 6**	Go to **Step 2**
6	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DIAGNOSTIC INFORMATION & PROCEDURES

DTC P0300

Circuit Description

The diagnostic illuminates the malfunction indicator lamp (MIL) when a non-cylinder specific misfire is present. The powertrain control module (PCM) uses the crankshaft position (CKP) sensor and camshaft position (CMP) sensor to determine engine misfire. The CKP sensor and the CMP sensor monitor their respective components and evaluate changes in the crankshaft rotational speed for each cylinder. Irregular changes in the crankshaft rotational speed indicate a possible misfire. The MIL illuminates when the misfire rate equals or exceeds a pre-determined count. A misfire rate that is high enough can cause the catalytic converter to overheat under certain driving conditions. The MIL will flash ON and OFF when the conditions for catalytic converter overheating are present. Each cylinder is monitored individually for a misfire condition. A DTC P0300 indicates that engine misfire was indicated in more than one cylinder at the same time.

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P0300 Engine Misfire Detected

Conditions for Running the DTC

- DTC P0107, DTC P0108, DTC P0112, DTC P0113, DTC P0117, DTC P0118, DTC P0122, DTC P0123, DTC P0222, DTC P0223, DTC P0335, DTC P0336, DTC P1128, DTC P1129, DTC P2227, DTC P2228, and DTC P2229 are not set.
- The engine speed is between 500-6,500 RPM.
- The engine coolant temperature (ECT) is more than -10°C (14°F) at start-up.
- The intake air temperature (IAT) sensor 2 is more than -10°C (14°F) at start-up.
- The manifold absolute pressure (MAP) is within a specified range for a calculated engine load.
- DTC P0300 runs continuously once the above conditions are met.

Condition 1 for Setting the DTC

The PCM detects 30-100 misfires every 200 engine revolutions.

Condition 2 for Setting the DTC

The PCM detects 70 misfires every 1,000 engine revolutions.

Action Taken When the DTC Sets

Condition 1

- The PCM flashes the malfunction indicator lamp (MIL) the first time the diagnostic fails indicating that catalytic converter damage can occur.
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Freeze Frame data.

Condition 2

- The PCM illuminates the MIL the second time the diagnostic fails.
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL on the third consecutive trip cycle during which the diagnostic has been run and the fault condition is no longer present.
- The DTC will clear if there is no misfire detected when the vehicle is operated in the same condition that the misfire was originally set.
- The DTC can be cleared by using the scan tool Clear DTC Information function.

Diagnostic Aids

Check for any of the following conditions:

- If any DTCs other than misfire P0301-P0306 are set, diagnose those DTCs first.
- An intermittent ignition system malfunction may cause DTC P0300 to set. Check ignition system performance with an engine oscilloscope.
- Review the misfire counters located in the Engine Data list of the scan tool while the engine is running. If the Misfire Current Cylinder# data parameter is increasing, the misfire condition is present. Misfire activity can be monitored with the scan tool in the Misfire Current Cyl # data list parameter of the appropriate cylinder. Use this information in order to determine if the fault is present or an intermittent malfunction.
- Inspect for good quality recently purchased fuel. Inferior quality fuel or fuel that has aged can cause poor combustion that results in detectable engine misfire. If the fuel is suspect, drain and replace as necessary.
- An intermittent can also be the result of a defective CKP sensor signal rotor. Inspect the CKP signal rotor for nicks, dents, missing teeth, and foreign material.
- Check for engine overheating. Refer to **Engine Overheating** in Engine Cooling.

An intermittent malfunction may be caused by a fault in the electrical circuits of the ignition system or fuel system of the misfiring cylinder. Inspect the wiring harness and the components for an intermittent condition. Refer to **Intermittent Conditions** .

Repair any electrical circuit faults that were found. Refer to **Wiring Repairs** in Wiring Systems.

The information included in the Freeze Frame data can be useful in determining the vehicle operating conditions when the DTC first set.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step verifies whether the misfire is present. The scan tool will display increasing counts in one or more of the Misfire Current Cyl. # parameter of the misfiring cylinder when a misfire is occurring.

4: If the Misfire Current Counters are incrementing, but the engine is NOT misfiring, this indicates a mechanical condition. For example, an accessory drive belt could cause this condition.

DTC P0300 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views or Splice Pack Connector End Views in Wiring Systems**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **The engine may only misfire when the engine is under a load. An engine load may be necessary to verify the condition.** 1. Turn ON the ignition, with the engine OFF. 2. Clear the DTCs with a scan tool. 3. Start the engine and allow the engine to idle. 4. Allow the engine to reach operating temperature. 5. Monitor the Misfire Current Cyl. 1-6 Counter parameters with a scan tool. Are any of the Misfire Current Counters incrementing?	-	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?		Go to **Step 4**	Go to Diagnostic Aids
4	Is the engine misfiring?	-	Go to **Step 5**	Go to **Symptoms - Engine Mechanical** in Engine Mechanical - 3.5L (L66)
5	Observe the DTC Info with a scan tool. Is DTC P0201, P0202, P0203, P0204, P0205, P0206, P0335, P0336, P0401, P0403, P0404, P0406, P2647, P2648, or P2649 also set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 6**
6	Is there an engine mechanical noise?	-	Go to **Symptoms - Engine Mechanical** in Engine Mechanical - 3.5L (L66)	Go to **Step 7**
7	Is there more than one misfire DTC set?	-	Go to **Step 8**	Go to **DTC P0301-P0306**
8	1. Inspect or test for the following conditions: • Inspect the vacuum hoses for splits, kinks, and proper connections. • Inspect the throttle body and the intake manifold for vacuum leaks. • Inspect the crankcase ventilation valve and/or system for any vacuum leaks. Refer to **Crankcase Ventilation System Inspection/Diagnosis** in Engine Mechanical - 3.5L (L66). • Test for the correct fuel pressure. Refer to **Fuel System Diagnosis** . • Inspect the fuel system for any restrictions, leaks or fuel contamination. Refer to **Fuel System Diagnosis** or **Alcohol/Contaminants-in-Fuel Diagnosis** . • Inspect for fouled or damaged spark plugs. Determine what caused the spark plugs to foul. Refer to **Spark Plug Inspection** and**Spark Plug**	-		

	Replacement . • Inspect the exhaust system for restrictions. Refer to **Restricted Exhaust** in Engine Exhaust. • Inspect the splice pack for the ignition 1 circuits of the ignition coils for water intrusion and poor connections. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems. • Inspect the engine control grounds for being clean, tight, and in the correct location. 2. Repair as necessary. Did you find and correct the condition?		Go to **Step 9**	Go to **Symptoms - Engine Mechanical** in Engine Mechanical - 3.5L (L66)
9	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 10**
10	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0301-P0306

Circuit Description

Each cylinder is monitored individually for a misfire condition and can set a cylinder specific diagnostic trouble code (DTC). The powertrain control module (PCM) uses the crankshaft position (CKP) sensor and camshaft position (CMP) sensors to determine engine misfire. The CKP sensor and the CMP sensors monitor their respective components and evaluate changes in the crankshaft rotational speed for each cylinder. Irregular changes in the crankshaft rotational speed indicate a possible misfire. The malfunction indicator lamp (MIL) illuminates when the misfire rate equals or exceeds a pre-determined count. A misfire rate that is high enough can cause the catalytic converter to overheat under certain driving conditions. The MIL will flash ON and OFF when the conditions for catalytic converter overheating are present.

DTC Descriptors

This diagnostic procedure supports the following DTCs.

- DTC P0301 Cylinder 1 Misfire Detected
- DTC P0302 Cylinder 2 Misfire Detected
- DTC P0303 Cylinder 3 Misfire Detected
- DTC P0304 Cylinder 4 Misfire Detected
- DTC P0305 Cylinder 5 Misfire Detected
- DTC P0306 Cylinder 6 Misfire Detected

Conditions for Running the DTC

- DTC P0107, DTC P0108, DTC P0112, DTC P0113, DTC P0117, DTC P0118, DTC P0122, DTC P0123, DTC P0222, DTC P0223, DTC P0335, DTC P0336, DTC P1121, DTC P1122, DTC P1128, DTC P1129, DTC P2227, DTC P2228, and DTC P2229 are not set.
- The engine speed is between 500-6,500 RPM.
- The engine coolant temperature (ECT) is more than -10°C (14°F) at start-up.
- The intake air temperature (IAT) sensor 2 is more than -10°C (14°F) at start-up.
- The manifold absolute pressure (MAP) is within a specified range for a calculated engine load.
- DTC P0301-P0306 runs continuously once the above conditions are met.

Condition 1 for Setting the DTC

The PCM detects 30-100 misfires every 200 engine revolutions depending on engine speed and engine load.

Condition 2 for Setting the DTC

The PCM detects 70 misfires every 1,000 engine revolutions.

Action Taken When the DTC Sets

Condition 1

- The PCM flashes the malfunction indicator lamp (MIL) the first time the diagnostic fails indicating that catalytic converter damage can occur.
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Freeze Frame data.

Condition 2

- The PCM illuminates the MIL the second time the diagnostic fails.
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL on the third consecutive trip cycle during which the diagnostic has been run and the fault condition is no longer present.
- The DTC will clear if there is no misfire detected when the vehicle is operated in the same condition that the misfire was originally set.
- A DTC can be cleared by using the scan tool Clear DTC Information function.

Diagnostic Aids

Check for any of the following conditions:

- If any DTCs other than misfire P0300-P0306 are set, diagnose those DTCs first.
- An intermittent ignition system malfunction may cause DTC P0301-P0306 to set. Check ignition system performance with an engine oscilloscope.
- Review the misfire counters located in the Engine Data list of the scan tool while the engine is running. Misfire activity can be monitored with the scan tool in the Misfire Current Cyl # data list parameter of the appropriate cylinder. Use this information in order to determine if the fault is present or an intermittent malfunction.
- An intermittent can also be the result of a defective CKP sensor signal rotor. Inspect the CKP signal rotor for nicks, dents, missing teeth, and foreign material.
- Check for engine overheating. Refer to **Engine Overheating** in Engine Cooling.

An intermittent malfunction may be caused by a fault in the electrical circuits of the ignition system or fuel system of the misfiring cylinder. Inspect the wiring harness and the components for an intermittent condition. Refer to **Intermittent Conditions** .

Repair any electrical circuit faults that were found. Refer to **Wiring Repairs** in Wiring Systems.

The information included in the Freeze Frame data can be useful in determining the vehicle operating conditions when the DTC first set.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

> **1:** The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

DTC P0301-P0306 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-		Go to **Diagnostic System Check -**

			Go to **Step 2**	**Engine Controls**
2	Were you sent here from DTC P0300?	-	Go to **Step 3**	Go to **DTC P0300**
3	1. Turn OFF the ignition. 2. Remove the ignition coil of the misfiring cylinder, but leave the electrical connector connected. Refer to the appropriate procedure: • **Ignition Coil(s) Replacement - Bank 1** • **Ignition Coil(s) Replacement - Bank 2** 3. Inspect the ignition coil boot for the following conditions: • Holes • Tears • Carbon tracking • Oil contamination or water intrusion Did you find a condition with the ignition coil boot?	-	Go to **Step 12**	Go to **Step 4**
4	1. Remove the fuel pump fuse from the electrical center. 2. Install the **J 26792** Spark Tester to the ignition coil boot and a good ground. 3. Crank the engine while observing the **J 26792** . Does the spark tester spark and is the spark consistent?	-	Go to **Step 5**	Go to **Electronic Ignition (EI) System Diagnosis**
5	1. Turn OFF the ignition. 2. Remove the spark plug from the cylinder that indicated a misfire. 3. Inspect the spark plug. Refer to **Spark Plug Inspection** . Does the spark plug appear to be OK?	-	Go to **Step 9**	Go to **Step 6**
6	Is the spark plug oil or coolant fouled?	-	Go to **Symptoms - Engine Mechanical** in Engine Mechanical - 3.5L (L66)	Go to **Step 7**

7	Is the spark plug gas fouled?	-	Go to **Step 10**	Go to **Step 8**
8	Does the spark plug show any signs of being cracked, worn, or incorrectly gap?	-	Go to **Step 11**	Go to **Step 9**
9	1. Swap the suspected spark plug with another cylinder that is operating correctly. 2. Start the engine. 3. Operate the engine within the conditions that the misfire occurred. 4. Monitor the Misfire Current Counters with a scan tool. Did the misfire move with the spark plug?	-	Go to **Step 11**	Go to **Step 10**
10	**IMPORTANT:** • **Make sure all the fuel injectors operate. High resistance in an fuel injector circuit causes the fuel injector to be inoperative without setting a fuel injector DTC.** • **Return to this diagnostic after you complete the Fuel Injector Coil Test.** Perform the fuel injector coil test. Refer to **Fuel Injector Coil Test** .Did you find and correct the condition?	-	Go to **Step 13**	Go to **Symptoms - Engine Mechanical** in Engine Mechanical - 3.5L (L66)
11	Replace the spark plug. Refer to **Spark Plug Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
12	Replace the ignition coil. Refer to the appropriate procedure: • **Ignition Coil(s) Replacement - Bank 1** • **Ignition Coil(s) Replacement - Bank 2** Did you complete the replacement?	-	Go to **Step 13**	-
13	Was the customer's concern that the MIL is flashing?	-	Go to **DTC P0420 or P0430**	Go to **Step 14**
14	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?		Go to **Step 2**	Go to **Step 15**
15	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0325

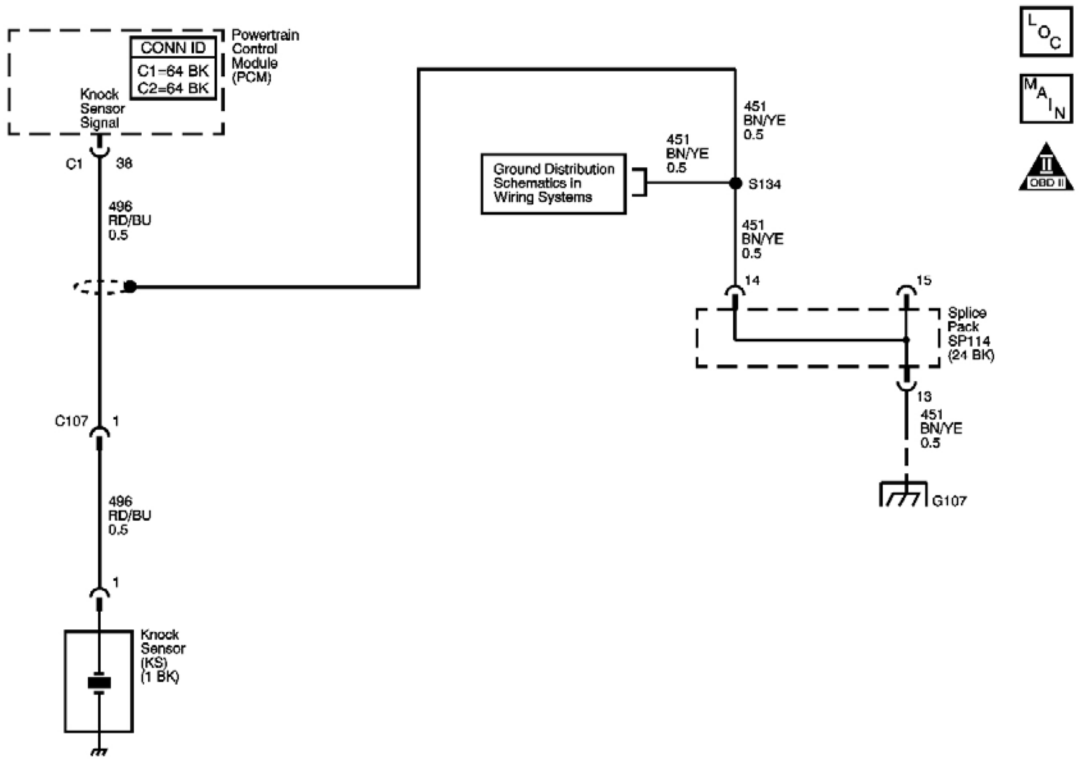


Fig. 1: DTC P0325 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0325 Knock Sensor (KS) Circuit diagnostic monitors the activity on the knock sensor circuit. The KS is used to detect engine detonation. The KS is constructed of a piezoelectric element which generates an AC signal when vibrated. Normal engine operation will cause the KS to generate a signal of a certain known frequency. When engine knock is present, the KS frequency changes which signals the PCM to retard ignition timing. By retarding the ignition timing, the engine detonation detected should be reduced.

DTC Descriptors

This diagnostic procedure supports the following DTC.

DTC P0325 Knock Sensor (KS) Circuit

Conditions for Running the DTC

- The engine speed is at least 2,000 RPM.
- The engine coolant temperature (ECT) is at least 60°C (140°F).
- DTC P0325 runs continuously once the above conditions are met.

Conditions for Setting the DTC

No KS signal is detected for more than 5 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the MIL.
- The PCM stores the conditions which were present when the DTC set as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL on the third consecutive trip cycle during which the diagnostic has been run and the fault condition is no longer present.
- The DTC clears after 40 consecutive warm-up cycles have occurred without a fault.
- A DTC can be cleared by using the scan tool Clear DTC Information function.

Diagnostic Aids

- A loose KS can cause a loss of the KS signal. Check the KS for the proper torque.
- An intermittent malfunction may be caused by a fault in the KS sensor electrical circuit. Inspect the wiring harness and the components for an intermittent condition. Refer to **Intermittent Conditions** .

The information included in the Freeze Frame data can be useful in determining the vehicle operating conditions present when the DTC first set.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step checks whether DTC P0325 is the result of a hard failure or an intermittent condition.

4: This step tests the KS signal circuit and the PCM. Shorting the signal circuit to 5 volts enables validation of the signal wire and the PCM recognition of a voltage input. The EGR valve is the most convenient 5-volt supply for performing this test.

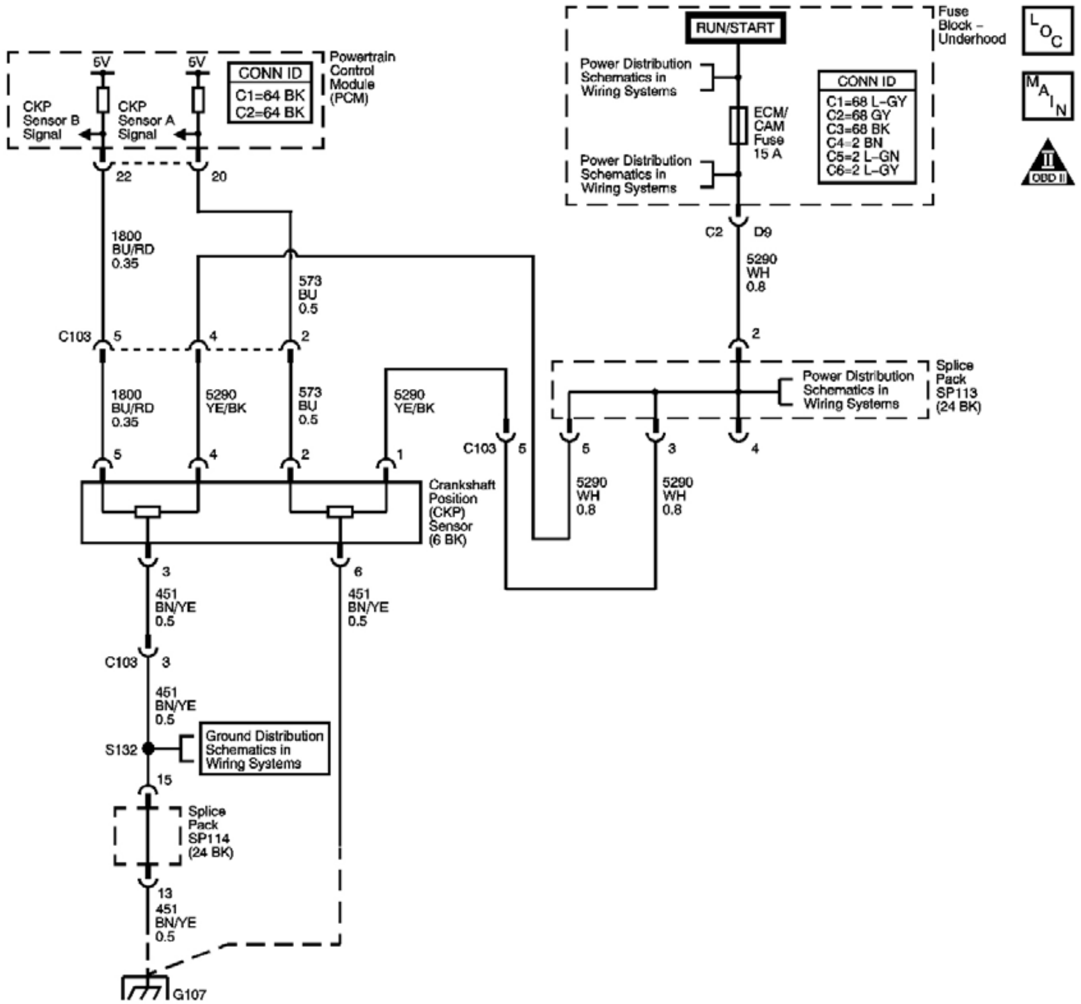
7: After replacing the PCM a new minimum throttle position and idle speed must also be established.

DTC P0325 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to**Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Install a scan tool. 2. Start the engine. 3. Observe the Knock Control parameter on the scan tool while performing several acceleration events. Did the Knock Control parameter switch from Inactive to Active at least once during AA acceleration event?	-	Go to**Step 3**	Go to**Step 4**
3	1. Perform the scan tool Clear DTC Information function. 2. Operate the vehicle within the Freeze Frame conditions as specified. Does DTC P0325 set?	-	Go to**Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the knock sensor connector. 3. Connect a fused jumper wire to the KS signal circuit and the 5-volt reference circuit of the EGR position sensor. 4. Turn ON the ignition with the engine OFF. Is the DC voltage within the specified range?	3.8-4.0 V	Go to**Step 5**	Go to**Step 6**
5	Replace the knock sensor. Refer to **Knock Sensor (KS) Replacement** . Is the action complete?	-	Go to**Step 8**	-
	1. Check for an open or a short in the KS signal circuit. Ensure that the terminal connection at the			

6	sensor is good. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and repair a wiring condition?	-	Go to**Step 8**	Go to**Step 7**
7	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to**Step 8**	-
8	1. Use the scan tool in order to clear the DTCs. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text or until the DTC P0325 diagnostic test has run. Does the DTC run and pass?	-	Go to**Step 9**	Go to**Step 2**
9	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0335



<u>Fig. 2: DTC P0335 Circuit</u>
Courtesy of GENERAL MOTORS CORP.

Circuit Description

This diagnostic monitors the signal from the CKP sensor A. The CKP sensor is a magnetic generator type sensor, producing an alternating current signal. The CKP sensor signal increases in both frequency and amplitude as the engine speed increases. The CKP sensor sends this reference signal to the powertrain control module (PCM) to indicate the crankshaft speed and position. This reference signal is used by the PCM to calculate fuel injection pulse, establish top dead center (TDC) for ignition timing and where to start ignition coil and injection sequencing. There will be no spark or fuel delivery if there is no CKP sensor signal from either CKP sensor.

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P0335 Crankshaft Position (CKP) Sensor A Circuit

Conditions for Running the DTC

- DTC P0340, P0341, or P0385 are not set.
- The starter is cranking the engine or the engine is running.
- DTC P0335 runs continuously once the above conditions are met.

Conditions for Setting the DTC

No crankshaft position sensor signal to the PCM for 5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL after 3 consecutive trips without a fault.
- The PCM clears a History DTC after 40 consecutive warm-up cycles without a fault.
- Use the scan tool Clear DTC Information function.

Diagnostic Aids

Inspect for the following conditions:

- Inspect the crankshaft position (CKP) sensor output signal with a scan tool. The scan tool will display engine speed while cranking when the PCM detects the CKP sensor A signal. Observe the Engine Speed parameter while cranking the engine. The scan tool should indicate at least a steady 200-300 RPM while cranking.
- If DTC P0335 and DTC P0385 are both setting, inspect for a loose CKP sensor assembly or damage, foreign material on the signal marks of the crankshaft pulley.

An intermittent malfunction may be caused by a fault in the CKP sensor electrical circuit. Inspect the wiring harness and the components for an intermittent condition. Refer to **Intermittent Conditions** .

Repair any electrical circuit faults that were found. Refer to **Wiring Repairs** in Wiring Systems.

The information included in the Freeze Frame data can be useful in determining the vehicle operating conditions when the DTC first set.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step determines whether the DTC P0335 is the result of a hard failure or an intermittent condition.

6: This step tests the CKP sensor input circuit.

13: After replacing the PCM new minimum throttle position and idle speed must also be established.

DTC P0335 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to**Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Select Crankshaft Position Sensor A parameter on the scan tool. Does the scan tool display a rolling count within the specified range?	0-3 Counts	Go to **Step 3**	Go to **Step 4**
3	1. Turn ON the ignition, with the engine OFF. 2. Save the DTC and Freeze Frame information into the scan tool memory. 3. Perform the scan tool Clear DTC Information function. 4. Operate the vehicle within the Freeze Frame conditions as specified. Is DTC P0335 set?	-	Go to **Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the CKP sensor electrical connector. 3. Connect a test lamp between the CKP sensor A ground circuit and B+. Did the test lamp illuminate?	-	Go to**Step 5**	Go to**Step 8**
5	1. Connect a DMM to the ignition 1 voltage circuit of the CKP sensor A and ground. 2. Turn ON the ignition, with the engine OFF. Is the voltage near the specified value?	12 V	Go to **Step 6**	Go to**Step 9**

6	1. Connect the DMM to the signal circuit of CKP sensor A and ground. 2. Turn ON the ignition, with the engine OFF. Is the voltage near the specified value?	5.0 V	Go to **Step 11**	Go to **Step 7**
7	1. Test for an open or a short in the CKP sensor A signal circuit. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and repair a condition?	-	Go to **Step 15**	Go to **Step 10**
8	1. Repair the open in the CKP sensor A ground circuit. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 14**	-
9	1. Locate and repair the open in the ignition 1 voltage circuit of the CKP sensor A. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 14**	-
10	1. Test for an intermittent or a poor electrical connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. 2. Repair as necessary Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 14**	Go to **Step 13**
11	1. Test for an intermittent or a poor electrical connection at the CKP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. 2. Repair as necessary Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 14**	Go to **Step 12**
12	Replace the crankshaft position sensor. Refer to **Crankshaft Position (CKP) Sensor Replacement** .	-		

	Did you complete the replacement?		Go to **Step 14**	-
13	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 14**	-
14	1. Use the scan tool in order to clear the DTCs. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC run and pass?	-	Go to **Step 15**	Go to **Step 2**
15	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0336

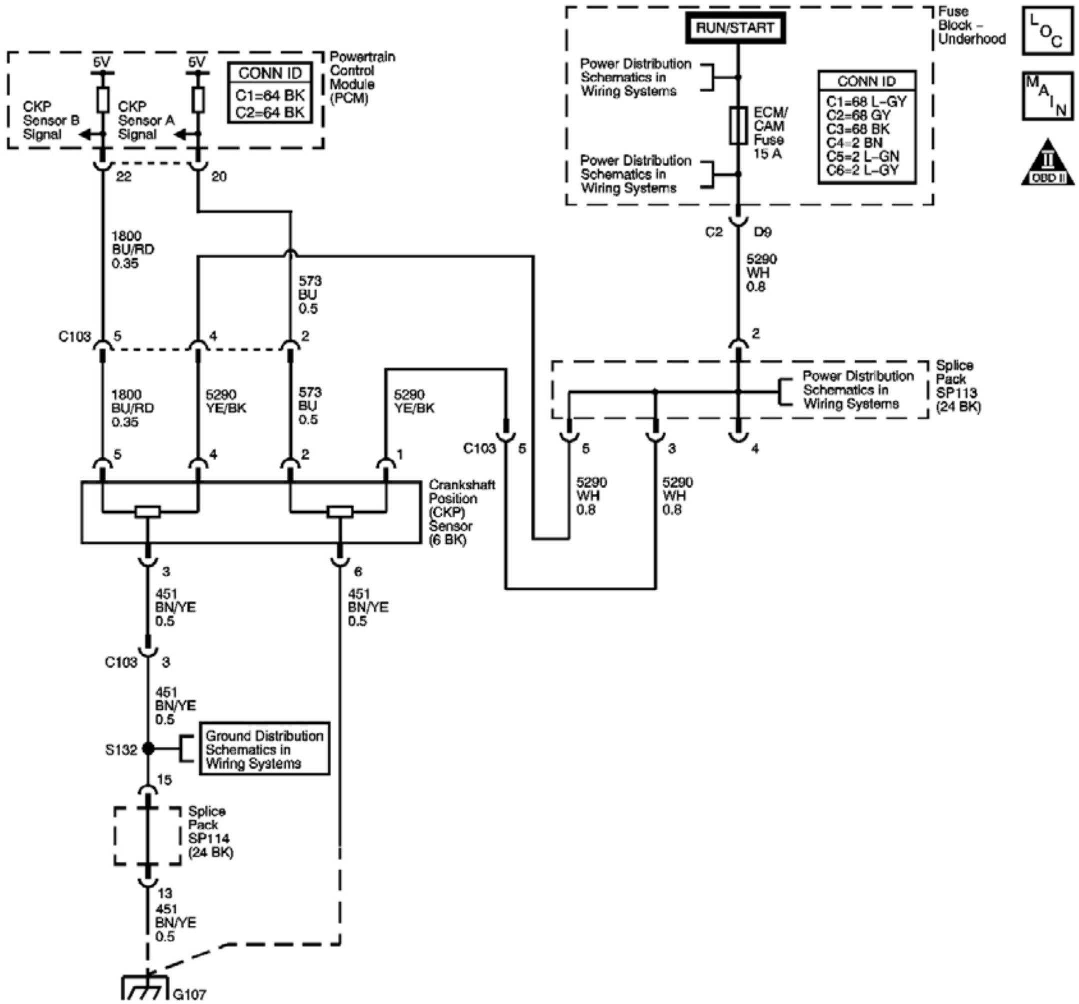


Fig. 3: DTC P0336 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0336 Crankshaft Position (CKP) Sensor A Performance diagnostic monitors the stability of the signal from the CKP sensor A. The CKP sensor is a magnetic generator type sensor, producing an alternating current signal. The CKP sensor signal increases in both frequency and amplitude as the engine RPM increases. The CKP sensor sends this reference signal to the powertrain control module (PCM) to indicate the crankshaft RPM and position. This reference signal is used by the PCM to calculate fuel injection pulse, establish top dead center (TDC) for ignition timing and where to start ignition coil and injection sequencing. There will be no spark or fuel delivery if there is no CKP sensor signal.

DTC Descriptors

This diagnostic procedure supports the following DTC.

DTC P0336 Crankshaft Position (CKP) Sensor A Performance

Conditions for Running the DTC

- DTC P0340, P0341, or P0385 are not set.
- The engine is running.
- DTC P0336 runs continuously once the above conditions are met.

Conditions for Setting the DTC

The PCM detects less than or more than 22 pulses per crankshaft revolution.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

Excess crankshaft end play causes the reluctor wheel to move out of alignment with the CKP sensor. This could result in an intermittent DTC P0336.

An intermittent malfunction may be caused by a fault in the CKP sensor circuit. Inspect the wiring harness and the components for an intermittent condition. Refer to **Intermittent Conditions** .

If the DTC P0336 cannot be duplicated, the information included in the Freeze Frame data can be useful in determining the vehicle operating conditions when the DTC was first set.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step determines whether the DTC P0336 is the result of a hard failure or an intermittent condition.

6: This step tests the CKP sensor input circuit.

14: After replacing the PCM a new minimum throttle position and idle speed must also be established.

DTC P0336 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to**Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Select Crankshaft Position Sensor A parameter on the scan tool. Does the scan tool display a rolling count within the specified range?	0-3 Counts	Go to **Step 3**	Go to **Step 4**
3	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Save the DTC and Freeze Frame information into the scan tool memory. 4. Perform the scan tool Clear DTC Information function. 5. Operate the vehicle within the Freeze Frame conditions as specified. Is DTC P0335 set?	-	Go to **Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the CKP sensor electrical connector. 3. Connect a test lamp between the CKP sensor ground circuit and B+. Did the test lamp illuminate?	-	Go to**Step 5**	Go to**Step 8**
5	1. Connect a DMM to the ignition positive voltage circuit of the CKP sensor and ground. 2. Turn ON the ignition, with the engine OFF.	12 V		

	Is the voltage near the specified value?		Go to **Step 6**	Go to**Step 9**
6	1. Connect the DMM to the signal circuit of CKP sensor A and ground. 2. Turn ON the ignition, with the engine OFF. Is the voltage near the specified value?	5.0 V	Go to **Step 11**	Go to **Step 7**
7	1. Test for an open or a short in the CKP sensor A signal t circuit. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and repair a condition?	-	Go to **Step 15**	Go to **Step 10**
8	1. Repair the open in the CKP sensor ground circuit. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 15**	-
9	1. Locate and repair the open in the ignition positive voltage circuit of the CKP sensor A. 2. Repair as necessary. Refer to**Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 15**	-
10	1. Test for an intermittent or a poor electrical connection at the PCM. Refer to**Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. 2. Repair as necessary Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 15**	Go to **Step 14**
11	1. Inspect for any of the following conditions: • Loose CKP sensor fasteners • Damaged signal marks on the crankshaft pulley 2. Repair as necessary Refer to**Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 15**	Go to **Step 12**

12	1. Test for an intermittent or a poor electrical connection at the CKP sensor. Refer to**Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. 2. Repair as necessary Refer to**Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 15**	Go to **Step 13**
13	Replace the crankshaft position sensor. Refer to **Crankshaft Position (CKP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
14	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 15**	-
15	1. Use the scan tool in order to clear the DTCs. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC run and pass?	-	Go to **Step 16**	Go to **Step 2**
16	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0340

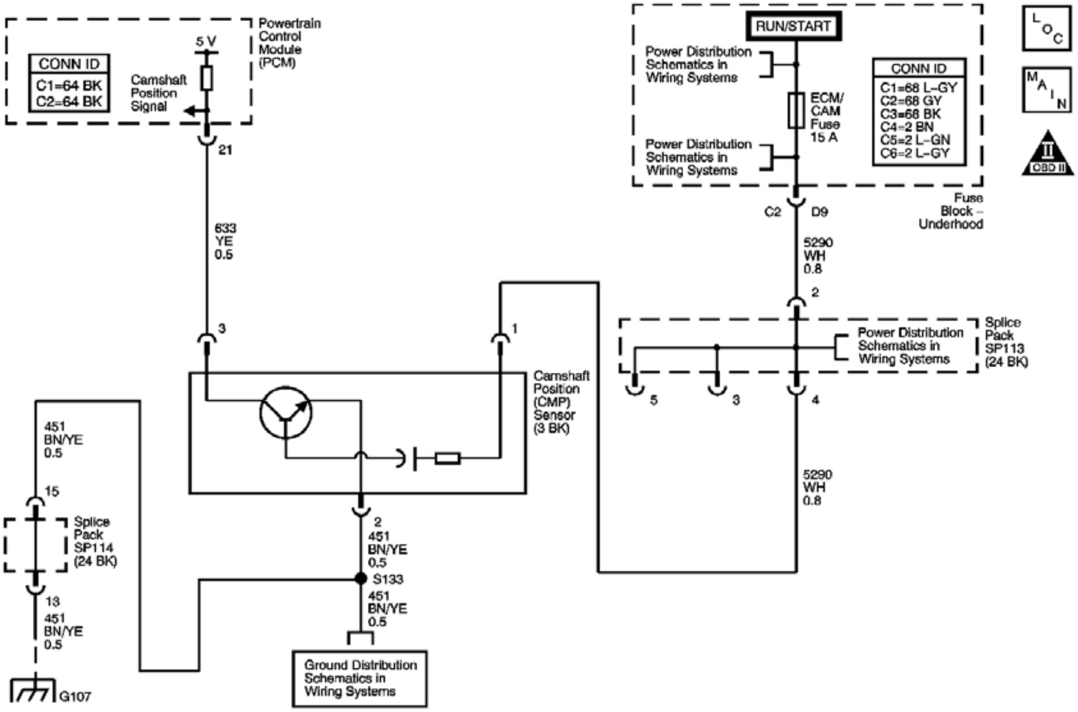


Fig. 4: DTC P0340 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0340 Camshaft Position (CMP) Sensor Circuit diagnostic monitors the signal from the CMP sensor. The CMP sensor is a magnetic generator type sensor, producing an alternating current signal. The CMP sensor sends this signal to the powertrain control module (PCM) to indicate the camshaft position. The CMP signal is used by the PCM to modify fuel injection pulse, ignition timing and misfire detection.

DTC Descriptors

This diagnostic procedure supports the following DTC.

DTC P0340 Camshaft Position (CMP) Sensor Circuit

Conditions for Running the DTC

- DTC P0335, P0336, P0385, or P0386 are not set.
- The engine is running.
- DTC P0340 runs continuously once the above conditions are met

Conditions for Setting the DTC

No camshaft position sensor signal to the PCM for 16 crankshaft revolutions.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL after 3 consecutive trips without a fault.
- The PCM clears a History DTC after 40 consecutive warm-up cycles without a fault.
- Use the scan tool Clear DTC Information function.

Diagnostic Aids

Check for any of the following conditions:

- A loose CMP sensor or damage, foreign material on the signal marks of the camshaft gear can cause a DTC P0340.
- An intermittent malfunction may be caused by a fault in the CMP sensor electrical circuit. Inspect the wiring harness and the components for an intermittent condition. Refer to **Intermittent Conditions** .

Repair any electrical circuit faults that were found. Refer to **Wiring Repairs** in Wiring Systems.

The information included in the Freeze Frame data can be useful in determining the vehicle operating conditions when the DTC first set.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step determines whether the DTC P0340 is the result of a hard failure or an intermittent condition.

5: This step tests the CMP sensor input circuit.

12: After replacing the PCM a new minimum throttle position and idle speed must also be established.

DTC P0340 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-		Go to **Diagnostic System Check -**

			Go to**Step 2**	**Engine Controls**
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Save the DTC and Freeze Frame information into the scan tool memory. 4. Perform the scan tool Clear DTC Information function. 5. Operate the vehicle within the Freeze Frame conditions as specified. Is DTC P0340 set?	-	Go to **Step 3**	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the CMP sensor electrical connector. 3. Connect a test lamp between the CMP sensor ground circuit and B+. Did the test lamp illuminate?	-	Go to**Step 4**	Go to**Step 7**
4	1. Connect a DMM to the ignition positive voltage circuit of the CMP sensor and ground. 2. Turn ON the ignition, with the engine OFF. Is the voltage near the specified value?	12 V	Go to **Step 5**	Go to**Step 8**
5	1. Connect the DMM to the signal circuit of CMP sensor and ground. 2. Turn ON the ignition, with the engine OFF. Is the voltage near the specified value?	5.0 V	Go to **Step 10**	Go to **Step 6**
6	1. Test for an open or a short in the CMP sensor signal circuit. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and repair a condition?	-	Go to **Step 13**	Go to **Step 9**
7	1. Repair the open in the CMP sensor ground circuit. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 13**	-
	1. Locate and repair the open in the ignition			

8	positive voltage circuit of the CMP sensor. 2. Repair as necessary. Refer to**Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 13**	-
9	1. Test for an intermittent or a poor electrical connection at the PCM. Refer to**Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. 2. Repair as necessary Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 13**	Go to **Step 12**
10	1. Test for an intermittent or a poor electrical connection at the CMP sensor. Refer to**Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. 2. Repair as necessary Refer to**Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 13**	Go to **Step 11**
11	Replace the CMP sensor. Refer to **Camshaft Position (CMP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
12	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 13**	-
13	1. Use the scan tool in order to clear the DTCs. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC run and pass?	-	Go to **Step 14**	Go to **Step 2**
14	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have	-	Go to **Diagnostic Trouble Code**	

	not diagnosed?		**(DTC) List**	System OK

DTC P0341

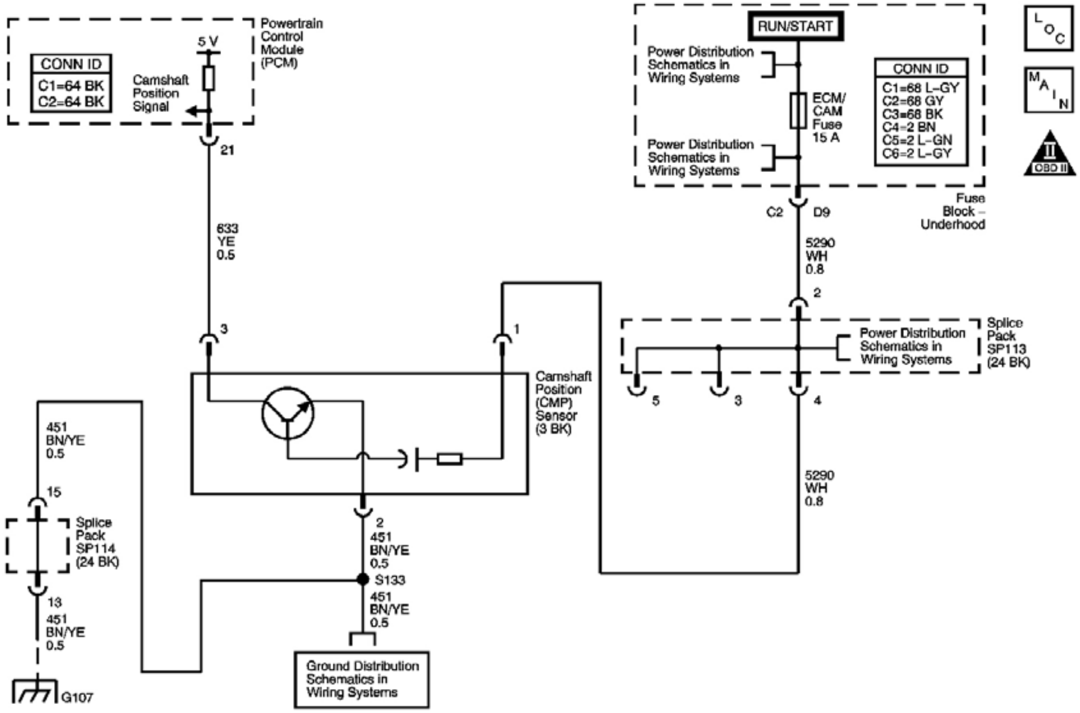


Fig. 5: DTC P0341 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0341 Camshaft Position (CMP) Sensor Performance diagnostic monitors the stability of the signal from the CMP sensor. The CMP sensor is a magnetic generator type sensor, producing an alternating current signal. The CMP sensor sends this signal to the powertrain control module (PCM) to indicate the camshaft position. The CMP signal is used by the PCM to modify fuel injection pulse, ignition timing and misfire detection.

DTC Descriptors

This diagnostic procedure supports the following DTC.

DTC P0341 Camshaft Position (CMP) Sensor Performance

Conditions for Running the DTC

- DTC P0335, P0336, P0385, or P0386 are not set.

- The engine speed is more than 400 RPM.
- DTC P0341 runs continuously once the above conditions are met

Conditions for Setting the DTC

- The PCM detects 2 less or 2 more pulses than expected per camshaft revolution.
- The above condition occurs for 30 crankshaft revolutions.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

Excess camshaft end play causes the reluctor wheel to move out of alignment with the CMP sensor. This could result in any one of the following conditions:

An intermittent malfunction may be caused by a fault in the CMP sensor circuit. Inspect the wiring harness and the components for an intermittent condition. Refer to **Intermittent Conditions** .

If the DTC P0341 cannot be duplicated, the information included in the Freeze Frame data can be useful in determining the vehicle operating conditions when the DTC was first set.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step determines whether the DTC P0341 is the result of a hard failure or an intermittent condition.

5: This step tests the CMP sensor input circuit.

13: After replacing the PCM new minimum throttle position and idle speed must also be established.

DTC P0341 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to**Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Save the DTC and Freeze Frame information into the scan tool memory. 4. Perform the scan tool Clear DTC Information function. 5. Operate the vehicle within the Freeze Frame conditions as specified. Is DTC P0341 set?	-	Go to **Step 3**	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the CMP sensor electrical connector. 3. Connect a test lamp between the CMP sensor ground circuit and B+. Did the test lamp illuminate?	-	Go to**Step 4**	Go to**Step 7**
4	1. Connect a DMM to the ignition positive voltage circuit of the CMP sensor and ground. 2. Turn ON the ignition, with the engine OFF. Is the voltage near the specified value?	12 V	Go to **Step 5**	Go to**Step 8**
5	1. Connect the DMM to the signal circuit of CMP sensor and ground. 2. Turn ON the ignition, with the engine OFF. Is the voltage near the specified value?	5.0 V	Go to **Step 10**	Go to **Step 6**
6	1. Test for an open or a short in the CMP sensor signal circuit. 2. Repair as necessary. Refer to **Wiring Repairs**	-		

	in Wiring Systems. Did you find and repair a condition?		Go to **Step 14**	Go to **Step 9**
7	1. Repair the open in the CMP sensor ground circuit. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 14**	-
8	1. Locate and repair the open in the ignition positive voltage circuit of the CMP sensor. 2. Repair as necessary. Refer to**Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 14**	-
9	1. Test for an intermittent or a poor electrical connection at the PCM. Refer to**Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. 2. Repair as necessary Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 14**	Go to **Step 13**
10	1. Inspect for any of the following conditions: • Loose CMP sensor fasteners • Damaged signal marks on the camshaft gear 2. Repair as necessary Refer to**Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 14**	Go to **Step 11**
11	1. Test for an intermittent or a poor electrical connection at the CMP sensor. Refer to**Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. 2. Repair as necessary Refer to**Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 14**	Go to **Step 12**
12	Replace the CMP sensor. Refer to **Camshaft Position (CMP) Sensor Replacement** .	-		-

	Did you complete the replacement?		Go to **Step 14**	
13	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 14**	-
14	1. Use the scan tool in order to clear the DTCs. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC run and pass?	-	Go to **Step 15**	Go to **Step 2**
15	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0385

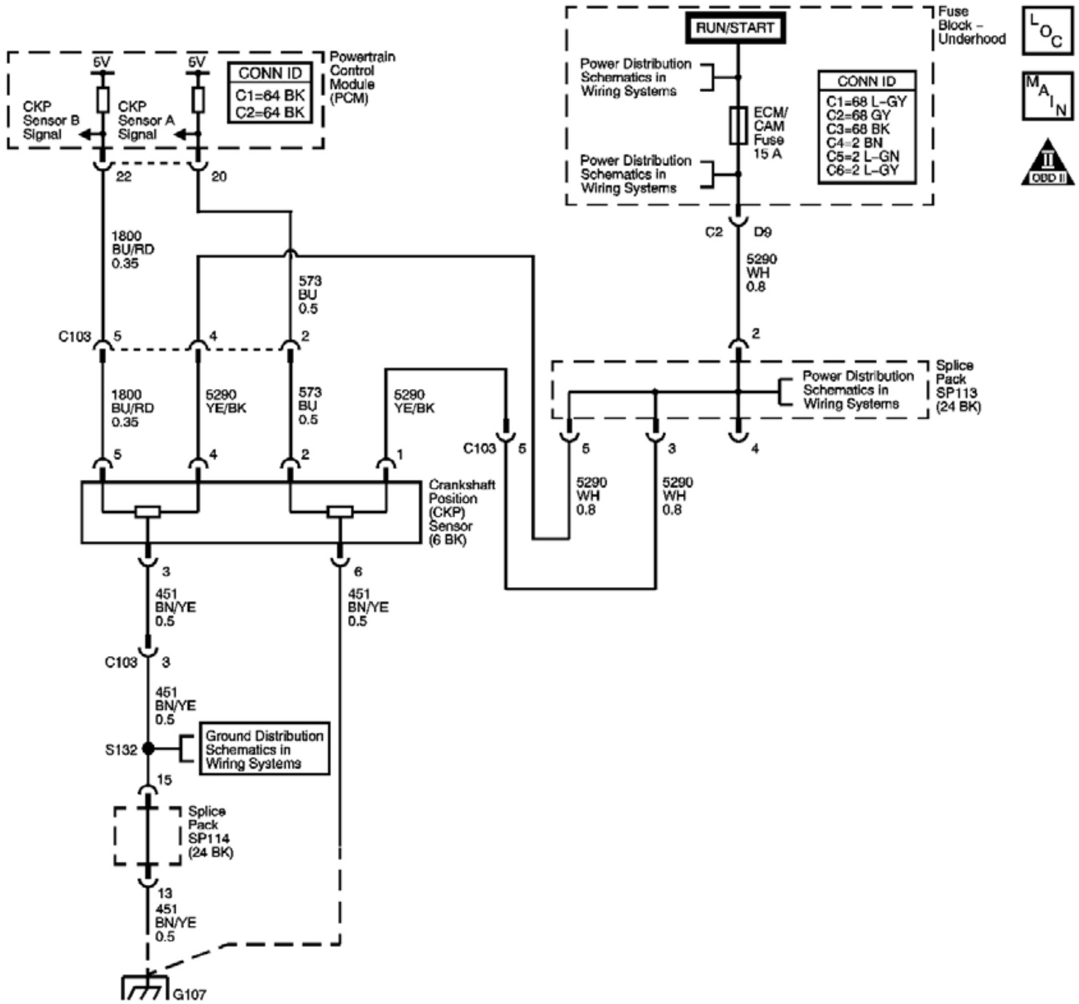


Fig. 6: DTC P0385 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

This diagnostic monitors the signal from the CKP sensor B. The CKP sensor is a magnetic generator type sensor, producing an alternating current signal. The CKP sensor signal increases in both frequency and amplitude as the engine speed increases. The CKP sensor sends this reference signal to the powertrain control module (PCM) to indicate the crankshaft speed and position. This reference signal is used by the PCM to calculate fuel injection pulse, establish top dead center (TDC) for ignition timing and where to start ignition coil and injection sequencing. There will be no spark or fuel delivery if there is no CKP sensor signal from either CKP sensor.

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P0385 Crankshaft Position (CKP) Sensor B Circuit

Conditions for Running the DTC

- DTC P0335, P0340, or P0341 are not set.
- The starter is cranking the engine or the engine is running.
- DTC P0385 runs continuously once the above conditions are met.

Conditions for Setting the DTC

No crankshaft position sensor signal to the PCM for 16 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL after 3 consecutive trips without a fault.
- The PCM clears a History DTC after 40 consecutive warm-up cycles without a fault.
- Use the scan tool Clear DTC Information function.

Diagnostic Aids

Check for any of the following conditions:

- The Crankshaft Position Sensor B parameter on the scan tool is normally zero counts. Only when the PCM has determined the CKP sensor A signal to be missing or unreliable, does the scan tool display a rolling count on for CKP sensor B.
- If DTC P0335 and DTC P0385 are both setting, inspect for a loose CKP sensor assembly or damage, foreign material on the crankshaft signal rotor.

An intermittent malfunction may be caused by a fault in the CKP sensor electrical circuit. Inspect the wiring harness and the components for an intermittent condition. Refer to **Intermittent Conditions** .

Repair any electrical circuit faults that were found. Refer to **Wiring Repairs** in Wiring Systems.

The information included in the Freeze Frame data can be useful in determining the vehicle operating conditions when the DTC first set.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step determines whether the DTC P0385 is the result of a hard failure or an intermittent condition.

5: This step tests the CKP sensor input circuit.

12: After replacing the PCM new minimum throttle position and idle speed must also be established.

DTC P0385 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to**Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Save the DTC and Freeze Frame information into the scan tool memory. 3. Perform the scan tool Clear DTC Information function. 4. Operate the vehicle within the Freeze Frame conditions as specified. Is DTC P0385 set?	-	Go to **Step 3**	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the CKP sensor electrical connector. 3. Connect a test lamp between the CKP sensor B ground circuit and B+. Did the test lamp illuminate?	-	Go to**Step 4**	Go to**Step 7**
4	1. Connect a DMM to the ignition 1 voltage circuit of the CKP sensor B and ground. 2. Turn ON the ignition, with the engine OFF. Is the voltage near the specified value?	12 V	Go to **Step 5**	Go to**Step 8**
5	1. Connect the DMM to the signal circuit of CKP sensor B and ground. 2. Turn ON the ignition, with the engine OFF. Is the voltage near the specified value?	5.0 V	Go to **Step 10**	Go to **Step 6**
	1. Test for an open or a short in the CKP sensor B			

6	signal circuit. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and repair a condition?	-	Go to **Step 13**	Go to **Step 9**
7	1. Repair the open in the CKP sensor B ground circuit. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 13**	-
8	1. Locate and repair the open in the ignition 1 voltage circuit of the CKP sensor B. 2. Repair as necessary. Refer to**Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 13**	-
9	1. Test for an intermittent or a poor electrical connection at the PCM. Refer to**Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. 2. Repair as necessary Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 13**	Go to **Step 12**
10	1. Test for an intermittent or a poor electrical connection at the CKP sensor. Refer to**Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. 2. Repair as necessary Refer to**Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 13**	Go to **Step 11**
11	Replace the crankshaft position sensor. Refer to **Crankshaft Position (CKP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
12	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** .	-		

	Did you complete the replacement?		Go to **Step 13**	-
13	1. Use the scan tool in order to clear the DTCs. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC run and pass?	-	Go to **Step 14**	Go to **Step 2**
14	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0386

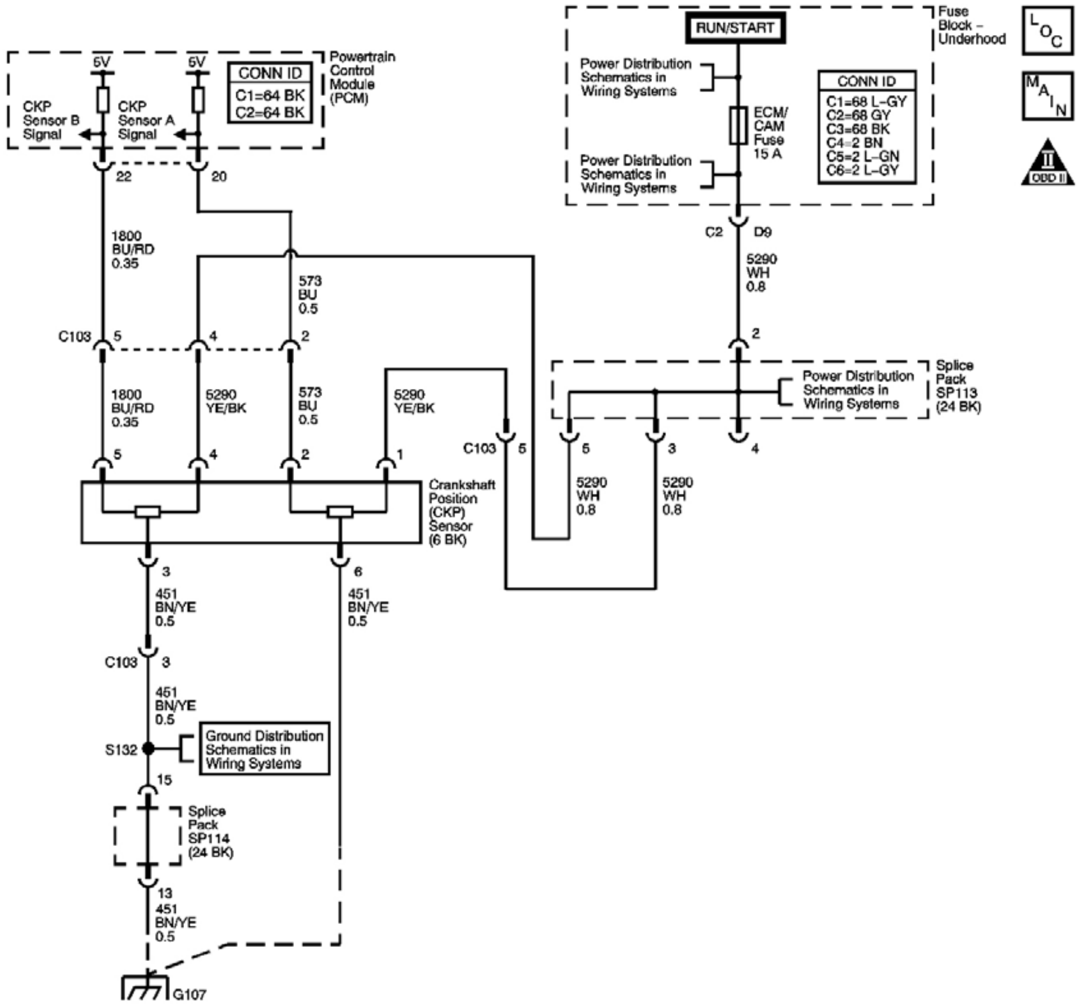


Fig. 7: DTC P0386 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0386 Crankshaft Position (CKP) Sensor B Performance diagnostic monitors the stability of the signal from the CKP sensor B. The CKP sensor is a magnetic generator type sensor, producing an alternating current signal. The CKP sensor signal increases in both frequency and amplitude as the engine RPM increases. The CKP sensor sends this reference signal to the powertrain control module (PCM) to indicate the crankshaft RPM and position. This reference signal is used by the PCM to calculate fuel injection pulse, establish top dead center (TDC) for ignition timing and where to start ignition coil and injection sequencing. There will be no spark or fuel delivery if there is no CKP sensor signal.

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P0386 Crankshaft Position (CKP) Sensor B Performance

Conditions for Running the DTC

- DTC P0335, P0340, or P0341 are not set.
- The engine is running.
- DTC P0386 runs continuously once the above conditions are met.

Conditions for Setting the DTC

The PCM detects less than or more than 22 pulses per crankshaft revolution.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- The Crankshaft Position Sensor B parameter on the scan tool is normally zero counts. Only when the PCM has determined the CKP sensor A signal to be missing or unreliable, does the scan tool display a rolling count on for CKP sensor B.
- An intermittent malfunction may be caused by a fault in the CKP sensor circuit. Inspect the wiring harness and the components for an intermittent condition. Refer to **Intermittent Conditions** .

If the DTC P0386 cannot be duplicated, the information included in the Freeze Frame data can be useful in determining the vehicle operating conditions when the DTC was first set.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step determines whether the DTC P0386 is the result of a hard failure or an intermittent condition.

5: This step tests the CKP sensor signal circuit.

13: After replacing the PCM a new minimum throttle position and idle speed must also be established.

DTC P0386 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to**Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Save the DTC and Freeze Frame information into the scan tool memory. 4. Perform the scan tool Clear DTC Information function. 5. Operate the vehicle within the Freeze Frame conditions as specified. Is DTC P0386 set?	-	Go to **Step 3**	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the CKP sensor electrical connector. 3. Connect a test lamp between the CKP sensor ground circuit and B+. Did the test lamp illuminate?	-	Go to**Step 4**	Go to**Step 7**
4	1. Connect a DMM to the ignition positive voltage circuit of the CKP sensor and ground. 2. Turn ON the ignition, with the engine OFF. Is the voltage near the specified value?	12 V	Go to **Step 5**	Go to**Step 8**
5	1. Connect the DMM to the signal circuit of CKP sensor B and ground. 2. Turn ON the ignition, with the engine OFF. Is the voltage near the specified value?	5.0 V	Go to **Step 10**	Go to **Step 6**

6	1. Test for an open or a short in the CKP sensor B signal circuit. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and repair a condition?	-	Go to **Step 14**	Go to **Step 9**
7	1. Repair the open in the CKP sensor ground circuit. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 14**	-
8	1. Locate and repair the open in the ignition positive voltage circuit of the CKP sensor A. 2. Repair as necessary. Refer to**Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 14**	-
9	1. Test for an intermittent or a poor electrical connection at the PCM. Refer to**Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. 2. Repair as necessary Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 14**	Go to **Step 13**
10	1. Inspect for any of the following conditions: • Loose CKP sensor fasteners • Damaged teeth on the signal rotor of the crankshaft pulley 2. Repair as necessary Refer to**Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 14**	Go to **Step 11**
11	1. Test for an intermittent or a poor electrical connection at the CKP sensor. Refer to**Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. 2. Repair as necessary Refer to**Wiring Repairs** in Wiring Systems.	-		

	Did you find and correct a condition?		Go to **Step 14**	Go to **Step 12**
12	Replace the crankshaft position sensor. Refer to **Crankshaft Position (CKP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 14**	-
13	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 14**	-
14	1. Use the scan tool in order to clear the DTCs. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC run and pass?	-	Go to **Step 15**	Go to **Step 2**
15	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0401

Circuit Description

The DTC P0401 Exhaust Gas Recirculation (EGR) Flow Insufficient diagnostic monitors the operation of the EGR valve. The powertrain control module (PCM) uses expected changes in the manifold absolute pressure (MAP) sensor readings, to evaluate the performance of the EGR system. The PCM tests the EGR system during deceleration. The PCM does this by momentarily commanding the EGR valve to open while monitoring the signal circuit of the MAP sensor. When the EGR valve is opened, the PCM will expect to see a predetermined increase in MAP. If the expected increase in MAP is not detected, the PCM suspects that the EGR valve flow is incorrect.

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P0401 Exhaust Gas Recirculation (EGR) Flow Insufficient

Conditions for Running the DTC

- Before the PCM can report DTC P0401 failed, DTCs P0404 and P2413 must run and pass.

- DTC P0030, P0050, P0135, P0155, P0403, P0404, P0443, P0496, P0501, P0506, P0507, P0641, P0651, P2100, P2101, P2108, P2122, P2123, P2127, P2128, P2138, P2176, P2227, P2228, P2229, P2282, P2413, P2414, P2415, P2646, P2647, P2648, P2649, and U0107 are not set.
- The battery voltage is more than 10.5 volts.
- The engine coolant temperature (ECT) is more than 69°C (156°F).
- The engine speed is between 1,100-2,200 RPM.
- The manifold absolute pressure (MAP) sensor is 14 kPa or more.
- The throttle position (TP) sensor indicates a closed throttle.
- The vehicle speed sensor is at least 49 km/h (30 mph) before deceleration.
- The diagnostic test will run during decelerate.
- DTC P0401 runs once per drive cycle after the above conditions have been met.

Conditions for Setting the DTC

The MAP changes monitored by the PCM during the EGR flow tests indicate an insufficient amount of EGR flow.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

Inspect for the following conditions:

- A vacuum restriction to the MAP sensor-A skewed MAP sensor reading can cause the PCM to read incorrect MAP changes during the EGR flow test.
- An engine that is running poorly due to a mechanical condition such as worn piston rings, worn camshaft, etc.-These types of conditions can cause low engine vacuum and thus can cause a less than expected

MAP changes during the flow test.

- Excessive back pressure in the exhaust system may cause this DTC to set. This condition can cause low engine vacuum and thus can cause a less than expected MAP changes during the EGR flow test. Possible causes of this could be a restriction in the exhaust system or non original equipment manufacture (OEM) exhaust parts.
- A restriction in the intake manifold such as carbon deposits and casting flash

Test Description

The number below refers to the step number on the diagnostic table.

2: This step tests the physical movement of the EGR valve. Normal EGR position voltage at the full open position is 3.10-3.20 volts.

4: Exhaust system leaks can cause an insufficient amount of EGR flow through the EGR valve. This condition can cause a less than expected MAP changes due to insufficient exhaust back pressure. Possible causes of this could be a leaking exhaust system, a leaking EGR pipe, or non original equipment manufacture (OEM) exhaust parts.

5: Intake system leaks can affect exhaust gas flow into the intake manifold from the EGR valve. This condition can cause a less than expected MAP change causing the DTC P0401 diagnostic to fail.

DTC P0401 Circuit

Step	Action	Values	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Run the engine until the engine coolant temperature is at least 85°C (185°F). 3. With the scan tool, command the EGR valve from 0 to 100 percent while observing the EGR Sensor data parameter. Refer to **Scan Tool Output Controls** . Was the EGR sensor voltage more than the specified value when at 100 percent?	3.10 V	Go to **Step 3**	Go to **Step 7**
3	1. Observe the Freeze Frame/Failure Records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to Diagnostic Aids

4	Inspect the exhaust system for leaks, restrictions, and for modification of original equipment manufacture (OEM) parts. Did you find and correct the condition?	-	Go to **Step 8**	Go to **Step 5**
5	Inspect for a vacuum leak between the EGR valve and the intake manifold. Did you find and correct the condition?	-	Go to **Step 8**	Go to **Step 6**
6	1. Remove the EGR valve. Refer to **Exhaust Gas Recirculation (EGR) Valve Replacement** . 2. Inspect for any of the following conditions: • Inspect the EGR valve pintle and the EGR valve passages for leaks or for restrictions. • Inspect the exhaust gas passages for excessive carbon deposits and restrictions or blockage. • Inspect the intake manifold passages for restrictions and blockage. • Clean and remove any deposits, restrictions, or blockage as necessary. Did you find and correct a condition?	-	Go to **Step 8**	Go to **Step 7**
7	Replace the EGR valve. Refer to **Exhaust Gas Recirculation (EGR) Valve Replacement** . Did you complete the replacement?	-	Go to **Step 8**	-
8	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 9**
9	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0403

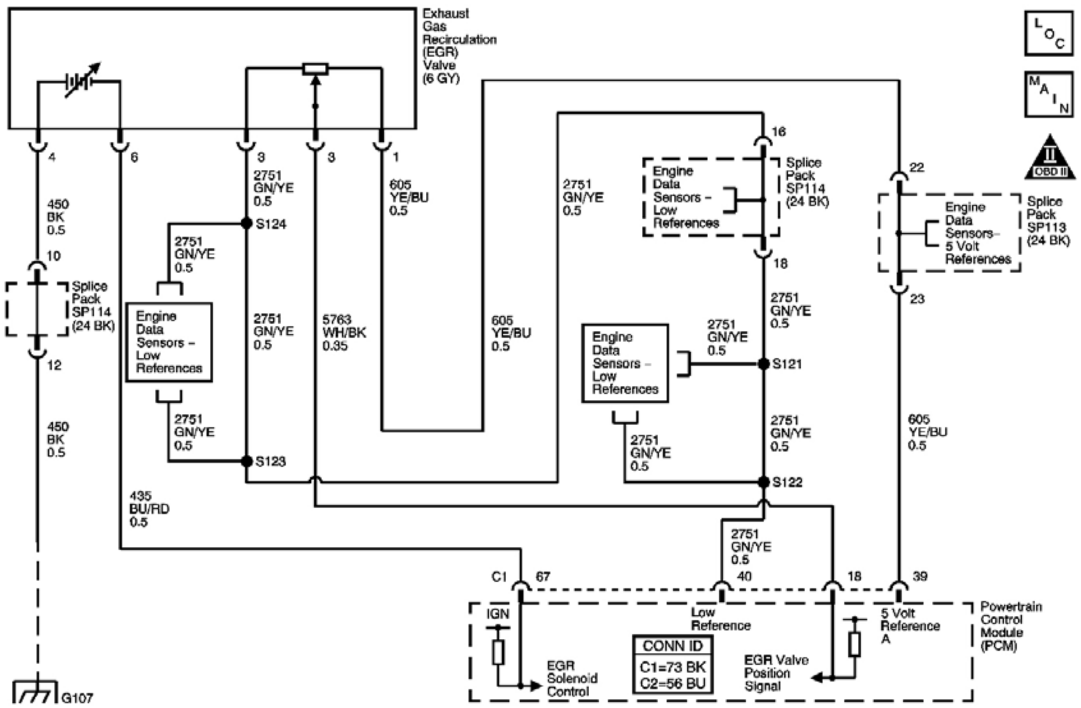


Fig. 8: DTC P0403 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0403 Exhaust Gas Recirculation (EGR) Solenoid Control Circuit diagnostic detects faults in the EGR valve electrical circuit. The powertrain control module (PCM) controls the EGR valve with a solid state device called a driver. The driver supplies the EGR solenoid with 12 volts that is pulse width modulated (PWM) through the EGR solenoid high control circuit. A ground path is provided by the PCM through the EGR solenoid low control circuit. The driver has the ability to detect an electrical malfunction on the EGR solenoid control circuits. If the PCM determines that the driver has detected an electrical malfunction on one of these circuits, this DTC sets.

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P0403 Exhaust Gas Recirculation (EGR) Solenoid Control Circuit

Conditions for Running the DTC

- DTC P0030, P0050, P0097, P0098, P0107, P0108, P0117, P0118, P0135, P0155, P0335, P0336, P0401, P0404, P0406, P0641, P0651, P1128, P1129, P2238, P2239, P2241, P2242, P2243, P2245, P2247, P2249, P2252, P2253, P2255, P2256, P2413, P2414, P2415, P2630, and P2631 are not set.

- The engine is running.
- The EGR is operating between 2-98 percent duty cycle.
- DTC P0403 runs continuously once the above conditions have been met.

Conditions for Setting the DTC

- The PCM detects an electrical malfunction in the EGR solenoid control circuit.
- The above condition is present for more than 5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

5: This step checks for an open in the EGR solenoid control circuit. The PCM provides a 12 volt bias signal on the solenoid control circuit that is pulled low when the solenoid is OK and has a good ground.

6: This step tests whether the PCM is actually commanding ON the EGR valve.

12: After replacing the PCM a new minimum throttle position and idle speed must be established.

DTC P0403 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	1. Start and run the engine until the coolant temperature is 85°C (185°F). 2. Command the EGR from 0 percent to 100			

2	percent with a scan tool. Refer to **Scan Tool Output Controls** . 3. Observe the EGR position sensor parameter with the scan tool. Is the EGR Sensor parameter within the specified value?	3.0-3.2 V	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the EGR valve. 3. Measure the resistance of the EGR solenoid with a DMM. Is the solenoid resistance within the specified value?	6.3-7.0 ohm at 20°C (68° F)	Go to **Step 5**	Go to **Step 11**
5	1. Connect the DMM to the EGR solenoid control circuit and ground. 2. Turn ON the ignition, with the engine OFF. Is the voltage near the specified value?	12 V	Go to **Step 6**	Go to **Step 7**
6	1. Connect a test lamp between the EGR solenoid control circuit and the EGR solenoid ground circuit. 2. Command the EGR valve from 0-100 percent with the scan tool. Does the test lamp illuminate?	-	Go to **Step 9**	Go to **Step 8**
7	Test the EGR solenoid high control circuit for an open or a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 10**
	Test the EGR solenoid ground circuit for an open			

8	or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 13**	Go to **Step 12**
9	Test for an intermittent and for a poor connection at the EGR valve. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 11**
10	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
11	Replace the EGR valve. Refer to **Exhaust Gas Recirculation (EGR) Valve Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
12	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 13**	-
13	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 14**
14	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0404

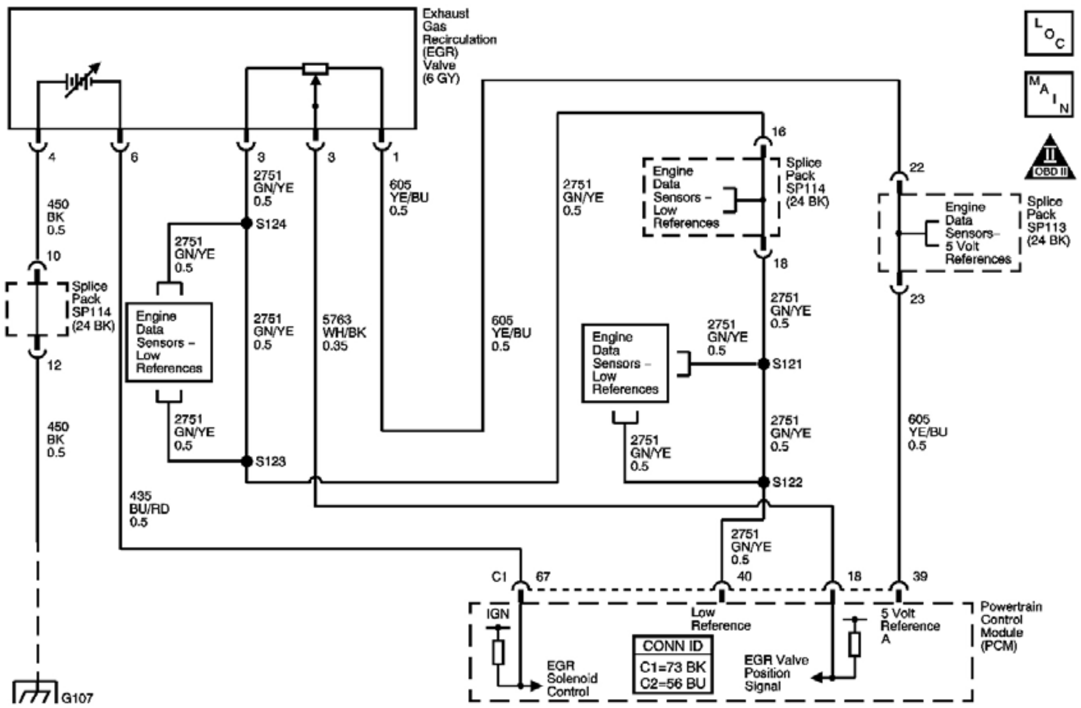


Fig. 9: DTC P0404 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0404 Exhaust Gas Recirculation (EGR) Open Position Performance monitors EGR valve movement. The EGR valve position sensor is monitored by the powertrain control module (PCM). The 5-volt reference circuit, low reference circuit and the EGR valve position signal circuit are used by the PCM to determine the EGR valve position. The PCM compares the EGR Position Sensor parameter with the desired EGR Position parameter when the valve is commanded open or closed. If the PCM detects a calibrated difference between the EGR Position Sensor parameter and desired EGR Position parameter for a calibrated amount of time, this DTC sets.

DTC Descriptors

This diagnostic procedure supports the following DTC.

DTC P0404 Exhaust Gas Recirculation (EGR) Open Position Performance

Conditions for Running the DTC

- DTC P0030, P0050, P0107, P0108, P0112, P0113, P0117, P0118, P0135, P0155, P0335, P0336, P0401, P0403, P0406, P0641, P0651, P1128, P1129, P2413, P2414, and P2415 are not set.
- The battery voltage is at least 10.5 volts

- The EGR valve is commanded open to at least 0.25 mm (0.010 in).
- Engine speed is less than 4,000 RPM.
- DTC P0404 runs once per drive cycle once the above conditions have been met.

Conditions for Setting the DTC

- The difference between the desired EGR position and the measured EGR position, as determined by the EGR position sensor, is more than 1.020 mm (0.041 in).
- The above condition is present for more than 5 seconds

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Inspect for excessive deposits on the EGR pintle or seat. Inspect for deposits that may interfere with the EGR valve pintle extending completely or cause the pintle to stick.
- If the condition is intermittent, refer to **Intermittent Conditions** .

Test Description

The number below refers to the step number on the diagnostic table.

5: This step tests for high resistance in reference voltage circuit. If the test lamp does not illuminates at all, there is excessive resistance in the 5-volt reference circuit or low reference ground circuit.

8: This step tests for high resistance in the EGR solenoid control circuit and ground circuits. The PCM provides a 12 volt bias signal on the solenoid control circuit that is pulled low when the solenoid is OK and has a good ground. If the circuit resistance is OK, the DMM should measure ignition voltage.

19: After replacing the PCM a new minimum throttle position and idle speed must be established.

DTC P0404 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Is DTC P0403 or P0406 also set?	-	Go to **DTC P0403** or **DTC P0406**	Go to **Step 3**
3	1. Start the engine. 2. Run the engine until the engine coolant temperature is at least 85°C (185°F). 3. With the scan tool, command the EGR valve from 0 to 50 percent while observing the EGR Sensor data parameter. Refer to **Scan Tool Output Controls** . 4. Command the EGR valve from 50 percent to 100 percent while observing the EGR sensor. Was the EGR Sensor voltage within the first specified value when at 50 percent and within the second specified value when at 100 percent?	2.10-2.20 V 3.10-3.20 V	Go to **Step 4**	Go to **Step 5**
4	1. Observe the Freeze Frame/Failure Records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 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. Did the DTC fail this ignition?	-	Go to **Step 5**	Go to Diagnostic Aids
5	1. Disconnect the EGR valve electrical connector. 2. Turn ON the ignition, with the engine OFF. 3. Connect the J 35616-200 test lamp between the 5-volt reference circuit of the EGR position sensor and the low reference circuit of the position sensor.	-		

	Does the test lamp illuminate at least dimly?		Go to **Step 6**	Go to **Step 7**
6	1. Connect a 3-amp fused jumper wire between the 5-volt reference circuit of the EGR position sensor and the sensor signal circuit. 2. Observe the EGR Sensor parameter on the scan tool. Is the EGR sensor voltage near the specified value?	4.96 V	Go to **Step 8**	Go to **Step 12**
7	Connect the test lamp between the 5-volt reference circuit of the EGR valve and a good ground. Does the test lamp illuminate at least dimly?	-	Go to **Step 11**	Go to **Step 13**
8	1. At the EGR valve electrical connector, connect a DMM between the EGR solenoid control circuit and the EGR solenoid ground circuit. 2. Turn ON the ignition, with the engine OFF. Is the voltage near the specified value?	12 V	Go to **Step 10**	Go to **Step 9**
9	Connect the DMM between the EGR solenoid control circuit and a known good ground. Is the voltage near the specified value?	12 V	Go to **Step 15**	Go to **Step 14**
10	1. Remove the EGR valve. Refer to **Exhaust Gas Recirculation (EGR) Valve Replacement** 2. Inspect the EGR valve pintle and seat area for foreign debris. Remove as necessary. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 16**
11	Test the low reference circuit of the EGR position sensor for high resistance. Refer to **Exhaust Gas Recirculation (EGR) Valve Replacement** Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 17**
12	Test the EGR position sensor signal circuit for the following conditions: • An open • A short to ground • High resistance Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 17**
	1. Test the 5-volt reference circuit of the EGR			

13	position sensor for an open or for high resistance. 2. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 17**
14	Test the control circuit of the EGR valve for resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 17**
15	Repair the condition of high resistance in the ground circuit of the EGR valve. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 20**	-
16	Test for an intermittent and for a poor connection at the EGR valve. Refer to **Testing for Intermittent Conditions and Poor ConnectionsConnector Repairs** and in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 18**
17	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 19**
18	Replace the EGR valve. Refer to **Exhaust Gas Recirculation (EGR) Valve Replacement** . Did you complete the replacement?	-	Go to **Step 20**	-
19	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 20**	-
20	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 21**
	Observe the Capture Info with a scan tool.		Go to	

21	Are there any DTCs that have not been diagnosed?	-	**Diagnostic Trouble Code (DTC) List**	System OK

DTC P0406

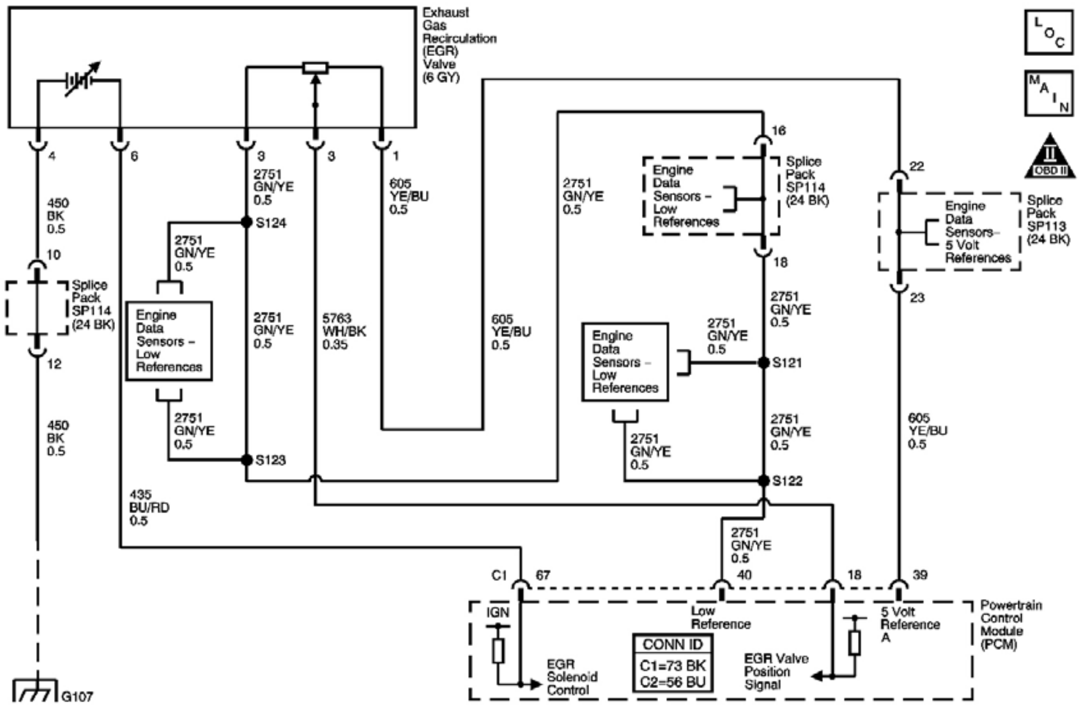


Fig. 10: DTC P0406 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0406 Exhaust Gas Recirculation (EGR) Position Sensor Circuit High Voltage diagnostic monitors the signal voltage of the position sensor. The EGR valve position sensor is monitored by the powertrain control module (PCM). The 5-volt reference circuit, low reference circuit and the EGR valve position signal circuit are used by the PCM to determine the EGR valve position. If the EGR valve position sensor signal voltage is pulled above a calibrated value, this DTC sets.

DTC Descriptors

This diagnostic procedure supports the following DTC.

DTC P0406 Exhaust Gas Recirculation (EGR) Position Sensor Circuit High Voltage

Conditions for Running the DTC

- The engine is running.
- DTC P0406 runs continuously.

Conditions for Setting the DTC

- The EGR Position Sensor parameter is more than 4.88 volts.
- The above condition is present for more than 2 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

4: This step tests for a short to voltage on the EGR position sensor signal circuit. With the sensor disconnected, the signal circuit should be near zero volts.

11: After replacing the PCM a new minimum throttle position and idle speed must be established.

DTC P0406 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Is a DTC P0098, P0118, or P0713 also set?	-	Go to **Step 8**	Go to **Step 3**
	1. Turn ON the ignition, with the engine OFF.			

3	2. Observe the exhaust gas recirculation (EGR) Sensor parameter with a scan tool. Is the EGR Sensor parameter more than the specified value?	4.88 V	Go to **Step 5**	Go to **Step 4**
4	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 90 seconds. 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. Did the DTC fail this ignition?	-	Go to **Step 5**	Go to **Intermittent Conditions**
5	1. Disconnect the EGR valve. 2. Turn ON the ignition with the engine OFF. 3. Observe the EGR Sensor parameter with a scan tool. Is the voltage more than the specified value?	0 V	Go to **Step 7**	Go to **Step 6**
6	1. Connect a test lamp between the low reference circuit of the EGR position sensor and B+. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	-	Go to **Step 10**	Go to **Step 8**
7	Test the signal circuit of the EGR valve for short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
8	Test the low reference circuit of the EGR valve for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
9	Test for an intermittent and for a poor connection at the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
10	Replace the EGR valve. Refer to **Exhaust Gas Recirculation (EGR) Valve Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-

11	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 13**
13	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0420 OR P0430

Description

In order to control emissions of hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx), a three-way catalytic (TWC) converter is used. The catalyst within the converter promotes a chemical reaction that oxidizes the HC and the CO that is present in the exhaust gases. The oxidation process converts the HC and CO into harmless water vapor and carbon dioxide. The catalyst also reduces NOx by converting NOx to nitrogen. The powertrain control module (PCM) has the ability to monitor this process using the fuel control heated oxygen sensors (HO2S) and catalyst monitoring HO2S. The fuel control HO2S produces an output signal which indicates the amount of oxygen present in the exhaust gases entering the TWC converter. The catalyst monitor HO2S produces an output signal that indicates the oxygen storage capacity of the catalyst in the TWC converter. The oxygen storage capacity of the catalyst is an indicator of the converter ability to convert exhaust gases efficiently. The fuel control HO2S output signal will be far more active than the catalyst monitor HO2S output signal when the converter catalyst is operating efficiently. if the PCM detects a level of catalyst monitor HO2S activity that indicates the catalyst is no longer operating effectively, this DTC will set.

DTC Descriptors

This diagnostic procedure supports the following DTCs.

- DTC P0420 Catalyst System Low Efficiency Bank 1
- DTC P0430 Catalyst System Low Efficiency Bank 2

Condition for Running the DTC

- Before the PCM can report DTC P0420 or DTC P0430 failed, DTC P0442 must run and pass.
- DTCs P0030, P0036, P0050, P0056, P0101, P0102, P0103, P0107, P0108, P0112, P0113, P0117, P0118, P0133, P0135, P0137, P0138, P0139, P0141, P0153, P0155, P0157, P0158, P0159, P0161, P0171, P0172, P0174, P0175, P0201-P0206, P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0335, P0336, P0341, P0401, P0403, P0404, P0443, P0496, P0501, P0641, P0651, P0720, P1128, P1129, P2227, P2228, P2229, P2297, P2298, P2413, P2414, P2415, or P2646 are not set.
- The engine coolant temperature is more than 69°C (156° F).
- The intake air temperature is more than -21°C (6° F).
- The estimated TWC temperature is more than 500° C (932°F).
- The engine speed is between 1,150 RPM and 2,000 RPM.
- The manifold absolute pressure (MAP) is between 22 kPa and 74 kPa.
- The vehicle speed is 7 km/h (4 mph) or more.
- The engine is in closed loop.
- DTC P0420 and DTC P0430 run once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

The PCM determined the catalyst efficiency has degraded below a calibrated threshold.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) after 2 consecutive ignition cycles in which the diagnostic runs with the fault active.
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Freeze Frame buffer.

Conditions for Clearing the MIL/DTC

- The MIL turns OFF after 3 consecutively passing trips without a fault present.
- A history DTC clears after 40 consecutive warm-up cycles without a fault.
- Perform the scan tool Clear DTC Information function in order to clear the DTC.

Diagnostic Aids

- Inspect for the following conditions:
  - An exhaust leak can affect the HO2S accuracy.
  - Inspect for a damaged front or rear oxygen sensor wiring harness.
- A TWC converter failure may be caused by any of the following conditions:
  - Engine misfire can cause catalytic converter overheating.
  - Inadequate secondary ignition voltage can cause incomplete combustion and catalytic converter overheating.

    - Retarded ignition timing can cause performance concerns.
    - Excessive engine oil or engine coolant consumption can damage the catalytic converter.
    - Rich engine fueling can cause catalytic converter overheating.
- If a DTC P0420 or a DTC P0430 is intermittent, driving the vehicle under the conditions outlined in the Inspection/Maintenance (I/M) section can verify whether the fault is present.
- If a DTC P0420 or DTC P0430 cannot be duplicated, the information included in the Freeze Frame data can be useful in determining the vehicle operating conditions when the DTC was first set.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and to store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

3: This step verifies whether the malfunction is presently occurring.

8: In order to avoid repeated replacement of the catalytic converter, inspect for the cause of the converter failure and repair as necessary. Refer to Diagnostic Aids.

DTC P0420 or P0430 Circuit

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Check any for any heated oxygen sensor DTCs and diagnose those DTCs first. Are there any heated oxygen sensor DTCs set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	1. Install a scan tool. 2. Start the engine. 3. Run the engine until the normal operating temperature is reached. 4. Verify that the engine is operating in Closed Loop. 5. Run the engine at the specified value for 3 minutes. 6. Monitor the fuel control HO2S and the catalyst monitor HO2S signals of the suspect converter on the scan tool. Is the catalyst monitoring HO2S signal as active as the fuel control HO2S signal?	2,500-3,000 RPM	Go to **Step 5**	Go to **Step 4**

4	1. Perform the scan tool Clear DTC Information function. 2. Operate the vehicle within the Freeze Frame conditions as specified or until the P0420/P0430 diagnostic test has run. Refer to the Test Description. Did DTC P0420 or DTC P0430 set?	-	Go to **Step 5**	Go to Diagnostic Aids
5	1. Visually and physically inspect the 3-way catalytic converter for the following concerns: • Dents or physical damage • Severe discoloration caused by excessive temperatures • Holes or punctures • Internal rattles caused by a damaged catalyst element 2. Verify that the 3-way catalytic converter is a high quality part that meets the OEM specifications. Did you find a problem?	-	Go to **Step 8**	Go to **Step 6**
6	1. Visually and physically inspect the exhaust system for any of the following conditions: • Exhaust Leaks. Refer to **Exhaust Leakage** in Engine Exhaust. • Physical damage • Loose or missing hardware 2. Repair as necessary. Was a repair necessary?	-	Go to **Step 9**	Go to **Step 7**
7	1. Visually and physically inspect the catalyst monitor HO2S of the suspect converter for the following conditions: • The pigtail and wiring harness making contact with exhaust pipe • A loose HO2S • Any road damage 2. Repair as necessary. Was a repair necessary?	-	Go to **Step 9**	Go to **Step 8**

8	**IMPORTANT:** **Locate and repair the cause of the TWC converter failure before installing the replacement converter.** Replace the 3-way catalytic converter.Is the action complete?	-	Go to **Step 10**	-
9	1. Start the engine. 2. Run the engine until the normal operating temperature is reached. 3. Verify that the engine is operating in Closed Loop. 4. Run the engine at the specified value for 3 minutes. 5. Monitor the fuel control HO2S and the catalyst monitor HO2S signals of the suspect converter on the scan tool. Is the catalyst monitoring HO2S signal as active as the fuel control HO2S signal?	2,500-3,000 RPM	Go to Diagnostic Aids	Go to **Step 10**
10	1. Turn OFF the ignition. 2. Start the engine. 3. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text or until the DTC P0420 or P0430 diagnostic test has run. Does the DTC run and pass?	-	Go to **Step 11**	Go to **Step 2**
11	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0442

System Description

The DTC P0442 Evaporative Emission (EVAP) System Leak Detected diagnostic monitors the EVAP system for a small leak. The diagnostic runs when the ignition is in the OFF position, and the correct conditions are met. While the vehicle is operating, there are sources of heat transferred into the tank from the following:

- Exhaust heat
- Engine heat
- Ambient temperature

When the engine is stopped and the ignition is in the OFF position a change in the fuel tank vapor temperature occurs. This results in a change in the pressure of the fuel tank vapor space. This change in pressure is monitored by the control module, using the fuel tank pressure (FTP) sensor input. The EVAP diagnostic detects leaks as small as 0.51 mm (0.020 in). If the control module detects a change in the fuel tank vacuum/pressure less than a calibrated amount, this DTC sets.

DTC Descriptor

This diagnostic supports the following DTC.

DTC P0442 Evaporative Emissions (EVAP) System Small Leak Detected

Conditions for Running the DTC

IMPORTANT: The following conditions must be met prior to ignition OFF.

- Before the PCM can report DTC P0442 failed, DTCs P0455, and P2199 must run and pass.
- DTCs P0107, P0108, P0117, P0118, P0452, P0453, P0496, P0498, P0499, P1128, P1129, P2227, P2228, and P2229 are not set.
- A refueling event is not detected.
- The fuel volatility is not excessive.
- The ambient air temperature is 4°C (40°F) or above.
- The engine coolant temperature is more than 69°C (156°F).
- The fuel level is between 15 and 85 percent.
- The engine run time is more than 25 minutes.
- DTC P0442 runs once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

The control module detects a vacuum/pressure change that is less than the calibrated amount.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.

- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- To help locate an intermittent leak, use the **J 41413-200** Evaporative Emissions System Tester (EEST) to introduce smoke into the EVAP system. Move all EVAP components while observing smoke with the **J 41413-SPT** High Intensity White Light. Introducing smoke in 15 second intervals will allow less pressure into the EVAP system. When the system is less pressurized, the smoke will sometimes escape in a more condensed manner.
- To improve the visibility of the smoke exiting the EVAP system, observe the suspected leak area from different angles with the **J 41413-SPT** High Intensity White Light.
- For an intermittent condition, refer to **Intermittent Conditions** .

Test Description

The numbers below refer to the step numbers on the diagnostic table.

3: Introducing smoke in 15 second intervals may allow smaller leak areas to be more noticeable. When the system is less pressurized, the smoke will sometimes escape in a more condensed manner.

4: This step verifies that repairs are complete and that no other condition is present.

DTC P0442 Circuit

Step	Action	Yes	No
Schematic Reference: Evaporative Emissions (EVAP) Hose Routing Diagram			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Inspect the evaporative emission (EVAP) system for the following conditions: • Loose, missing, or damaged service port dust cap and/or schrader valve • Loose, incorrect, missing, or damaged fuel fill cap • A damaged EVAP purge solenoid 2. Raise the vehicle on a hoist. Refer to **Lifting and Jacking the Vehicle** in General Information. 3. Inspect the EVAP system for the following conditions: • Disconnected, improperly routed, kinked, or damaged EVAP pipes and hose • A damaged EVAP vent valve or EVAP canister Did you find and correct the condition?	Go to **Step 4**	Go to **Step 3**
	IMPORTANT:		

3	**Ensure that the vehicle underbody temperature is similar to the ambient temperature and allow the surrounding air to stabilize before starting the diagnostic procedure. System flow will be less with higher temperatures.** 1. Turn OFF the ignition. 2. Connect the **J 41413-200** Evaporative Emissions System Tester (EEST) power supply clips to a known good 12-volt source. **IMPORTANT:** **The GE-41415-50 fuel cap adapter, may not be available for the start of production. Once the J41415-50 is available, start the diagnosis at the fuel fill cap.** 3. Install the nitrogen/smoke supply hose onto one of the following sources: • Connect the **GE-41415-50** to the fuel fill pipe, and the **J 41413-200** nitrogen/smoke supply hose to the fuel cap adapter. • Connect the **J 41413-200** nitrogen/smoke supply hose to the EVAP service port. 4. Turn ON the ignition with the engine OFF. 5. Command the EVAP vent valve closed with a scan tool. 6. Turn the nitrogen/smoke valve on the **J 41413-200** control panel to SMOKE. 7. Use the remote switch to introduce smoke into the EVAP system for 60 seconds. 8. Inspect the entire EVAP system for exiting smoke with the **J 41413-SPT** High Intensity White Light. 9. Continue to introduce smoke at 15 second intervals until the leak source has been located. Did you locate and repair a leak source?	Go to**Step 4**	Go to Diagnostic Aids
	IMPORTANT: **Larger volume fuel tanks and/or those with lower fuel levels may require several minutes for the floating indicator to stabilize.** 1. Turn the nitrogen/smoke valve to nitrogen. 2. Connect the nitrogen/smoke hose to the 0.5 mm (0.020 in) test orifice on the bottom-front of the **J 41413-200** . 3. Use the remote switch to activate the **J 41413-200** .		

4	4. Align the red flag on the flow meter with the floating indicator. Use the remote switch to de-activate the **J 41413-200** . 5. Remove the nitrogen/smoke hose from the test orifice. **IMPORTANT:** **The GE-41415-50 fuel cap adapter, may not be available for the start of production. Once the J41415-50 is available, start the diagnosis at the fuel fill cap.** Install the nitrogen/smoke supply hose onto one of the following sources: • Connect the **GE-41415-50** to the fuel fill pipe, and the **J 41413-200** nitrogen/smoke supply hose to the fuel cap adapter. • Connect the **J 41413-200** nitrogen/smoke supply hose to the EVAP service port. 6. Turn ON the ignition, with the engine OFF. 7. Command the EVAP vent solenoid closed with a scan tool. 8. Use the remote switch to introduce nitrogen and fill the EVAP system until the floating stabilizes. 9. Compare the flow meter's stable floating indicator position to the red flag. Is the floating indicator below the red flag?	Go to **Step 5**	Go to **Step 2**
5	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0443

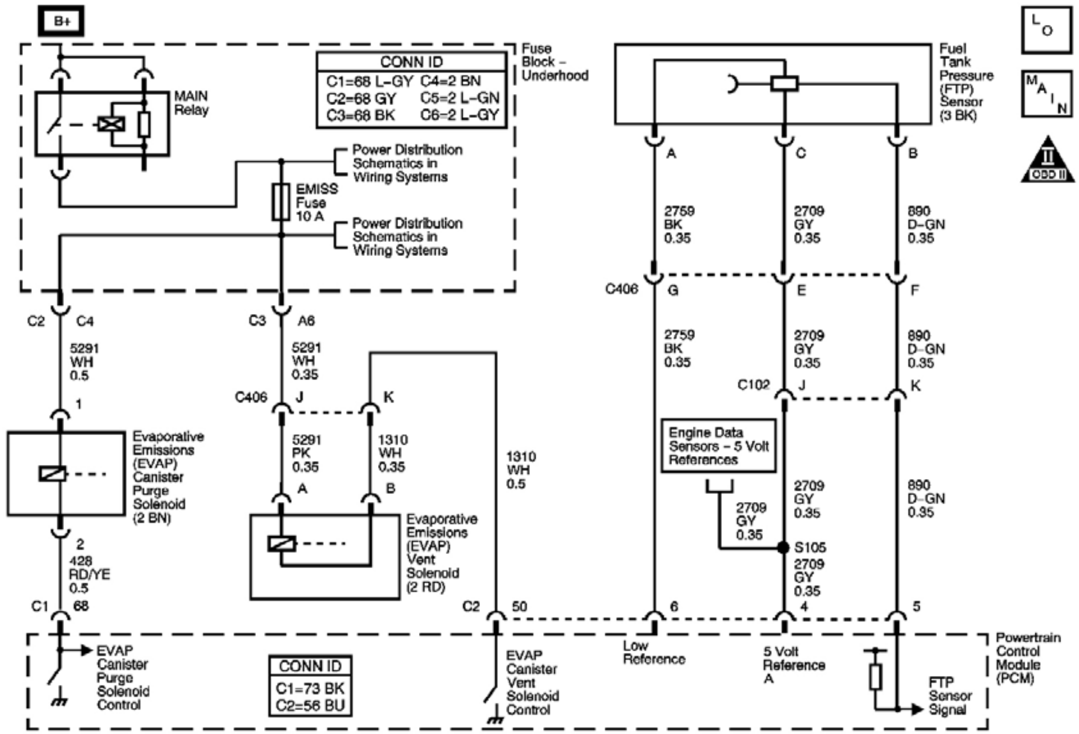


Fig. 11: DTC P0443 Circuit
Courtesy of GENERAL MOTORS CORP.

The DTC P0443 Evaporative Emission (EVAP) Purge Solenoid Control Circuit diagnostic detects faults in the purge solenoid electrical circuit. An ignition voltage is supplied directly to the evaporative emission (EVAP) canister purge solenoid. The EVAP canister purge solenoid is pulse width modulated (PWM). The scan tool displays the amount of ON time as a percentage. The control module monitors the status of the driver. The control module controls the EVAP canister purge solenoid ON time by grounding the control circuit via an internal switch called a driver. If the control module detects an incorrect voltage for the commanded state of the driver, this DTC sets.

DTC Descriptor

This diagnostic supports the following DTC.

DTC P0443 Evaporative Emission (EVAP) Purge Solenoid Control Circuit

Conditions for Running the DTC

- DTCs P0442, P0496, P0498, and P0499 are not set.
- The engine is running.
- The battery voltage is 10 volts.
- The control module has commanded the purge solenoid ON and OFF at least once during the ignition

cycle.

- DTC P0443 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The control module detects that the commanded state of the driver and the actual state of the control circuit Do NOT match.
- The above conditions are present for a minimum of 5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step tests if the concern is active. The EVAP purge solenoid is pulse width modulated (PWM). Clicking should be heard or felt when the purge solenoid is commanded to 20 percent and should stop when the EVAP purge solenoid is commanded to 0 percent. The rate at which the solenoid cycles should increase as the commanded state is increased and decreased as the commanded state is decreased. Repeat the commands as necessary.

5: This step tests if a ground is constantly being applied to the EVAP purge solenoid.

6: This step verifies that the control module is providing ground to the EVAP purge solenoid.

13: After replacing the PCM, a new minimum throttle position and idle speed must also be established.

DTC P0443 Circuit

Step	Action	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or			

Engine Controls Connector End Views

1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Command the EVAP purge solenoid to 20 percent and then to 0 percent with a scan tool, Do you hear or feel a clicking from the EVAP purge solenoid when the solenoid is commanded to 20 percent?	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 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. Did the DTC fail this ignition?	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the EVAP purge solenoid. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition 1 voltage circuit of the EVAP purge solenoid with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 11**
5	1. Connect a test lamp between the control circuit of the EVAP purge solenoid and the ignition 1 voltage circuit of the EVAP purge solenoid. 2. Command the EVAP purge solenoid to 0 percent with a scan tool. Does the test lamp illuminate?	Go to **Step 8**	Go to **Step 6**
6	Command the EVAP purge solenoid to 20 percent with a scan tool. Does the test lamp illuminate or pulse when the EVAP purge solenoid is commanded to 20 percent?	Go to **Step 9**	Go to **Step 7**
7	Test the control circuit of the EVAP purge solenoid for an open or short to voltage. Refer to **Circuit Testing** and		

	Wiring Repairs in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 10**
8	Test the control circuit of the EVAP purge solenoid for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
9	Test for an intermittent and for a poor connection at the EVAP purge solenoid. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 12**
10	Test for an intermittent and for a poor connection at the control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
11	Repair the open or short to ground in the ignition 1 voltage circuit of the EVAP purge solenoid. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 14**	-
12	Replace the EVAP purge solenoid. Refer to **Evaporative Emission (EVAP) Canister Purge Solenoid Valve Replacement** . Did you complete the replacement?	Go to **Step 14**	-
13	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	Go to **Step 14**	-
14	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 15**
15	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0446

System Description

The DTC P0446 Evaporative Emission (EVAP) Vent System Performance diagnostic tests for a restricted or blocked EVAP vent system. The control module commands the EVAP canister purge solenoid Open and the EVAP canister vent solenoid Closed. This allows vacuum to be applied to the EVAP system. Once a calibrated vacuum level has been reached, the control module commands the EVAP canister purge solenoid Closed and the EVAP canister vent solenoid Open. The control module monitors the fuel tank pressure (FTP) sensor for a decrease in vacuum. If the vacuum does not decrease to near 0 inches H2O in a calibrated time, this DTC sets.

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

DTC P0446 Circuit

Control Module Command	EVAP Canister Purge Solenoid	EVAP Canister Vent Solenoid
ON	Open	Closed
OFF	Closed	Open

DTC Descriptor

This diagnostic supports the following DTC. DTC P0446 Evaporative Emission (EVAP) Vent System Performance.

Conditions for Running the DTC

- DTCs P0107, P0108, P0117, P0118, P0335, P0452, P0453, P0496, P0498, P0499, P1128, P1129, P2227, P2228, and P2229 are not set.
- The battery voltage is more than 10 volts.
- The fuel system is operating in closed loop.
- The engine coolant temperature (ECT) is between 4-65°C (39-149°F) at start-up.
- DTC P0446 runs once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

- The FTP is less than -13 inches H2O.
- The condition is present for as long as 3 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

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

Evaporative Emission (EVAP) Vent System Performance

Step	Action	Values	Yes	No
Schematic Reference: Evaporative Emissions (EVAP) Hose Routing Diagram				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Inspect the evaporative emission (EVAP) system for the following conditions: • A damaged EVAP vent valve • A damaged EVAP canister Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Disconnect the purge line from the EVAP canister purge solenoid. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Fuel Tank Pressure parameter with a scan tool. Is the Fuel Tank Pressure sensor parameter within the specified range?	-1 and +1 in H20	Go to **Step 4**	Go to **Step 8**
	1. Turn OFF the ignition. 2. Remove the EVAP canister. Refer to **Evaporative Emission (EVAP) Canister Replacement** . 3. Remove the EVAP vent valve from the			

4	EVAP canister. Refer to **Evaporative Emission (EVAP) Canister Vent Solenoid Valve Replacement** . 4. With the EVAP canister removed from the vehicle, connect the EVAP vent valve electrical connector. 5. Turn ON the ignition with the engine OFF. 6. Command the EVAP vent valve ON and OFF with a scan tool. Does the EVAP vent valve open and close?	-	Go to **Step 5**	Go to **Step 6**
5	1. Remove the fresh air inlet cover from the EVAP canister. 2. Inspect the fresh air inlet for a restriction or a blockage. 3. Inspect the fresh air inlet filter for a restriction or a blockage. Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 7**
6	Replace the EVAP vent valve. Refer to **Evaporative Emission (EVAP) Canister Vent Solenoid Valve Replacement** . Did you complete the replacement?	-	Go to **Step 9**	-
7	Replace the EVAP canister. Refer to **Evaporative Emission (EVAP) Canister Replacement** . Did you complete the replacement?	-	Go to **Step 9**	-
8	Replace the FTP sensor. Refer to **Fuel Tank Pressure Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 9**	-
	IMPORTANT: **Do not exceed the specified value in this step. Exceeding the specified value may produce incorrect test results.** 1. Turn OFF the ignition. 2. Connect all disconnected components. 3. Connect the **J 41413-200** Evaporative Emissions System Tester (EEST) power supply clips to a known good 12-volt source. **IMPORTANT:** **The GE-41415-50 fuel cap adapter, may not be available for the start of production. Once the J41415-50 is available, start the**			

9	**diagnosis at the fuel fill cap.** 4. Install the nitrogen/smoke supply hose onto one of the following sources: • Connect the **GE-41415-50** to the fuel fill pipe, and the **J 41413-200** nitrogen/smoke supply hose to the fuel cap adapter. • Connect the **J 41413-200** nitrogen/smoke supply hose to the EVAP service port. 5. Turn ON the ignition. 6. Command the EVAP vent solenoid closed with a scan tool. 7. Turn the nitrogen/smoke valve on the **J 41413-200** control panel to NITROGEN. 8. Pressurize the EVAP system to the first specified value with the remote switch. 9. Observe the fuel tank pressure sensor in H2O. 10. Command the EVAP vent solenoid open with a scan tool. Is the fuel tank pressure sensor parameter less than the second parameter?	5 in H2O 1 in H2O	Go to **Step 10**	Go to **Step 2**
10	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0452

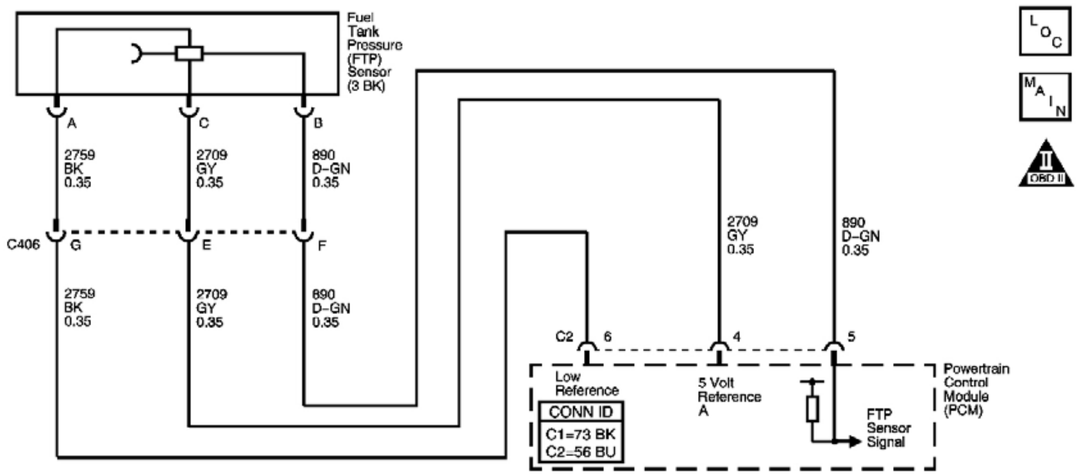


Fig. 12: DTC P0452 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0452 Fuel Tank Pressure (FTP) Sensor Circuit Low Voltage diagnostic monitors the function of the FTP sensor circuit. The control module monitors the FTP sensor signal in order to detect vacuum decay and excess vacuum during the evaporative emission (EVAP) diagnostic test. The control module supplies a 5-volt reference and a low reference circuit to the FTP sensor. If the control module detects the FTP sensor signal voltage above a calibrated value, this DTC will set.

The following table illustrates the relationship between FTP sensor signal voltage and the EVAP system pressure/vacuum.

DTC P0452

FTP Sensor Signal Voltage	Fuel Tank Pressure
High, Approximately 1.5 Volts or More	Negative Pressure/Vacuum
Low, Approximately 1.5 Volts or Less	Positive Pressure

DTC Descriptor

This diagnostic supports the following DTC.

DTC P0452 Fuel Tank Pressure (FTP) Sensor Circuit Low Voltage

Conditions for Running the DTC

- DTC P0453 is not set.
- The ignition is ON.

- DTC P0452 runs once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

The FTP sensor voltage is more than 4.9 volts for more than 3 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- The FTP sensor parameter on the scan tool should read between 1.4 volts and 1.5 volts with the ignition ON, engine OFF and the fuel cap removed. This represents atmospheric pressure of 0 inches H2O of vacuum.
- The FTP sensor 5-volt reference circuit is shared with the following sensors:
  - The exhaust gas recirculation (EGR) sensor
  - A/C Refrigerant Pressure Sensor
  - A/T Input Shaft Speed (ISS) Sensor
  - The accelerator pedal position (APP) sensor 2
- Inaccurate readings will occur if resistance measurements are taken on a FTP sensor. The FTP sensor contains an internal amplifier circuit that requires applied voltage to function properly
- To locate an intermittent problem, monitor the FTP sensor voltage with the ignition ON, engine OFF. Wiggling wires, while watching for change in the FTP sensor voltage, may help locate the area where fault may exist.
- For intermittent conditions, refer to **Intermittent Conditions**

Test Description

The number below refers to the step number on the diagnostic table.

2: If DTC P0651 set, the 5-volt reference circuit may be shorted to a voltage.

12: After replacing the PCM a new minimum throttle position and idle speed must also be established.

DTC P0452 Circuit

Step	Action	Values	Yes	No
Connector End View Reference:Powertrain Control Module (PCM) Connector End Views or **Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine, and let idle for 10 seconds. 2. Monitor the diagnostic trouble codes (DTC) information using the scan tool. Is DTC P0651 also set?	-	Go to **DTC P0651**	Go to **Step 3**
3	1. Turn the ignition switch OFF. 2. Remove the fuel fill cap. 3. Turn the ignition ON with the engine OFF. 4. Observe the fuel tank pressure (FTP) sensor voltage with a scan tool. Does the scan tool indicate that the FTP sensor voltage is more than the specified value?	4.2 V	Go to **Step 5**	Go to **Step 4**
4	1. Observe the Freeze Frame/Failure Records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text or as close to the Freeze Frame/Failure Records data that you observed. Does the DTC fail this ignition?	-	Go to **Step 5**	Go to **Intermittent Conditions**
5	1. Turn OFF the ignition. 2. Disconnect the FTP sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. With a scan tool, observe the FTP sensor. Does the scan tool indicate that the FTP sensor	4.2 V		

	voltage is greater than the specified value?		Go to **Step 6**	Go to **Step 7**
6	Test the FTP signal circuit for a short to voltage or a short to a 5-volt reference circuit. Refer to **Testing for a Short to Voltage** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
7	Probe the low reference circuit of the FTP sensor with a test lamp connected to battery voltage. Refer to **Troubleshooting with a Test Lamp** in Wiring Systems. Did the test lamp illuminate?	-	Go to **Step 9**	Go to **Step 8**
8	Test the low reference circuit of the FTP sensor for an open. Refer to **Testing for Continuity** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 10**
9	Inspect for poor connections at the harness connector of the FTP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 11**
10	Inspect for poor connections at the harness connector of the control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
11	Replace the FTP sensor. Refer to **Fuel Tank Pressure Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
12	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 13**	-
13	1. Use the scan tool in order to clear the DTCs. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC run and pass?	-	Go to **Step 14**	Go to **Step 2**
	With a scan tool, observe the stored information,		Go to	

14	Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	**Diagnostic Trouble Code (DTC) List**	System OK

DTC P0453

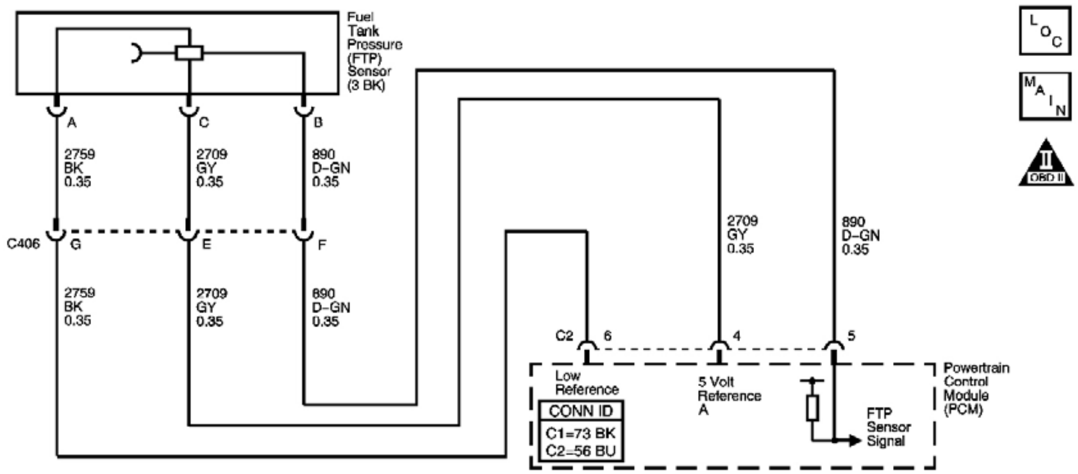


Fig. 13: DTC P0453 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0453 Fuel Tank Pressure (FTP) Sensor Circuit High Voltage diagnostic monitors the function of the FTP sensor circuit. The control module monitors the FTP sensor signal in order to detect vacuum decay and excess vacuum during the evaporative emission (EVAP) diagnostic test. The control module supplies a 5-volt reference and a low reference circuit to the FTP sensor. If the control module detects the FTP sensor signal voltage below a calibrated value, this DTC will set.

The following table illustrates the relationship between FTP sensor signal voltage and the EVAP system pressure/vacuum.

DTC P0453 Circuit

FTP Sensor Signal Voltage	Fuel Tank Pressure
High, Approximately 1.5 Volts or More	Negative Pressure/Vacuum
Low, Approximately 1.5 Volts or Less	Positive Pressure

DTC Descriptor

This diagnostic supports the following DTC.

DTC P0453 Fuel Tank Pressure (FTP) Sensor Circuit High Voltage

Conditions for Running the DTC

- DTC P0452 is not set.
- The ignition is ON.
- DTC P0453 runs once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

The FTP sensor voltage is less than 0.2 volts, for more than 3 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- The FTP sensor parameter on the scan tool should read between 1.4 volts and 1.5 volts with the ignition ON, engine OFF and the fuel cap removed. This represents atmospheric pressure of 0 inches H2O of vacuum.
- The FTP sensor 5-volt reference circuit is shared with the following sensors:
  - The exhaust gas recirculation (EGR) sensor
  - A/C Refrigerant Pressure Sensor
  - A/T Input Shaft Speed (ISS) Sensor
  - The accelerator pedal position (APP) sensor 2
- Inaccurate readings will occur if resistance measurements are taken on a FTP sensor. The FTP sensor contains an internal amplifier circuit that requires applied voltage to function properly
- To locate an intermittent problem, monitor the FTP sensor voltage with the ignition ON, engine OFF.

Wiggling wires, while watching for change in the FTP sensor voltage, may help locate the area where fault may exist.

- For intermittent conditions, refer to **Intermittent Conditions**

Test Description

The number below refers to the step number on the diagnostic table.

2: If DTC P0651 set, the 5-volt reference circuit may be shorted to ground.

5: This step tests for the proper operation of the circuit in the high voltage range.

11: After replacing the PCM a new minimum throttle position and idle speed must also be established.

DTC P0453 Circuit

Step	Action	Values	Yes	No
Connector End View Reference:Powertrain Control Module (PCM) Connector End Views or **Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine, and let idle for 10 seconds. 2. Monitor the diagnostic trouble codes (DTC) information using the scan tool. Is DTC P0651 also set?	-	Go to **DTC P0651**	Go to **Step 3**
3	1. Turn the ignition switch OFF. 2. Remove the fuel fill cap. 3. Turn the ignition ON with the engine OFF. 4. Observe the fuel tank pressure (FTP) sensor voltage with a scan tool. Does the scan tool indicate that the FTP sensor voltage is less than the specified value?	0.2 V	Go to **Step 5**	Go to **Step 4**
4	1. Observe the Freeze Frame/Failure Records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text or as close to the Freeze Frame/Failure Records data that you observed. Does the DTC fail this ignition?	-	Go to **Step 5**	Go to Diagnostic Aids

5	1. Turn OFF the ignition. 2. Disconnect the FTP sensor harness connector. 3. Connect a 3-amp fused jumper wire between the 5-volt reference circuit of the FTP sensor and the signal circuit of the FTP sensor. Refer to **Using Fused Jumper Wires** in Wiring Systems. 4. Turn ON the ignition, with the engine OFF. 5. With a scan tool, observe the FTP voltage. Does the scan tool indicate that the FTP voltage is at the specified value?	5 V	Go to **Step 8**	Go to **Step 6**
6	Test the 5-volt reference circuit of the FTP sensor for a short to ground, for high resistance, or for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 7**
7	Test the signal circuit of the FTP sensor for a short to ground, for high resistance, or for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
8	Inspect for poor connections at the harness connector of the FTP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and**Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 10**
9	Inspect for poor connections at the harness connector of the control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
10	Replace the FTP sensor. Refer to **Fuel Tank Pressure Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
11	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 12**	-
	1. Use the scan tool in order to clear the DTCs. 2. Turn OFF the ignition for 30 seconds.			

12	3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC run and pass?	-	Go to **Step 13**	Go to **Step 2**
13	With the scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0455

System Description

The DTC P0455 Evaporative Emission (EVAP) System Large Leak diagnostic detects large system leaks. The control module monitors the fuel tank pressure (FTP) sensor signal to determine the EVAP system vacuum level. When the conditions for running are met, the control module commands the EVAP canister purge valve OPEN and the EVAP vent valve CLOSED. This allows engine vacuum to enter the EVAP system. At a calibrated time, or vacuum level, the control module commands the EVAP canister purge valve closed, sealing the system, and monitors the FTP sensor input in order to determine the EVAP system vacuum level. If the system is unable to achieve the calibrated vacuum level, or the vacuum level decreases too rapidly, this DTC sets.

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

DTC P0455 Circuit

Control Module Command	EVAP Canister Purge Valve	EVAP Canister Vent Valve
ON	Open	Closed
OFF	Closed	Open

DTC Descriptor

This diagnostic supports the following DTC. DTC P0455 Evaporative Emission (EVAP) System Large Leak diagnostic

Conditions for Running the DTC

- Before the PCM can report DTC P0455 failed, DTC P0107, P0108, P0117, P0118, P0451, P0452, P0453, P0496, P0498, P0499, P1128, P1129, P2199, P2227, P2228, and P2229 must run and pass.
- The battery voltage is more than 10 volts.
- The fuel system is operating in closed loop.
- The fuel level is between 15-85 percent.

- The difference between the initial intake air temperature (IAT) and the initial engine coolant temperature (ETC) is between 6-10°C (11-18°F).
- The engine coolant temperature (ECT) is between 69-100°C (156-212°F).
- The vehicle speed sensor (VSS) is between 12 km/h (7 mph) and 132 km/h (82 mph).
- DTC P0455 runs once per drive cycle when the above conditions are met.

Conditions For Setting the DTC

The PCM detects the EVAP system is not able to achieve or maintain vacuum during the diagnostic test.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module will turn the malfunction indicator lamp (MIL) OFF during the first consecutive trip in which the diagnostic has been run and passed.
- A current DTC, Last Test Failed, clears when the control module turns OFF the MIL.
- The history DTC will clear after the control module runs and passes 40 consecutive warm up cycles with no failure.
- Use the scan tool in order to clear the DTC.

Diagnostic Aids

- To help locate intermittent leaks, use the **J 41413-200** Evaporative Emissions System Tester (EEST) to introduce smoke into the EVAP system. Move all EVAP components while observing smoke with the **J 41413-SPT** High Intensity White Light. Introducing smoke in 15 second intervals will allow less pressure into the EVAP system. When the system is less pressurized, the smoke will sometimes escape in a more condensed manner.
- A temporary blockage in the EVAP purge solenoid, purge pipe or EVAP canister could cause an intermittent condition. Inspect and repair any restriction in the EVAP system.
- To improve the visibility of the smoke exiting the EVAP system, observe the suspected leak area from different angles with the **J 41413-SPT** .
- Observe the Freeze Frame/Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition occurs that caused the DTC to set. This may assist in diagnosing the condition.
- For an intermittent condition, refer to **Intermittent Conditions** .

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4: Introducing smoke in 15 second intervals may allow smaller leak areas to be more noticeable. When the system is less pressurized, the smoke will sometimes escape in a more condensed manner.

6: This step verifies proper operation of the FTP sensor.

7: A normal operating FTP sensor should increase above 5 inches of H2O and stop between 6 inches of H2O and 7 inches of H2O.

9: This step tests the EVAP purge solenoid vacuum source between the EVAP purge solenoid and the intake manifold for restrictions or blockages.

Evaporative Emission (EVAP) System Large Leak Detected

Step	Action	Values	Yes	No
Schematic Reference: **Evaporative Emissions (EVAP) Hose Routing Diagram**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **Larger volume fuel tanks and/or those with lower fuel levels may require several minutes for the floating indicator to stabilize.** 1. Turn the nitrogen/smoke valve to nitrogen. 2. Connect the nitrogen/smoke hose to the 0.5 mm (0.020 in) test orifice on the bottom-front of the **J 41413-200** . 3. Use the remote switch to activate the **J 41413-200** . 4. Align the red flag on the flow meter with the floating indicator. Use the remote switch to de-activate the **J 41413-200** . 5. Remove the nitrogen/smoke hose from the test orifice. **IMPORTANT:** **The GE-41415-50 fuel cap adapter, may not be available for the start of production. Once theGE-41415-50 is available, start the diagnosis at the fuel fill cap.** Install the nitrogen/smoke supply hose onto one	-		

	of the following sources: • Connect the **GE-41415-50** to the fuel fill pipe, and the **J 41413-200** nitrogen/smoke supply hose to the fuel cap adapter. • Connect the **J 41413-200** nitrogen/smoke supply hose to the EVAP service port. 6. Turn ON the ignition, with the engine OFF. 7. Command the EVAP vent solenoid closed with a scan tool. 8. Use the remote switch to introduce nitrogen and fill the EVAP system until the floating stabilizes. 9. Compare the flow meter's stable floating indicator position to the red flag. Is the floating indicator below the red flag?		Go to **Step 6**	Go to **Step 3**
3	1. Inspect the evaporative emission (EVAP) system for the following conditions: • Loose, missing, or damaged service port schrader valve • Loose, incorrect, missing, or damaged fuel fill cap • A damaged EVAP purge solenoid 2. Raise the vehicle on a hoist. Refer to **Lifting and Jacking the Vehicle** in General Information. 3. Inspect the EVAP system for the following conditions: • Disconnected, incorrectly routed, kinked, or damaged EVAP pipes and hoses • A damaged EVAP vent valve or EVAP canister Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 4**
	IMPORTANT: **Ensure that the vehicle underbody temperature is similar to the ambient temperature and allow the surrounding air to stabilize before starting the diagnostic procedure. The system flow will be less with higher temperatures.** 1. Turn OFF the ignition. 2. Connect the **J 41413-200** Evaporative Emissions System Tester (EEST) power supply clips to a			

4	known good 12-volt source. **IMPORTANT:** **The GE-41415-50 fuel cap adapter, may not be available for the start of production. Once theGE-41415-50 is available, start the diagnosis at the fuel fill cap.** 3. Install the nitrogen/smoke supply hose onto one of the following sources: • Connect the **GE-41415-50** to the fuel fill pipe, and the **J 41413-200** nitrogen/smoke supply hose to the fuel cap adapter. • Connect the **J 41413-200** nitrogen/smoke supply hose to the EVAP service port. 4. Turn ON the ignition with the engine OFF. 5. Command the EVAP vent valve closed with a scan tool. 6. Turn the nitrogen/smoke valve on the **J 41413-200** control panel to SMOKE. 7. Use the remote switch to introduce smoke into the EVAP system. 8. Continue to introduce smoke into the EVAP system for 60 seconds. 9. Inspect the entire EVAP system for exiting smoke with the **J 41413-SPT** High Intensity White Light. 10. Continue to introduce smoke at 15 second intervals until the leak source has been located. Did you locate and repair a leak source?	-	Go to **Step 19**	Go to **Step 5**
5	1. Disconnect the **GE-41415-50** from the fuel fill pipe. 2. Install the fuel fill cap to the fuel fill pipe. 3. Connect the **J 41413-200** nitrogen/smoke supply hose to the EVAP service port. 4. Use the remote switch to introduce smoke into the EVAP system. 5. Inspect the entire EVAP system for exiting smoke with the **J 41413-SPT** High Intensity White Light. 6. Continue to introduce smoke at 15 second intervals until the leak source has been located.	-		

	Did you locate and repair a leak source?		Go to **Step 19**	Go to **Step 6**
6	1. Use the remote switch to stop introducing smoke. 2. Command the EVAP vent valve open with a scan tool. 3. Compare the Fuel Tank Pressure parameter with a scan tool to the **J 41413-200** pressure/vacuum gage. Is the scan tool Fuel Tank Pressure sensor parameter within the specified value of the **J 41413-200** pressure/vacuum gage?	1 in H2O	Go to **Step 7**	Go to **Step 15**
7	1. Seal the EVAP system using the EVAP Purge/Seal function with a scan tool. 2. Turn the nitrogen/smoke valve on the **J 41413-200** control panel to NITROGEN. 3. Use the **J 41413-200** to pressurize the EVAP system to 10 in H2O. Is the Fuel Tank Pressure sensor parameter more than the specified value?	5 in H2O	Go to **Step 8**	Go to **Step 15**
8	1. Use the remote switch to stop introducing nitrogen into the EVAP system. 2. Increase the EVAP purge solenoid to 20 percent. Is the Fuel Tank Pressure sensor parameter less than the specified value?	1 in H2O	Go to Diagnostic Aids	Go to **Step 9**
9	Disconnect the EVAP purge vacuum source from the EVAP purge solenoid. Is the Fuel Tank Pressure parameter less than the specified value?	1 in H2O	Go to **Step 13**	Go to **Step 10**
10	Disconnect the EVAP purge pipe from the EVAP purge solenoid. Is the Fuel Tank Pressure parameter less than the specified value?	1 in H2O	Go to **Step 16**	Go to **Step 11**
11	Disconnect the EVAP purge pipe at the EVAP canister. Is the Fuel Tank Pressure parameter less than the specified value?	1 in H2O	Go to **Step 17**	Go to **Step 12**
12	Disconnect the EVAP vapor pipe at the EVAP canister. Is the Fuel Tank Pressure parameter less than the specified value?	1 in H2O	Go to **Step 18**	Go to **Step 14**
13	Repair the pinched or obstructed EVAP purge solenoid vacuum source. Did you complete the repair?	-	Go to **Step 19**	-

14	Repair the pinched or obstructed EVAP vapor pipe. Did you complete the repair?	-	Go to **Step 19**	-
15	Replace the FTP sensor. Refer to **Fuel Tank Pressure Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 19**	-
16	Replace the EVAP purge solenoid. Refer to **Evaporative Emission (EVAP) Canister Purge Solenoid Valve Replacement** . Did you complete the replacement?	-	Go to **Step 19**	-
17	Repair the restriction in the EVAP purge pipe. Refer to **Evaporative Emission (EVAP) Hoses/Pipes Replacement - Chassis/Canister** . Did you complete the repair?	-	Go to **Step 19**	-
18	Replace the EVAP canister. Refer to **Evaporative Emission (EVAP) Canister Replacement** . Did you complete the replacement?	-	Go to **Step 19**	-
19	**IMPORTANT:** **Larger volume fuel tanks and/or those with lower fuel levels may require several minutes for the floating indicator to stabilize.** 1. Turn the nitrogen/smoke valve to nitrogen. 2. Connect the nitrogen/smoke hose to the 0.5 mm (0.020 in) test orifice on the bottom-front of the **J 41413-200** Evaporative Emissions System Tester (EEST). 3. Use the remote switch to activate the **J 41413-200** . 4. Align the red flag on the flow meter with the floating indicator. Use the remote switch to de-activate the **J 41413-200** . 5. Remove the nitrogen/smoke hose from the test orifice. **IMPORTANT:** **The GE-41415-50 fuel cap adapter, may not be available for the start of production. Once the GE-41415-50 is available, start the diagnosis at the fuel fill cap.** Install the nitrogen/smoke supply hose onto one of the following sources: • Connect the **GE-41415-50** to the fuel fill pipe, and the **J 41413-200** nitrogen/smoke	-		

	supply hose to the fuel cap adapter. • Connect the **J 41413-200** nitrogen/smoke supply hose to the EVAP service port. 6. Turn ON the ignition, with the engine OFF. 7. Command the EVAP vent solenoid closed with a scan tool. 8. Use the remote switch to introduce nitrogen and fill the EVAP system until the floating indicator stabilizes. 9. Compare the flow meter's stable floating indicator position to the red flag. Is the floating indicator below the red flag?		Go to **Step 20**	Go to **Step 4**
20	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0496

System Description

The DTC P0496 Evaporative Emission (EVAP) System Flow During Non-Purge monitors the operation of the purge solenoid. This DTC tests for undesired intake manifold vacuum flow to the evaporative emission (EVAP) system. The control module seals the EVAP system by commanding the EVAP canister purge valve Closed and the EVAP canister vent valve Closed. The control module monitors the fuel tank pressure (FTP) sensor in order to determine if a vacuum is being drawn on the EVAP system. If vacuum in the EVAP system is more than a predetermined value within a predetermined time, this DTC sets.

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

DTC P0496 Circuit

Control Module Command	EVAP Canister Purge Valve	EVAP Canister Vent Valve
ON	Open	Closed
OFF	Closed	Open

DTC Descriptor

This diagnostic supports the following DTC. DTC P0496 Evaporative Emission (EVAP) System Flow During Non-Purge

Conditions for Running the DTC

- DTCs P0107, P0108, P0452, P0453, P0496, P0498, P0499, P1128, P1129, P2227, P2228, and P2229 are not set.

- The battery voltage is more than 10 volts.
- The start-up engine coolant temperature (ECT) is between 7-35°C (20-95°F).
- The start-up intake air temperature (IAT) is between 7-35°C (20-95°F).
- The difference between the initial intake air temperature (IAT) and the initial engine coolant temperature (ECT) is between 6-10°C (11-18°F).
- The engine is idling.
- The engine is in closed loop.
- DTC P0496 runs once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

The control module detects vacuum during a non-purge condition.

Action Taken When the DTC Sets

- The control module will illuminate the malfunction indicator lamp (MIL) during the second consecutive trip in which the diagnostic test ran and failed.
- The control module will store conditions which were present when the DTC set as Freeze Frame/Failure Records data.

Conditions for Clearing the MIL/DTC

- The control module will turn OFF the MIL during the third consecutive trip in which the diagnostic ran and passed.
- A history DTC clears after 40 consecutive warm-up cycles without a malfunction.
- Use the scan tool in order to clear the DTC.

Diagnostic Aids

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

Test Description

The number below refers to the step number on the diagnostic table.

> **3:** Removing the fuel fill cap will equalize the pressure inside the tank with atmospheric pressure. At 0 inches of H2O the FTP sensor should be near 1.5 volts. If the sensor is not, there is a concern with the sensor or related wiring.

Evaporative Emission (EVAP) System Flow During Non-Purge

Step	Action	Values	Yes	No
Schematic Reference: Evaporative Emissions (EVAP) Hose Routing Diagram				

1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Are DTCs P0452, or P0453 also set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	1. Remove the fuel fill cap. 2. Turn ON the ignition, with the engine OFF. 3. Monitor the fuel tank pressure (FTP) with a scan tool. Does the scan tool indicate FTP within the specified range?	-0.5 to +0.5 in H2O	Go to **Step 4**	Go to **DTC P0452**
4	1. Disconnect the evaporative emission (EVAP) purge pipe from the EVAP canister purge valve. 2. Install a hand held vacuum gage to the EVAP purge port. 3. Disconnect the EVAP canister purge valve harness connector. 4. Monitor vacuum on the vacuum gage. 5. Start the engine and allow the engine to idle. 6. Increase the engine speed to 1,200-1,500 RPM. Does the gage indicate an increase in vacuum?	-	Go to **Step 5**	Go to Diagnostic Aids
5	Replace the EVAP canister purge valve. Refer to **Evaporative Emission (EVAP) Canister Purge Solenoid Valve Replacement** . Did you complete the replacement?	-	Go to **Step 6**	-
6	1. Clear the DTCs with a scan tool. 2. Turn off the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the conditions for Running the DTC. You may also operate the vehicle within the conditions that you observe from the Freeze Frame failure records. Did the DTC fail this ignition?	-	Go to **Step 3**	Go to **Steps 7**
	Observe the Capture Info with a scan tool.		Go to **Diagnostic**	

7	Are there any DTCs that have not been diagnosed?	-	**Trouble Code (DTC) List**	System OK

DTC P0498

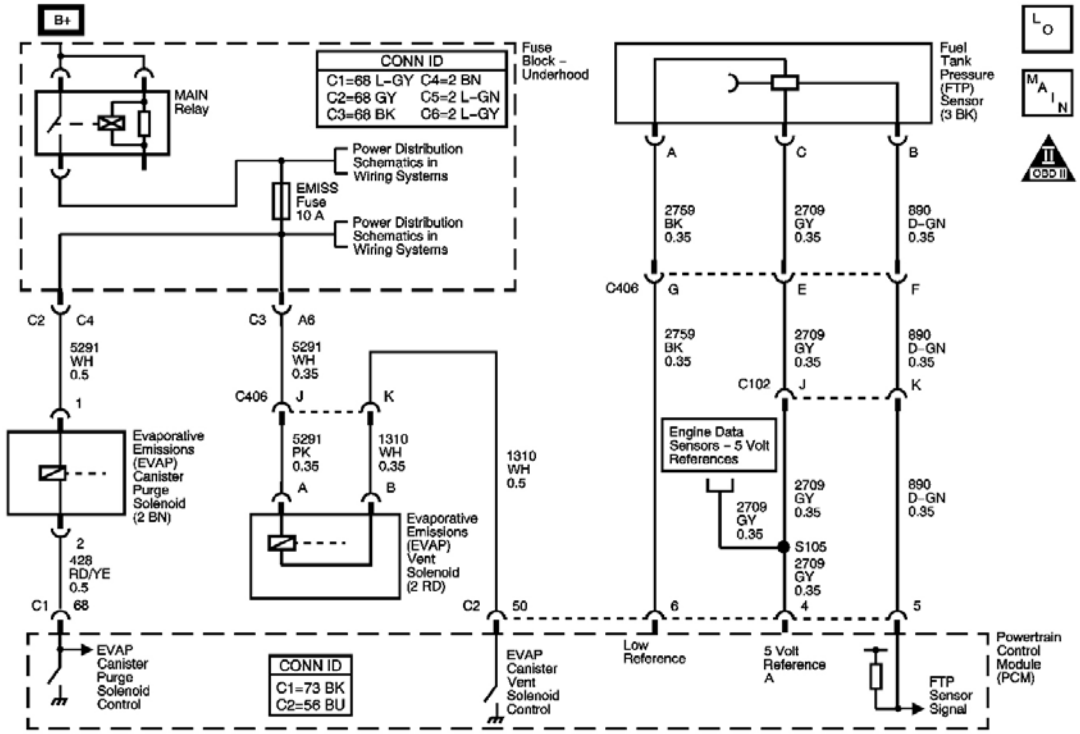


Fig. 14: DTC P0498 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0498 Evaporative Emission (EVAP) Vent Solenoid Control Circuit Low Voltage diagnostic detects faults in the vent solenoid electrical circuit. Battery positive voltage is supplied directly to the evaporative emission (EVAP) canister vent valve. The control module grounds the EVAP canister vent valve control circuit to close the valve by means of an internal switch called a driver. The scan tool displays the commanded state of the EVAP canister vent valve as ON or OFF. The control module monitors the status of the driver. If the control module detects low voltage on the control circuit when the driver is commanded OFF, this DTC sets.

The following table illustrates the relationship between the ON and OFF states, and the OPEN or CLOSED states of the EVAP canister vent valve.

DTC P0498 Circuit

Control Module Command	EVAP Canister Vent Valve Position

ON	CLOSED
OFF	OPEN

DTC Descriptor

This diagnostic supports the following DTC. DTC P0498 Evaporative Emission (EVAP) Vent Solenoid Control Circuit Low Voltage.

Conditions for Running the DTC

- The battery voltage is 10.1 volts.
- The engine is running.
- DTC P0498 runs continuously once the above conditions are met.

Conditions for Setting the DTC

The control module detects low voltage on the control circuit when the driver is commanded OFF.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool, if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

11: After replacing the PCM, a new minimum throttle position and idle speed must also be established.

DTC P0498 Circuit

Step	Action	Yes	No
Connector End View Reference:Engine Controls Connector End Views or **Powertrain Control Module (PCM) Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Command the evaporative emission (EVAP) vent valve ON and OFF with a scan tool. Do you hear or feel a click from the EVAP vent valve when the valve is commanded ON and OFF?	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the EVAP vent valve. 3. Turn ON the ignition, with the engine OFF. 4. Probe the battery positive voltage circuit of the EVAP vent valve with a test lamp connected to a good ground. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 9**
5	1. Connect a test lamp between the battery positive voltage circuit and the control circuit of the EVAP vent valve. 2. Command the EVAP vent valve ON with a scan tool. Does the test lamp illuminate?	Go to **Step 7**	Go to **Step 6**
6	Test the control circuit of the EVAP vent valve for an open or for a short to ground. Refer to **Testing for Short to Ground** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 8**

7	Test for an intermittent and for a poor connection at the EVAP vent valve. Refer to **Testing for Intermittent Conditions and Poor Connections** and**Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 10**
8	Test for an intermittent and for a poor connection at the control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and**Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 11**
9	1. Repair the battery positive voltage circuit of the EVAP vent valve for an open or for a short to ground. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Replace the fuse as necessary. 2. Replace the fuse as necessary. Did you complete the repair?	Go to **Step 12**	-
10	Replace the EVAP vent valve. Refer to **Evaporative Emission (EVAP) Canister Vent Solenoid Valve Replacement** . Did you complete the replacement?	Go to **Step 12**	-
11	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	Go to **Step 12**	-
12	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 13**
13	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0499

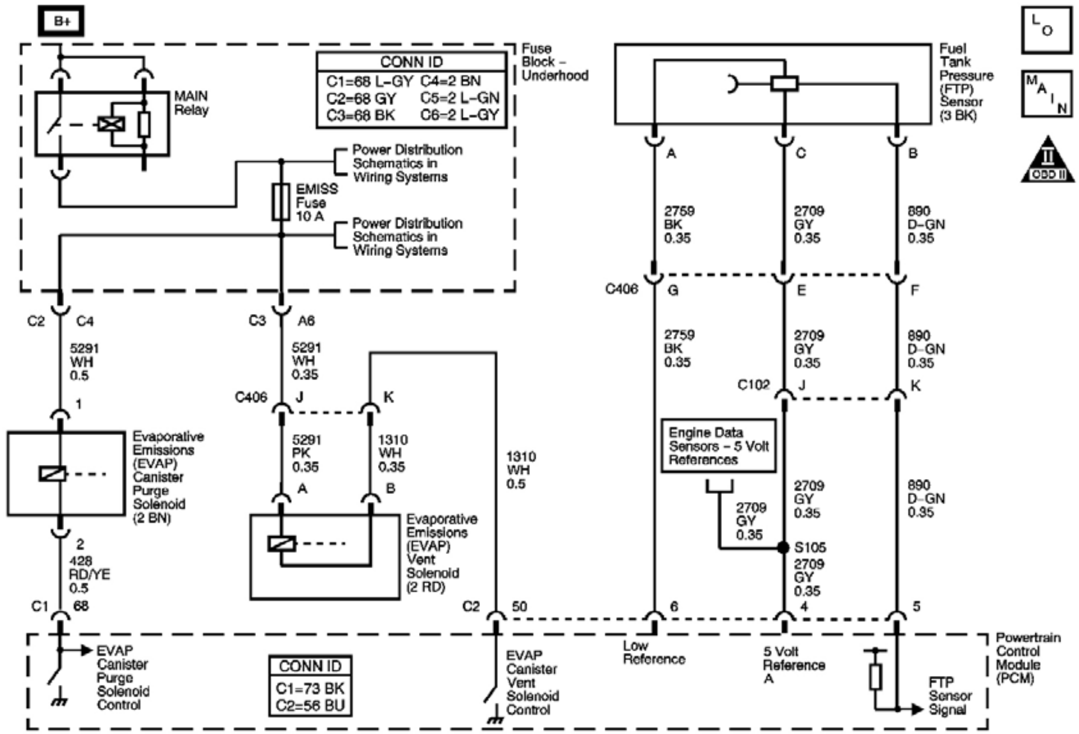


Fig. 15: DTC P0499 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0499 Evaporative Emission (EVAP) Vent Solenoid Control Circuit High Voltage diagnostic detects faults in the vent solenoid electrical circuit. Battery positive voltage is supplied to the evaporative emission (EVAP) canister vent valve. The control module grounds the EVAP canister vent valve control circuit to close the valve by means of an internal switch called a driver. The scan tool displays the commanded state of the EVAP canister vent valve as ON or OFF. The control module monitors the status of the driver. If the control module detects voltage on the control circuit when the driver is commanded ON, this DTC sets.

The following table illustrates the relationship between the ON and OFF states, and the OPEN or CLOSED states of the EVAP canister vent valve.

DTC P0499 Circuit

Control Module Command	EVAP Canister Vent Valve Position
ON	CLOSED
OFF	OPEN

DTC Descriptor

This diagnostic supports the following DTC.

DTC P0499 Evaporative Emission (EVAP) Vent Solenoid Control Circuit High Voltage.

Conditions for Running the DTC

- The battery voltage is 10.1 volts.
- The engine is running.
- DTC P0499 runs continuously once the above conditions are met.

Conditions for Setting the DTC

The actual state of the control circuit does not match the commanded state.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool, if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

9: After replacing the PCM, a new minimum throttle position and idle speed must also be established.

DTC P0499 Circuit

Step	Action	Yes	No
Connector End View Reference:Engine Controls Connector End Views or **Powertrain Control Module (PCM) Connector End Views**			
	Did you perform the Diagnostic System Check-Engine		Go to **Diagnostic**

1	Controls?	Go to **Step 2**	**System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Command the evaporative emission (EVAP) vent valve ON and OFF with a scan tool. Do you hear or feel a click from the EVAP vent valve when the valve is commanded ON and OFF?	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the EVAP vent valve. 3. Turn ON the ignition, with the engine OFF. 4. Probe the EVAP vent valve control circuit of the EVAP vent valve with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 6**
5	Test the control circuit of the EVAP vent valve for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 10**	Go to **Step 7**
6	Test for an intermittent and for a poor connection at the EVAP vent valve. Refer to **Testing for Intermittent Conditions and Poor Connections** and**Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 10**	Go to **Step 8**
7	Test for an intermittent and for a poor connection at the control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and**Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 10**	Go to **Step 9**
8	Replace the EVAP vent valve. Refer to **Evaporative Emission (EVAP) Canister Vent Solenoid Valve**		

	Replacement . Did you complete the replacement?	Go to **Step 10**	-
9	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	Go to **Step 10**	-
10	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 11**
11	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0506

Description

The DTC P0506 Idle Speed Low diagnostic monitors the engine speed. The powertrain control module (PCM) controls the throttle actuator control (TAC) motor in order to regulate the air flow through the throttle body. The amount of air flowing through the throttle body determines the engine speed. If there is a malfunction in the TAC system or other engine control system, DTC P0506 can set.

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P0506 Idle Speed Low

Conditions for Running the DTC

- DTCs P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0171, P0172, P0174, P0175, P0222, P0223, P0300-P0306, P0401, P0404, P0507, P1128, P1129, P2100, P2101, P2108, P2122, P2123, P2127, P2128, P2135, P2138, P2176, P2227, P2228, P2229, P2413, and U0107 are not set.
- Battery voltage is at least 10.5 volts.
- Intake air temperature (IAT) is at least 69°C (156°F).
- Engine coolant temperature (ECT) is at least 0°C (32°F).

- The engine has been running at least 15 seconds.
- Engine is running in Closed Loop at idle
- The throttle valve is fully closed
- The vehicle is in PARK with all engine accessories turned OFF
- DTC P0506 runs once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

- The actual engine speed is 100 RPM less than the desired engine speed.
- The above condition exists for more than 20 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) after 2 consecutive ignition cycles in which the diagnostic runs with the fault active.
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Freeze Frame buffer.

Conditions for Clearing the MIL/DTC

- The MIL turns OFF after 3 consecutively passing trips without a fault present.
- A history DTC clears after 40 consecutive warm-up cycles without a fault.
- Perform the scan tool Clear DTC Information function.

Diagnostic Aids

An incorrect TP learned value can cause a DTC P0506 to set. Reset the TP learned value. Refer to **Scan Tool Output Controls** .

Any malfunction that can cause a low idle condition can cause a DTC P0506 to set.

For an intermittent malfunction refer to **Intermittent Conditions** .

Test Description

The numbers below refer to the step numbers in the diagnostic table.

> **1:** The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

DTC P0506 Circuit

Step	Action	Values	Yes	No
	Did you perform the Diagnostic System Check-			Go to **Diagnostic**

1	Engine Controls?	-	Go to **Step 2**	**System Check - Engine Controls**
2	Are any throttle actuator control (TAC), throttle position (TP) sensor, or accelerator pedal position (APP) sensor DTCs set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	1. Start the engine. 2. Command the engine speed up to 1,400 RPM, down to 600 RPM, up to 1,400 RPM, and then exit using the scan tool. Is the actual engine speed within the specified value of the commanded engine speed, with each command?	100 RPM	Go to **Step 4**	Go to **Step 5**
4	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 5**	Go to **Intermittent Conditions**
5	1. Inspect for the following conditions: • Inspect for excess deposits in the throttle body • Insect for a parasitic load on the engine - For example, a transmission condition, a belt driven accessory condition 2. Repair the condition as necessary. Did you complete the repair?	-	Go to **Step 6**	-
6	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?		Go to **Step 7**	Go to **Step 2**
7	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0507

Description

The DTC P0507 Idle Speed High diagnostic monitors the engine speed. The powertrain control module (PCM) controls the throttle actuator control (TAC) motor in order to regulate the air flow through the throttle body. The amount of air flowing through the throttle body determines the engine speed. If there is a malfunction in the TAC system, an intake air leak, or other engine control system fault, DTC P0507 can set.

DTC Descriptors

This diagnostic procedure supports the following DTC.

DTC P0507 Idle Speed High

Conditions for Running the DTC

- DTCs P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0171, P0172, P0174, P0175, P0222, P0223, P0300-P0306, P0401, P0404, P0506, P1128, P1129, P2100, P2101, P2108, P2122, P2123, P2127, P2128, P2135, P2138, P2176, P2227, P2228, P2229, P2413, and U0107 are not set.
- Battery voltage is at least 10.5 volts.
- Intake air temperature (IAT) is at least 69°C (156°F).
- Engine coolant temperature (ECT) is at least 0°C (32°F).
- The engine has been running at least 15 seconds.
- Engine is running in Closed Loop at idle
- The throttle valve is fully closed
- The vehicle is in PARK with all engine accessories turned OFF
- DTC P0507 runs once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

- The actual engine speed is 200 RPM more than the desired engine speed.
- The above condition exists for more than 20 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) after 2 consecutive ignition cycles in which the diagnostic runs with the fault active.
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Freeze Frame buffer.

Conditions for Clearing the MIL/DTC

- The MIL turns OFF after 3 consecutively passing trips without a fault present.
- A history DTC clears after 40 consecutive warm-up cycles without a fault.
- Perform the scan tool Clear DTC Information function.

Diagnostic Aids

For an intermittent malfunction refer to **Intermittent Conditions** .

If the DTC P0507 cannot be duplicated, the information included in the Freeze Frame data can be useful in determining vehicle operating conditions when the DTC was first set.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step prompts the technician to check for any condition that can affect the ability of the TAC motor to control engine idle speed. A DTC P0507 can set even if there is no fault in the TAC system. Any condition that can affect the idle speed of the engine must be repaired first, in order to enable proper diagnosis of the DTC P0507.

4: This step tests whether the PCM can operate the TAC motor with the scan tool. The TAC motor can be commanded to increase and/or decrease engine speed by using the scan tool Engine Speed Control function. The Engine Speed Control function of the scan tool is disabled when the engine temperature is less than 85°C (185°F).

DTC P0507 Circuit

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	1. Inspect the engine for any of the following conditions: • A stuck or damaged throttle valve or throttle body			

2	• A vacuum or intake air leaks • An evaporative emission (EVAP) system malfunction • Faulty PCV system operation Refer to **Crankcase Ventilation System Inspection/Diagnosis** in Engine Mechanical - 3.5L. 2. Repair the condition as necessary. Did you find and correct a condition?	-	Go to **Step 4**	Go to **Step 3**
3	1. Use the scan tool in order to clear the DTCs. 2. Perform the Idle Learn Procedure. Refer to **Idle Learn Procedure** . 3. Turn OFF the engine for 30 seconds. Start the engine. 4. Observe the Desired Idle Speed and Engine Speed parameters on the scan tool. Are the Engine Speed and the Desired Idle Speed within the specified value of each other?	200 RPM	Go to **Step 6**	Go to **Step 4**
4	1. Start the engine. 2. Select Engine Speed Control in the Special Functions menu of the scan tool. Refer to **Scan Tool Output Controls** . 3. Use the scan tool to command the TAC motor to decrease the engine speed to the Desired Idle Speed. Did the engine speed decrease as commanded by the scan tool to the Desired Idle Speed?	-	Go to **Rough, Unstable, or Incorrect Idle and Stalling**	Go to **Step 5**
5	1. Locate the malfunction in the TAC system. 2. Repair as necessary. Did you complete the repair?	-	Go to **Step 6**	-
6	1. Use the scan tool in order to clear the DTCs. 2. Turn the ignition OFF for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions	-		

	for Running the DTC or until the DTC P0507 diagnostic has passed. Does the DTC run and pass?		Go to **Step 7**	Go to **Step 2**
7	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DIAGNOSTIC INFORMATION & PROCEDURES

DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, OR P2610

Description

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

DTC Descriptor

This Diagnostic procedure supports the following DTCs:

- DTC P0602 Control Module Not Programmed
- DTC P1621 Control Module Long Term Memory Performance
- DTC P2610 Control Module Ignition Off Timer Performance

Condition for Running the DTC

- The ignition is ON.
- DTC P0602, P1621, and P2610 run continuously once the above condition is met.

Conditions for Setting the DTC

- DTC P0602 and DTC 1621 set when an error is detected in the electrically erasable programmable read only memory (EEPROM) data readout.
- DTC P2610 sets when there is a discrepancy of 500 seconds or more between the EONV timer and the PCM internal clock.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL).
- The PCM will record operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame buffer.

Conditions for Clearing the MIL/DTC

- The MIL turns OFF after 3 consecutively passing trips without a fault present.
- A history DTC clears after 40 consecutive warm-up cycles without a fault.
- Perform the scan tool Clear DTC Information function.

Diagnostic Aids

Check the PCM for water contamination. Water entering the PCM can cause damage and corrosion to the circuit boards and to internal components. Repair the source of the water entry before the installation of a replacement PCM.

A DTC P0602 or DTC P1621 can set if an incorrect PCM is installed in the vehicle. Install the correct PCM according to the vehicle and/or the engine type and equipment options.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: A DTC P0602 indicates the PCM is not programmed.

5: Attempt to program the PCM. If the PCM fails to program a second time, replace the PCM.

DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610 Circuit

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **If the vehicle does not start, crank the engine in order to allow the DTC to set.** 1. Turn ON the ignition, with the engine OFF. 2. Observe the DTC Information with a scan tool. Is DTC P0602 set?	Go to **Step 3**	Go to **Step 5**
3	Program the PCM. Refer to **Service Programming System (SPS)** in Vehicle Control Systems. Does DTC P0602 reset?	Go to **Step 4**	Go to **Step 7**
4	1. Ensure that all tool connections are secure. 2. Ensure the programming equipment is operating correctly. 3. Ensure the correct software and the correct calibration is used. 4. Attempt to program the PCM. Refer to **Service Programming System (SPS)** in Vehicle Control Systems.		

	Does DTC P0602 reset?	Go to **Step 6**	Go to **Step 7**
5	Is DTC P0685 or P0688 set?	Go to **DTC P0685** or **DTC P0688**	Go to **Step 6**
6	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	Go to **Step 7**	-
7	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 8**
8	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0628

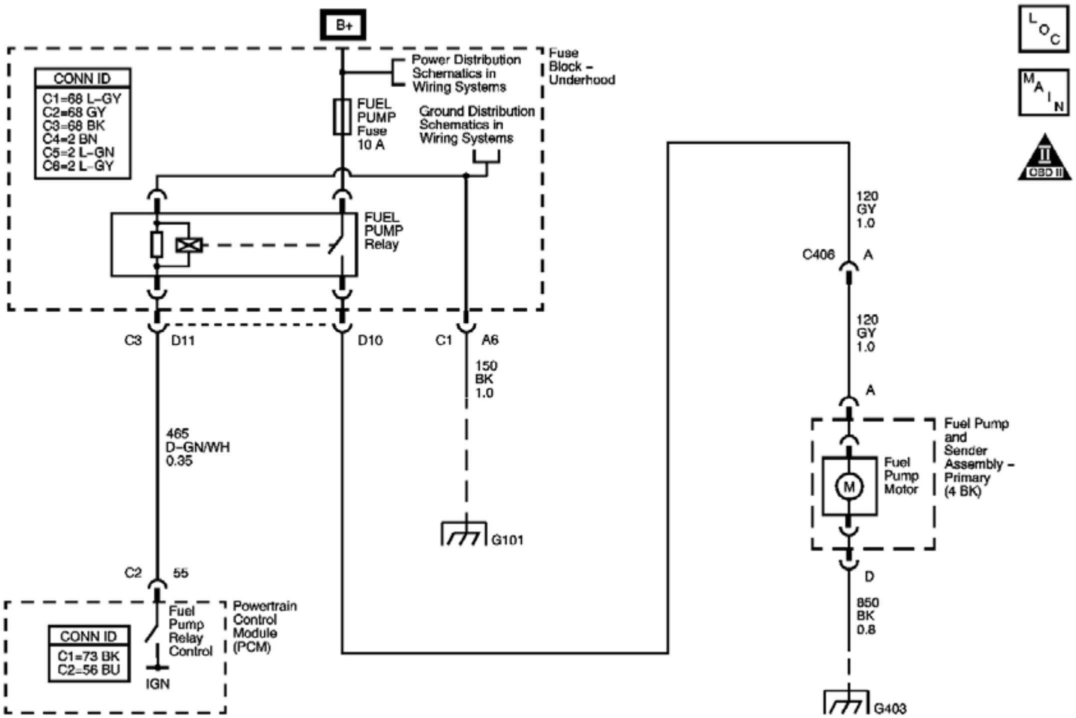


Fig. 1: DTC P0628 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0628 Fuel Pump Relay Control Circuit Low Voltage diagnostic detects an incorrect voltage on the coil control circuit. The fuel pump relay is controlled by the powertrain control module (PCM). The PCM energizes the relay coil for 2 seconds when the ignition switch is first turned ON and when ignition system reference pulses are detected. The fuel pump relay supplies ignition positive voltage to the fuel pump.

DTC Descriptors

This diagnostic procedure supports the following DTC.

DTC P0628 Fuel Pump Relay Control Circuit Low Voltage

Conditions for Running the DTC

- Battery voltage is 10.5 volts or more.
- DTC P0628 runs continuously with the above condition met.

Conditions for Setting the DTC

- The PCM detects a lower than expected voltage on the coil control circuit.

- The above condition is present for at least 1 second.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) the first time the diagnostic fails.
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Freeze Frame buffer.

Conditions for Clearing the MIL/DTC

- The MIL turns OFF after 3 consecutively passing trips without a fault present.
- A history DTC clears after 40 consecutive warm-up cycles without a fault.
- Perform the scan tool Clear DTC Information function.

Diagnostic Aids

Check for any of the following conditions:

- Check the resistance of the relay. The resistance across the coil terminals is 70-95 ohms at 20°C (68°F). The resistance across the switched load terminals is infinite.
- The relay electrical contacts may be pitted or sticking. Replace the relay if tapping gently on the relay or wiggling the relay causes a change in the relays operation.
- The performance of the relay may be affected by temperature. Test the relay after sitting outside overnight and after running the engine 30 minutes.

An intermittent malfunction may be caused by a fault in the relay electrical circuit. Inspect the wiring harness and components for an intermittent condition. Refer to **Intermittent Conditions** .

Use the following relay cavity table in order to locate the correct cavities to probe during diagnosis. The table layout corresponds to the cavity layout of the relay block.

Relay Cavity Identification

Front of Vehicle	
Switch Load	Battery Power Coil
Coil Control	Battery Power Load

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

4: This step will verify whether the PCM is providing a ground path for the relay circuit. When the coil ground circuit is grounded, the relay turns ON.

7: After replacing the PCM a new minimum throttle position and idle speed must also be established.

DTC P0628 Circuit

Step	Action	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Command the fuel pump ON and OFF with a scan tool. Does the fuel pump relay turn ON and OFF with each command?	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the fuel pump relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the control circuit of the fuel pump relay with a test lamp connected to a good ground. 5. Command the fuel pump ON and OFF with a scan tool. Does the test lamp turn ON and OFF?	Go to **Step 6**	Go to **Step 5**
5	Test the control circuit of the fuel pump relay for a short to ground. Refer **Circuit Testing** to and**Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	Go to **Step 8**	Go to **Step 7**
6	Replace the fuel pump relay. Did you complete the replacement?	Go to **Step 8**	-
	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** .		

7	2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	Go to **Step 8**	-
8	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 9**
9	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0629

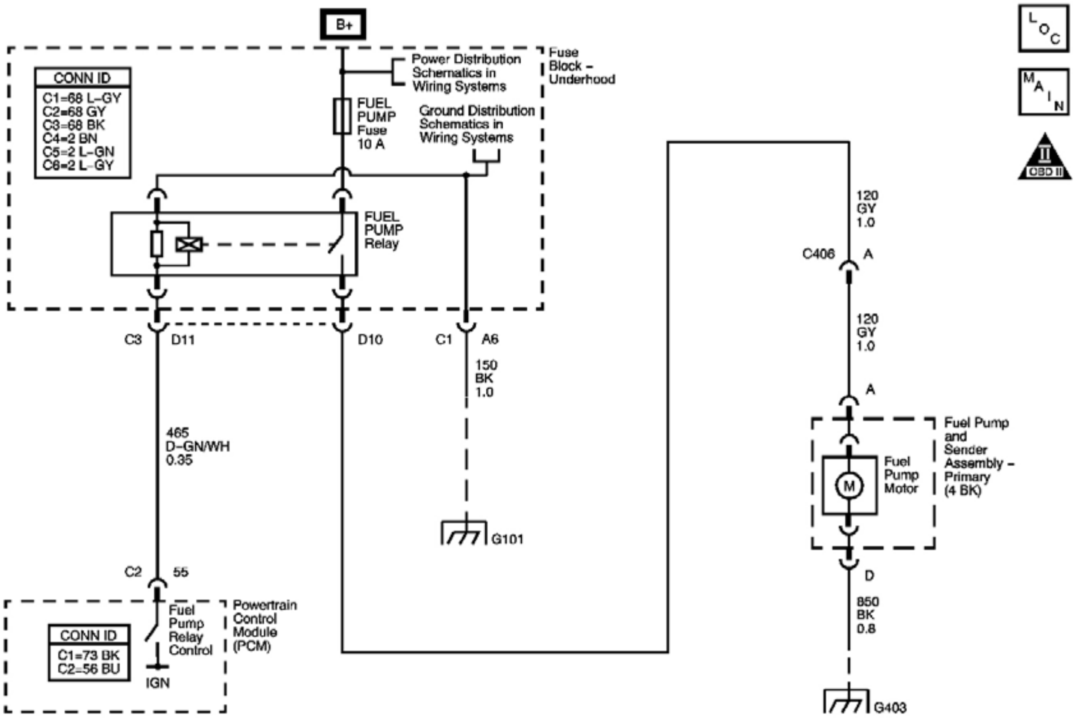


Fig. 2: DTC P0629 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0629 Fuel Pump Relay Control Circuit High Voltage diagnostic detects an incorrect voltage on the coil control circuit. The fuel pump relay, is controlled by the powertrain control module (PCM). The PCM energizes the relay coil for 2 seconds when the ignition switch is first turned ON and when ignition system reference pulses are detected. The fuel pump relay supplies ignition positive voltage to the fuel pump.

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P0629 Fuel Pump Relay Control Circuit High Voltage

Conditions for Running the DTC

- Battery voltage is 10.5 volts or more.
- DTC P0629 runs continuously with the above condition met.

Conditions for Setting the DTC

- The PCM detects a higher than expected voltage on the coil control circuit.
- The above condition is present for at least 1 second.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) the first time the diagnostic fails.
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Freeze Frame buffer.

Conditions for Clearing the MIL/DTC

- The MIL turns OFF after 3 consecutively passing trips without a fault present.
- A history DTC clears after 40 consecutive warm-up cycles without a fault.
- Perform the scan tool Clear DTC Information function.

Diagnostic Aids

Check for any of the following conditions:

- Check the resistance of the relay. The resistance across the coil terminals is 70-95 ohms at 20°C (68°F). The resistance across the switched terminals is infinite.
- The relay electrical contacts may be pitted or sticking. Replace the relay if tapping gently on the relay or wiggling the relay causes a change in the relays operation.
- The performance of the relay may be affected by temperature. Test the relay after sitting outside overnight and after running the engine 30 minutes.

An intermittent malfunction may be caused by a fault in the relay electrical circuit. Inspect the wiring harness and components for an intermittent condition. Refer to **Intermittent Conditions** .

Use the following relay cavity table in order to locate the correct cavities to probe during diagnosis. The table layout corresponds to the cavity layout of the relay block.

Relay Cavity Identification

Front of Vehicle	
Switch Load	Battery Power Coil
Coil Control	Battery Power Load

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4: This step verifies that the control module is providing voltage to the fuel pump relay.

5: This step tests for an open in the ground circuit to the fuel pump relay.

DTC P0629 Circuit

Step	Action	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Command the fuel pump ON and OFF with a scan tool. Does the fuel pump relay turn ON and OFF with each command?	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 4**	Go to Diagnostic Aids
	1. Turn OFF the ignition. 2. Disconnect the fuel pump relay.		

4	3. Turn ON the ignition, with the engine OFF. 4. Probe the control circuit of the fuel pump relay with a test lamp connected to a good ground. 5. Command the fuel pump ON and OFF with a scan tool. Does the test lamp turn ON and OFF when commanded?	Go to **Step 5**	Go to **Step 6**
5	1. Connect a test lamp between the control circuit of the fuel pump relay and the ground circuit of the fuel pump relay. 2. Command the fuel pump ON and OFF with a scan tool. Does the test lamp turn ON and OFF when commanded?	Go to **Step 7**	Go to **Step 9**
6	Test the control circuit of the fuel pump relay for a short to voltage or an open. Refer to **Circuit Testing** and **Wiring Repairs** Circuit in Wiring Systems. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 8**
7	Test for shorted terminals and for poor connections at the fuel pump relay. Refer to And in Wiring Systems. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 10**
8	Test for shorted terminals and for poor connections at the ECM. Refer to **Testing for Intermittent Conditions and Poor Connections** and**Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 11**
9	Repair the open ground circuit of the fuel pump relay. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 12**	-
10	Replace the fuel pump relay. Did you complete the replacement?	Go to **Step 12**	-
11	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	Go to **Step 12**	-
12	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed		Go to **Step 13**

	from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 2**	
13	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0641

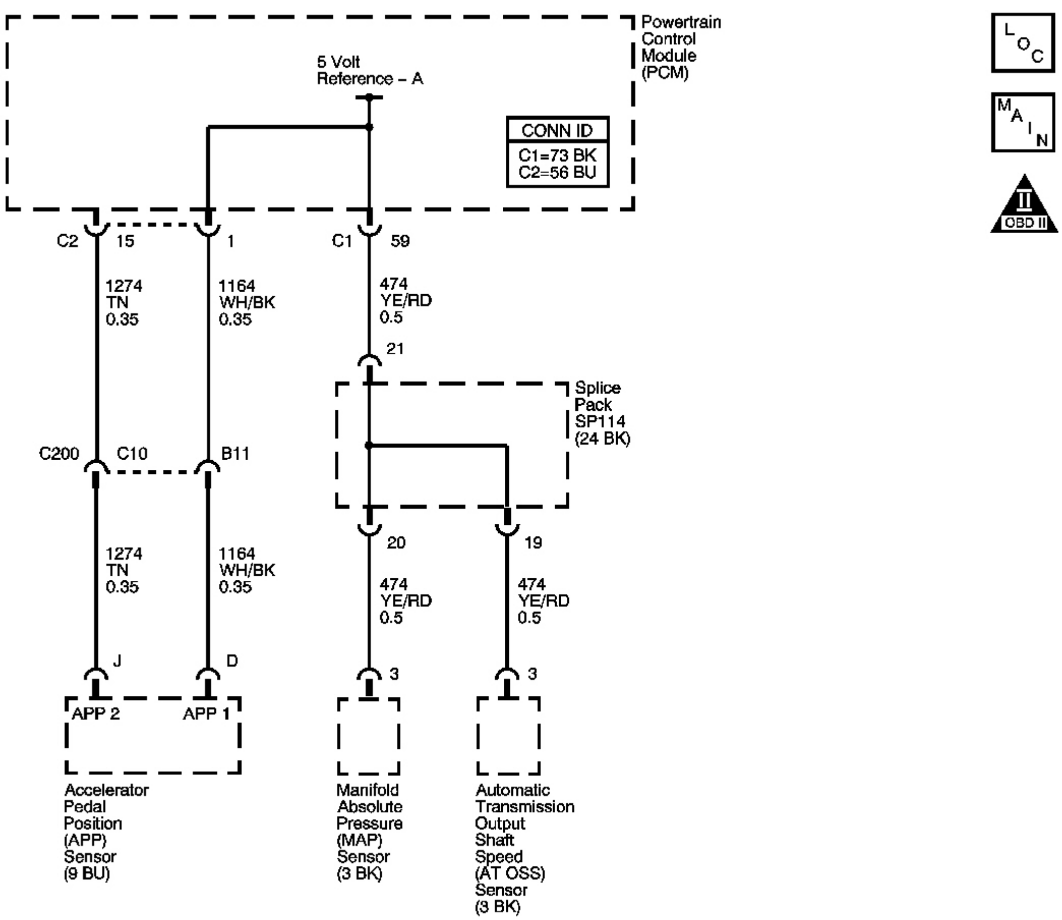


Fig. 3: DTC P0641 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0641 5-Volt Reference 1 Circuit diagnostic detects an incorrect voltage on the reference A supply circuit. The powertrain control module (PCM) provides 5 volts to the reference A circuit to the following sensors:

- The accelerator pedal position (APP) sensor 1
- The manifold absolute pressure (MAP) sensor
- The automatic transmission output shaft speed (AT 0SS) sensor

These 5-volt reference circuits are independent of each other outside the PCM, but are bussed together inside the PCM. Therefore a short circuit condition on the 5-volt reference of one sensor can affect the operation of the other sensors. The PCM monitors the voltage on the 5-volt reference circuit. If the PCM detects that the voltage is out of tolerance, DTC P0641 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P0641 5-Volt Reference 1 Circuit

Conditions for Running the DTC

- The ignition is ON.
- DTC P0641 runs continuously when the above condition is met.

Conditions for Setting the DTC

- The reference 1 circuit voltage is less than 4.8 volts or more than 5.2 volts.
- The above condition is present for at least 2 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame buffer.

Conditions for Clearing the MIL/DTC

- The MIL turns OFF after 3 consecutively passing trips without a fault present.
- A history DTC clears after 40 consecutive warm-up cycles without a fault.
- Perform the scan tool Clear DTC Information function.

Diagnostic Aids

Check for any of the following conditions:

A DTC P0641 can set when water shorts the reference circuit high or low. Inspect for water entry into the sensor or PCM electrical connectors.

An intermittent malfunction may be caused by a fault in the 5-volt reference 1 electrical circuit. Inspect the wiring harness and the components for an intermittent condition. Refer to **Intermittent Conditions** .

If the DTC P0641 cannot be duplicated, the information included in the Freeze Frame data can be useful in determining vehicle operating conditions when the DTC was first set.

Test Description

The number below refers to the step number on the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

12: After replacing the PCM a new minimum throttle position and idle speed must also be established.

DTC P0641 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Clear the DTC information with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 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. Does the DTC fail this ignition?	-	Go to **Step 3**	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the manifold absolute (MAP) pressure sensor. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the 5-volt reference circuit of the MAP sensor to a good ground with a DMM. Is the voltage within the specified range?	4.8-5.2 V	Go to **Step 9**	Go to **Step 4**
4	Is the voltage measured in step 3 more than the	5.2 V		

	specified value?		Go to **Step 8**	Go to **Step 5**
5	1. Disconnect the APP sensor. 2. Measure again the voltage from the 5-volt reference circuit of the MAP sensor to a good ground with the DMM. Is the voltage within the specified range?	4.8-5.2 V	Go to **Step 10**	Go to **Step 6**
6	1. Disconnect the AT OSS sensor. 2. Measure again the voltage from the 5-volt reference circuit of the MAP sensor to a good ground with the DMM. Is the voltage within the specified range?	4.8-5.2 V	Go to **Step 11**	Go to **Step 7**
7	1. Turn OFF the ignition. 2. Disconnect the powertrain control module (PCM). 3. Test all of the 5-volt reference 1 circuits for a short to ground. Refer to **Circuit Testing** in Wiring Systems. 4. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
8	1. Turn OFF the ignition. 2. Disconnect the PCM. 3. Turn ON the ignition, with the engine OFF. 4. Test all 5-volt reference 1 circuits for a short to voltage. Refer to **Circuit Testing** in Wiring Systems. 5. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
9	Replace the MAP sensor. Refer to **Manifold Absolute Pressure (MAP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
10	Replace the APP sensor. Refer to **Accelerator Pedal Position (APP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
11	Replace the AT OSS sensor. Refer to **Output Speed Sensor Replacement** in Automatic Transmission-5AT.	-		-

	Did you complete the replacement?		Go to **Step 13**	
12	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 13**	-
13	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 14**
14	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** a	System OK

DTC P0651

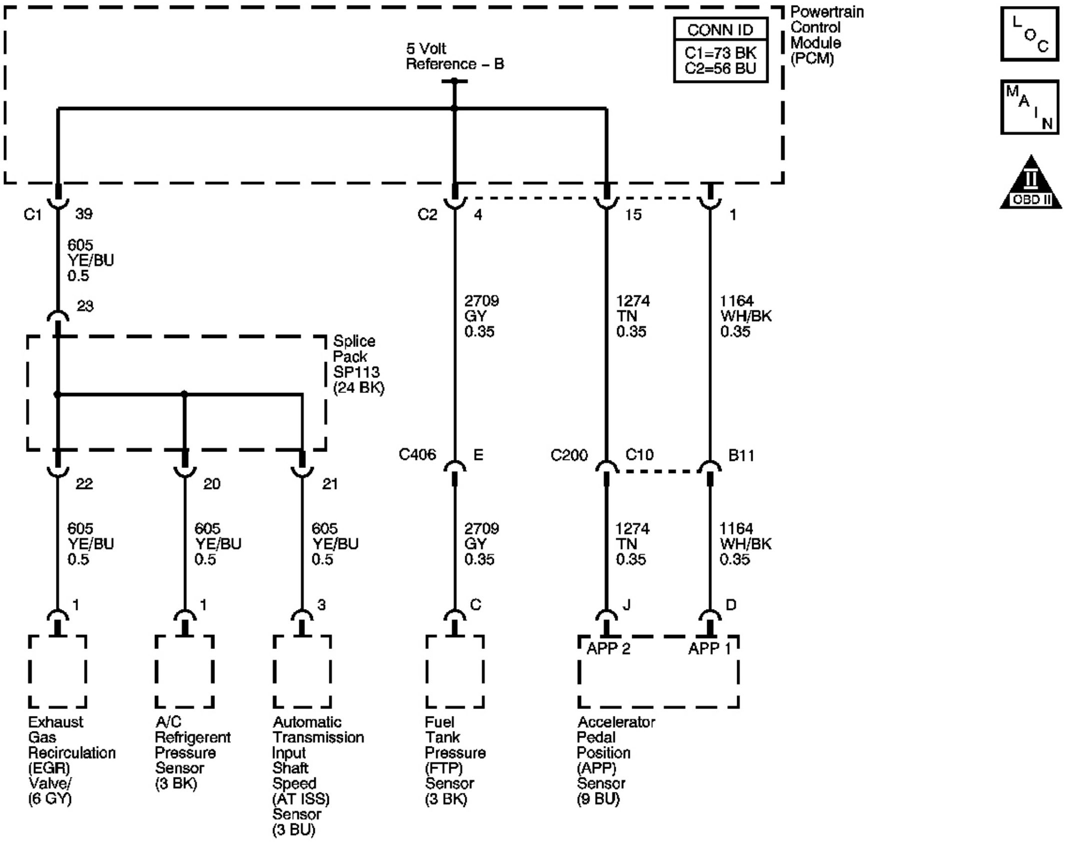


Fig. 4: DTC P0651 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P0651 5 Volt Reference 2 Circuit diagnostic detects an incorrect voltage on the reference B supply circuit. The powertrain control module (PCM) provides 5 volts to the reference B circuit to the following sensors:

- The accelerator pedal position (APP) sensor 2
- The fuel tank pressure (FTP) sensor
- The exhaust gas recirculation (EGR) sensor
- The automatic transmission input shaft speed (AT ISS) sensor
- The air conditioning (AC) pressure sensor

These 5-volt reference circuits are independent of each other outside the PCM, but are bussed together inside the PCM. Therefore a short circuit condition on the 5-volt reference of one sensor can affect the operation of the other sensors. The PCM monitors the voltage on the 5-volt reference circuit. If the PCM detects that the voltage is out of tolerance, DTC P0651 sets.

DTC Descriptors

This diagnostic procedure supports the following DTC.

DTC P0651 5 Volt Reference 2 Circuit

Conditions for Running the DTC

- The ignition is ON.
- DTC P0651 runs continuously when the above condition is met.

Conditions for Setting the DTC

- The reference 2 circuit voltage is less than 4.8 volts or more than 5.2 volts.
- The above condition is present for at least 2 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame buffer.

Conditions for Clearing the MIL/DTC

- The MIL turns OFF after 3 consecutively passing trips without a fault present.
- A history DTC clears after 40 consecutive warm-up cycles without a fault.
- Perform the scan tool Clear DTC Information function.

Test Description

The number below refers to the step number on the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

16: After replacing the PCM a new minimum throttle position and idle speed must also be established.

DTC P0651 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	1. Observe the Freeze Frame/Failure Records for			

2	this DTC. 2. Clear the DTC information with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 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. Does the DTC fail this ignition?	-	Go to **Step 3**	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the EGR position sensor electrical connector. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the 5-volt reference circuit of the EGR position sensor to a good ground with a DMM. Is the voltage within the specified value?	4.8-5.2 V	Go to **Step 11**	Go to **Step 4**
4	Is the voltage measured in step 3 more than the specified value?	5.2 V	Go to **Step 10**	Go to **Step 5**
5	1. Disconnect the APP sensor. 2. Measure again the voltage from the 5-volt reference circuit of the EGR position sensor to a good ground with the DMM. Is the voltage within the specified range?	4.8-5.2 V	Go to **Step 12**	Go to **Step 6**
6	1. Disconnect the AC pressure sensor. 2. Measure again the voltage from the 5-volt reference circuit of the EGR position sensor to a good ground with the DMM. Is the voltage within the specified range?	4.8-5.2 V	Go to **Step 14**	Go to **Step 7**
7	1. Disconnect the AT ISS sensor. 2. Measure again the voltage from the 5-volt reference circuit of the EGR position sensor to a good ground with the DMM. Is the voltage within the specified range?	4.8-5.2 V	Go to **Step 13**	Go to **Step 8**
	1. Disconnect the FTP sensor.			

8	2. Measure again the voltage from the 5-volt reference circuit of the EGR position sensor to a good ground with the DMM. Is the voltage within the specified range?	4.8-5.2 V	Go to **Step 15**	Go to **Step 9**
9	1. Turn OFF the ignition. 2. Disconnect the powertrain control module (PCM). 3. Inspect all the 5-volt reference 1 circuits for a short to ground. Refer to **Circuit Testing** in Wiring Systems. 4. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 16**
10	1. Turn OFF the ignition. 2. Disconnect the PCM. 3. Turn ON the ignition, with the engine OFF. 4. Test all 5-volt reference 1 circuits for a short to voltage. Refer to **Circuit Testing** in Wiring Systems. 5. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 16**
11	Replace the EGR valve. Refer to **Exhaust Gas Recirculation (EGR) Valve Replacement** . Did you complete the replacement?	-	Go to **Step 17**	-
12	Replace the APP sensor. Refer to **Accelerator Pedal Position (APP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 17**	-
13	Replace the AT ISS sensor. Refer to **Input Speed Sensor Replacement** in Automatic Transmission-5AT. Did you complete the replacement?	-	Go to **Step 17**	-
14	Replace the AC pressure sensor. Refer to **Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement** in Heating, Ventilation, and Air Conditioning. Did you complete the replacement?	-	Go to **Step 17**	-
15	Replace the FTP sensor. Refer to **Fuel Tank Pressure Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 17**	-

16	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 17**	-
17	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 18**
18	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** a	System OK

DTC P0685

Circuit Description

This diagnostic detects an inoperative relay. The ignition relay, or main Relay, is controlled by the powertrain control module (PCM). The PCM provides a ground for the relays coil anytime the ignition switch is ON. The MAIN relay supplies ignition positive voltage to many engine control systems and components. The following components receive power from the relay:

- The ignition coils
- The heated oxygen sensors (HO2S)
- The evaporative emission (EVAP) control system solenoids
- The camshaft and crankshaft position sensors
- The powertrain control module (PCM)

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P0685 Engine Controls Ignition Relay Control Circuit

Conditions for Running the DTC

- The engine is running.

- DTC P0685 runs continuously with the above condition met.

Conditions for Setting the DTC

The PCM detects that the MAIN Relay turned OFF before the PCM commanded the relay OFF.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) the first time the diagnostic fails.
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Freeze Frame buffer.

Conditions for Clearing the MIL/DTC

- The MIL turns OFF after 3 consecutively passing trips without a fault present.
- A history DTC clears after 40 consecutive warm-up cycles without a fault.
- Perform the scan tool Clear DTC Information function.

Diagnostic Aids

Check for any of the following conditions:

- Check the resistance of the relay. The resistance across the coil terminals is 75-90 ohms at 20°C (68°F). The resistance across the switched terminals is infinite.
- The relay electrical contacts may be pitted or sticking. Replace the relay if tapping gently on the relay or wiggling the relay causes a change in the relays operation.
- The performance of the relay may be affected by temperature. Test the relay after sitting outside overnight and after running the engine 30 minutes.

An intermittent malfunction may be caused by a fault in the relay electrical circuit. Inspect the wiring harness and components for an intermittent condition. Refer to **Intermittent Conditions** .

Use the following relay cavity table in order to locate the correct cavities to probe during diagnosis. The table layout corresponds to the cavity layout of the relay block.

Relay Cavity Identification

Front of Vehicle	
Ignition 1 voltage	Battery Power Coil
Coil Control	Battery Power Load

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

4: This step determines if there is a condition with the control circuit of the main relay. If the control circuit of the main relay is open, the relay will not click ON and OFF when you remove and install the relay.

13: After replacing the PCM a new minimum throttle position and idle speed must also be established.

DTC P0685 Circuit

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Inspect for an open ECM/CAM fuse. Is the fuse OK?	Go to **Step 3**	Go to **Step 10**
3	1. Swap the main relay with the cooling fan relay. 2. Turn ON the ignition, with the ignition OFF. Does the scan tool communicate with the PCM?	Go to **Step 12**	Go to **Step 4**
4	Remove and install the main relay several times while listening for a clicking sound from the relay. Does the relay click when removing and installing the relay?	Go to **Step 5**	Go to **Step 7**
5	1. Remove the main relay. 2. Probe the B+ supply circuit, switch side of the relay, at the underhood fuse block with a test lamp connected to a good ground. Refer to the Relay Cavity Identification table in Diagnostic Aids. Does the test lamp illuminate?	Go to **Step 6**	Go to **Step 11**
6	Test the ignition 1 voltage supply circuit of the main relay between the ECM/CAM fuse and the PCM for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 9**
7	1. Remove the main relay. 2. Probe the B+ supply circuit, coil side of the relay, at the underhood fuse block with a test lamp connected to a good ground. Refer to the Relay Cavity Identification table in Diagnostic Aids.		

	Does the test lamp illuminate?	Go to **Step 8**	Go to **Step 11**
8	1. Turn OFF the ignition. 2. Test the control circuit of the main relay for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 9**
9	Test for an intermittent and for a poor connection at PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
10	1. Repair the short to ground in the ignition 1 voltage circuit between the ECM/CAM fuse and the PCM. Refer to **Wiring Repairs** in Wiring Systems. 2. Replace the fuse as necessary. Did you complete the repair?	Go to **Step 14**	-
11	Repair the short to ground or open in the B+ supply circuit of the main relay. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 14**	-
12	Replace the main relay. Did you complete the repair?	Go to **Step 14**	-
13	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	Go to **Step 14**	-
14	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 15**
15	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0688

Circuit Description

This diagnostic detects that the main relay is stuck ON. The ignition relay, or main relay, is controlled by the powertrain control module (PCM). The PCM provides a ground for the relays coil anytime the ignition switch is ON. The main relay supplies ignition positive voltage to many engine control systems and components. The following components receive power from the relay:

- The ignition coils
- The heated oxygen sensors (HO2S)
- The evaporative emission (EVAP) control system solenoids
- The camshaft and crankshaft position sensors
- The powertrain control module (PCM)

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P0688 Engine Controls Ignition Relay Feedback Circuit

Conditions for Running the DTC

- The ignition is OFF.
- DTC P0688 runs continuously with the above condition met.

Conditions for Setting the DTC

The main relay remains ON even with the ignition OFF

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) the first time the diagnostic fails.
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Freeze Frame buffer.

Conditions for Clearing the MIL/DTC

- The MIL turns OFF after 3 consecutively passing trips without a fault present.
- A history DTC clears after 40 consecutive warm-up cycles without a fault.
- Perform the scan tool Clear DTC Information function.

Diagnostic Aids

- Check for any of the following conditions:
  - Check the resistance of the relay. The resistance across the coil terminals is 70-90 ohms at 20°C (68°F). The resistance across the switched terminals is infinite.

    - The relay electrical contacts may be pitted or sticking. Replace the relay if tapping gently on the relay or wiggling the relay causes a change in the relays operation.
    - The performance of the relay may be affected by temperature. Test the relay after sitting outside overnight and after running the engine 30 minutes.
    - An intermittent malfunction may be caused by a fault in the relay electrical circuit. Inspect the wiring harness and components for an intermittent condition. Refer to **Intermittent Conditions** .
- Use the following relay cavity table in order to locate the correct cavities to probe during diagnosis. The table layout corresponds to the cavity layout of the relay block.

Relay Cavity Identification

Front of Vehicle	
Ignition 1 voltage	Battery Power Coil
Coil Control	Battery Power Load

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step determines if a condition exists. The scan tool should not communicate with the PCM with the ignition OFF.

3: This step tests if the main relay is stuck in the ON position.

4: This step determines if there is a condition with the control circuit of the main relay. If the control circuit of the main relay is shorted to ground, the relay will click ON and OFF when you remove and install the relay.

DTC P0688 Circuit

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn OFF the ignition. 2. Attempt to communicate with the PCM with a scan tool. Does the scan tool communicate with the PCM?	Go to **Step 3**	Go to **Intermittent Conditions**
3	Swap the main relay with the cooling fan relay. Does the scan tool communicate with the PCM?	Go to **Step 4**	Go to **Step 9**

4	1. Turn OFF the ignition. 2. Remove and install the main relay several times while listening for a clicking sound from the relay. Does the relay click when removing and installing the relay?	Go to **Step 5**	Go to **Step 6**
5	1. Turn OFF the ignition. 2. Remove the main relay from the underhood fuse block. 3. Test the control circuit of the main relay for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 11**	Go to **Step 8**
6	Measure the voltage at the ignition 1 voltage of the main relay at the underhood fuse block with a DMM. Does the DMM display a voltage?	Go to **Step 7**	Go to **Step 9**
7	Test the ignition 1 voltage supply circuit of the main relay between the ECM/CAM fuse and the PCM for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 11**	Go to **Step 8**
8	Test for shorted terminals and poor connections at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 11**	Go to **Step 10**
9	Replace the main relay. Did you complete the replacement?	Go to **Step 11**	-
10	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	Go to **Step 11**	-
11	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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.		

	Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 12**
12	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P1128

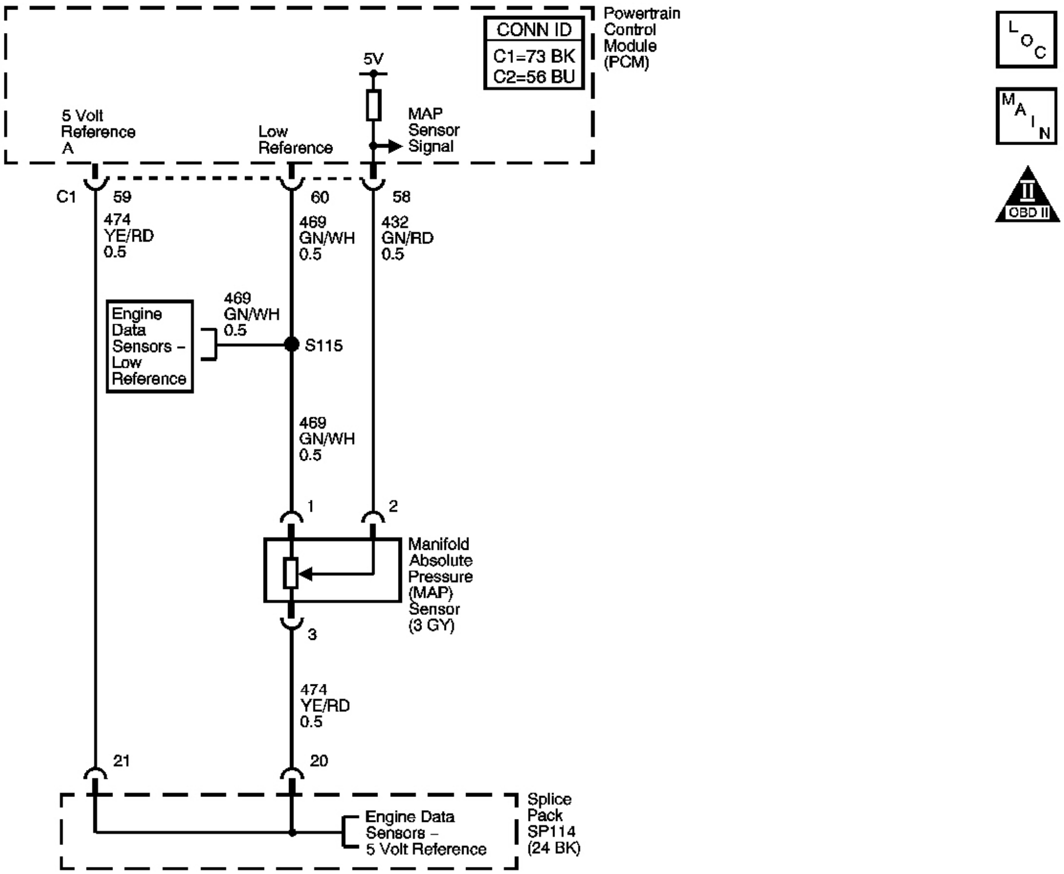


Fig. 5: DTC P1128 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P1128 Manifold Absolute Pressure (MAP) Sensor Low Pressure diagnostic monitors the MAP sensor response to pressure changes in the intake manifold. The pressure changes occur based on engine load and the throttle valve opening. The MAP sensor has the following circuits:

- A 5-volt reference circuit
- A low reference circuit

- A signal circuit

The powertrain control module (PCM) supplies 5 volts to the MAP sensor on the 5 volt reference circuit. The PCM also provides a ground on the low reference circuit. The PCM receives a low voltage on the signal circuit when manifold vacuum is high at idle or deceleration. The PCM receives a high voltage when manifold vacuum is low at wide open throttle (WOT) or when the ignition is ON and the engine is OFF. If the MAP sensor output is less than the expected value, a DTC P1128 can set.

The following table illustrates the difference between MAP kPa, signal voltage and engine vacuum.

DTC P1128 Circuit

Engine Condition	MAP kPa	MAP Signal Voltage	Manifold Vacuum
Idle	Low	Low	High
Deceleration	Low	Low	High
Ignition ON, Engine OFF	High	High	Zero
Wide-Open Throttle	High	High	Low

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P1128 Manifold Absolute Pressure (MAP) Sensor Low Pressure

Conditions for Running the DTC

- DTC P0107, P0108, P0117, P0118, P0122, P0123, P0171, P0172, P0174, P0175, P0201-P0206, P0222, P0223, P0300-P0306, P0335, P0401, P0403, P0404, P0443, P0496, P0501, P0506, P0507, P1129, P2100, P2101, P2108, P2122, P2123, P2127, P2128, P2135, P2138, P2176, P2227, P2228, P2229, P2413, P2646, P2647, P2648, P2649, and U0107 are not set.
- The engine speed is between 1,100-6,300 RPM.
- The engine coolant temperature is at least 69°C (156°F).
- The vehicle speed is 24 km/h (15 mph) or more.
- The throttle position (TP) sensor angle is 20 percent when the engine speed is 1,000 RPM.
- The throttle position (TP) sensor angle is at least 33 percent when the engine speed is 3,000 RPM.
- DTC P1128 runs once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

Condition 1:

- The MAP sensor output is 54 kPa or less when the barometric pressure is 104 kPa.
- The above condition is present for at least 2 seconds.

Condition 2:

- The MAP sensor output is 36 kPa or less when the barometric pressure is 61 kPa.
- The above condition is present for at least 2 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) after 2 consecutive ignition cycles in which the diagnostic runs with the fault active.
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Freeze Frame buffer.
- The PCM enters the Fail Safe Function and uses default MAP values based on the throttle position. The engine operates with the fuel control system in OPEN LOOP and the fuel cutoff is lowered to 3,000 RPM.

Conditions for Clearing the MIL/DTC

- The MIL turns OFF after 3 consecutively passing trips without a fault present.
- A history DTC clears after 40 consecutive warm-up cycles without a fault.
- Perform the scan tool Clear DTC Information function.

Diagnostic Aids

Inspect for a restriction or blockage in the vacuum passage to the MAP sensor orifice.

An intermittent malfunction may be caused by a fault in the MAP sensor circuit. Inspect the wiring harness and the components for an intermittent condition. Refer to **Intermittent Conditions** .

If the DTC P1128 cannot be duplicated, the information included in the Freeze Frame data can be useful in determining the vehicle operating conditions when the DTC was first set.

Test Description

The numbers below refer to the step numbers in the diagnostic table:

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool, if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

5: This step checks for the correct reference circuit voltage. The scan tool display of MAP sensor voltage will indicate more than 5 volts with an open in the sensor input circuit. This is caused by the scan tool software and should be considered normal.

6: This step checks the integrity of the MAP sensor signal circuit.

11: After replacing the PCM, a new minimum throttle position and idle speed must also be established.

DTC P1128 Circuit

Step	Action	Values	Yes	No

Connector End View Reference:Powertrain Control Module (PCM) Connector End Views or **Engine Controls Connector End Views**

1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Is there a DTC P0641 also set?	-	Go to **DTC P0641**	Go to **Step 3**
3	1. Turn ON the ignition, with the engine OFF. 2. Select the MAP sensor parameter on the scan tool. Is the MAP sensor display at or below the specified value?	0.23 V	Go to **Step 5**	Go to **Step 4**
4	1. Turn OFF the ignition. 2. Start the engine. 3. Operate the vehicle within the Freeze Frame conditions as noted. 4. Observe the MAP sensor voltage on the scan tool. Did a DTC P1128 set or did the MAP sensor voltage go below the specified value?	0.23 V	Go to **Step 5**	Go to Diagnostic Aids
5	1. Turn OFF the ignition. 2. Disconnect the MAP sensor electrical connector. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the 5 volt reference circuit to ground, harness side with a DMM. Is the voltage near the specified value?	5.0 V	Go to **Step 6**	Go to **Step 8**
6	1. Turn OFF the ignition. 2. Jumper the 5 volt reference circuit of the MAP sensor to the MAP sensor signal circuit. 3. Turn ON the ignition, with the engine OFF. 4. Observe the MAP sensor voltage on the scan tool. Is the scan tool voltage near the specified value?	5.0 V	Go to **Step 7**	Go to **Step 9**
7	Replace the MAP sensor. Refer to **Manifold Absolute Pressure (MAP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-

8	1. Check for an open in the 5 volt reference circuit between the PCM and the MAP sensor. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
9	1. Check for an open in the signal circuit between the PCM and the MAP sensor. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 10**
10	1. Inspect the PCM and the MAP sensor electrical connectors for faulty terminal contact. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems. 2. Repair as necessary. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
11	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Use the scan tool in order to clear the DTCs. 2. Turn the ignition OFF for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC or until the DTC P1128 diagnostic has passed. Does the DTC run and pass?	-	Go to **Step 13**	Go to **Step 2**
13	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P1129

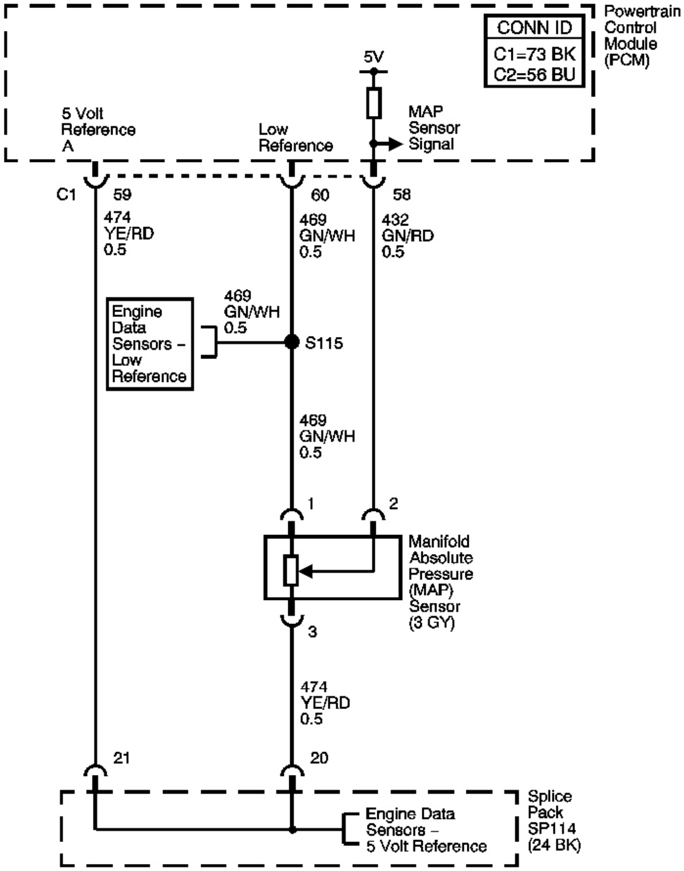


Fig. 6: DTC P1129 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P1129 Manifold Absolute Pressure (MAP) Sensor High Pressure diagnostic monitors the accuracy of the MAP sensor output. The pressure changes occur based on engine load and the throttle valve opening. The MAP sensor has the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The powertrain control module (PCM) supplies 5 volts to the MAP sensor on the 5 volt reference circuit. The PCM also provides a ground on the low reference circuit. The PCM receives a low voltage on the signal circuit when manifold vacuum is high at idle or deceleration. The PCM receives a high voltage when manifold vacuum is low at wide open throttle (WOT) or when the ignition is ON and the engine is OFF. If the MAP sensor output is more than the expected value, a DTC P1129 can set.

The following table illustrates the difference between MAP kPa, signal voltage and engine vacuum.

DTC P1129 Circuit

Engine Condition	MAP kPa	MAP Signal Voltage	Manifold Vacuum
Idle	Low	Low	High
Deceleration	Low	Low	High
Ignition ON, Engine OFF	High	High	Zero
Wide-Open Throttle	High	High	Low

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P1129 Manifold Absolute Pressure (MAP) Sensor High Pressure

Conditions for Running the DTC

- DTC P0107, P0108, P0117, P0118, P0122, P0123, P0171, P0172, P0174, P0175, P0201-P0206, P0222, P0223, P0300-P0306, P0335, P0401, P0403, P0404, P0443, P0496, P0501, P0506, P0507, P1128, P2100, P2101, P2108, P2122, P2123, P2127, P2128, P2135, P2138, P2176, P2227, P2228, P2229, P2413, P26046, P2647, P2648, P2649, and U0107 are not set.
- The engine speed is between 1,100-6,300 RPM.
- The throttle position (TP) sensor angle is zero percent.
- The engine coolant temperature is at least 69°C (156°F).
- The vehicle speed is 24 km/h (15 mph) or more.
- DTC P1129 runs once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

During deceleration the MAP sensor signal is 37 kPa or more for at least 2 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) after 2 consecutive ignition cycles in which the diagnostic runs with the fault active.
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Freeze Frame buffer.
- The PCM enters the Fail Safe Function and uses default MAP values based on the throttle position. The engine operates with the fuel control system in OPEN LOOP and the fuel cutoff is lowered to 3,000 RPM.

Conditions for Clearing the MIL/DTC

- The MIL turns OFF after 3 consecutively passing trips without a fault present.

- A history DTC clears after 40 consecutive warm-up cycles without a fault.
- Perform the scan tool Clear DTC Information function.

Diagnostic Aids

Inspect for the following conditions:

- Inspect for an exhaust gas recirculation (EGR) valve that is stuck open.
- Inspect for a restricted exhaust system. Refer to **Restricted Exhaust** in Engine Exhaust.

An intermittent malfunction may be caused by a fault in the MAP sensor circuit. Inspect the wiring harness and the components for an intermittent condition. Refer to **Intermittent Conditions** .

If the DTC P1129 cannot be duplicated, the information included in the Freeze Frame data can be useful in determining the vehicle operating conditions when the DTC was first set.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool, if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

4: This step checks for a faulty vacuum supply to the MAP sensor. The scan tool will indicate higher than normal MAP sensor voltage, if the manifold vacuum signal does not reach the MAP sensor vacuum port.

10: After replacing the PCM, a new minimum throttle position and idle speed must also be established.

DTC P1129 Circuit

Step	Action	Value (s)	Yes	No
Connector End View Reference:Powertrain Control Module (PCM) Connector End Views or **Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Install a scan tool. 3. Select the MAP sensor parameter on the scan tool. Is the MAP sensor voltage equal to or more than the specified value?	2.7 V	Go to **Step 4**	Go to **Step 3**
	1. Turn ON the ignition, with the engine OFF.			

3	2. Perform the scan tool Clear DTC Information function. 3. Operate the vehicle within the Freeze Frame conditions as noted. 4. Observe the MAP sensor voltage on the scan tool. Did a DTC P1129 set or was the MAP sensor voltage always more than the specified value?	2.7 V	Go to **Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Inspect for the following conditions: • A vacuum leak at the MAP sensor • A plugged MAP sensor vacuum port • A blockage in the intake manifold vacuum passage to the MAP sensor 3. Repair as necessary. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 5**
5	1. Turn OFF the ignition. 2. Disconnect the MAP sensor electrical connector. 3. Connect a test lamp to the harness side of the MAP sensor ground circuit and B+. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	-	Go to **Step 6**	Go to **Step 7**
6	1. Connect a DMM to the harness side of the MAP sensor signal circuit and ground. 2. Turn ON the ignition, with the engine OFF. 3. Measure the DC voltage with the DMM. Is the voltage near the specified value?	0.0 V	Go to **Step 9**	Go to **Step 8**
7	Repair the open circuit or poor connection in the MAP sensor ground circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 11**	-
	1. Check for a short to voltage in the MAP			

8	sensor signal circuit. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 10**
9	Replace the MAP sensor. Refer to **Manifold Absolute Pressure (MAP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 11**	-
10	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 11**	-
11	1. Use the scan tool in order to clear the DTCs. 2. Turn the ignition OFF for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC or until the DTC P1129 diagnostic has passed. Does the DTC run and pass?	-	Go to **Step 12**	Go to **Step 2**
12	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2100

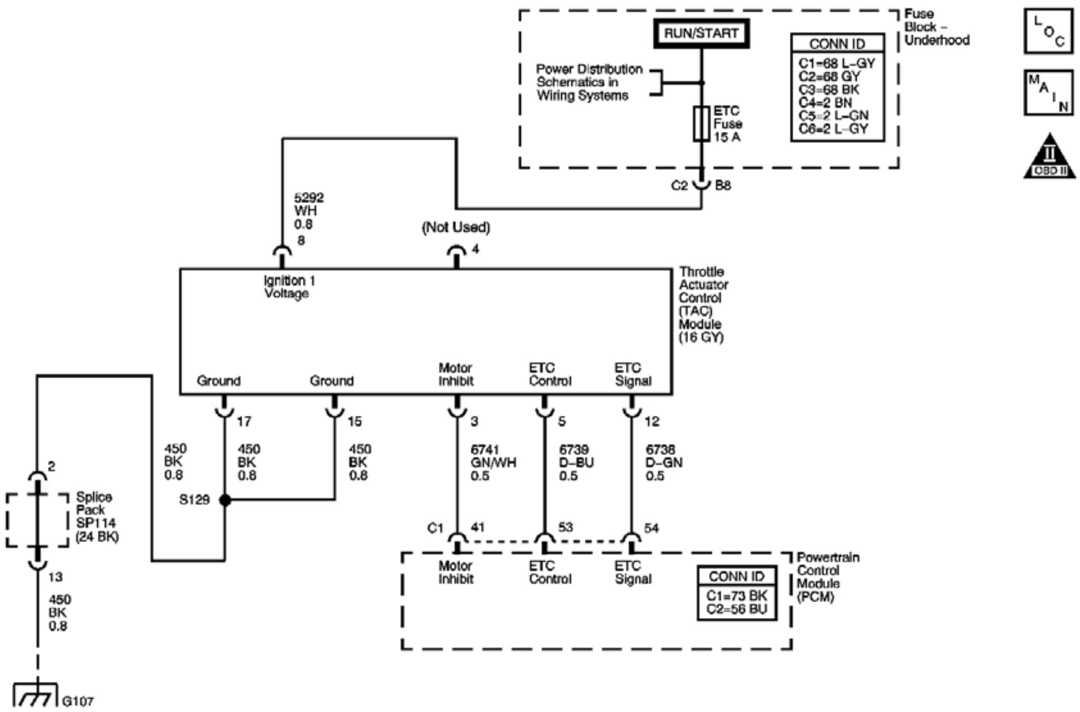


Fig. 7: DTC P2100 Circuit
Courtesy of GENERAL MOTORS CORP.

Description

This DTC monitors the operation of the throttle actuator control (TAC) motor and control circuitry. The TAC motor is the functional center or the TAC system and in an integral part of the TAC module. The powertrain control module (PCM) receives accelerator pedal position (APP) sensor information and calculates the desired throttle position. The PCM sends this desired throttle position or target value to the TAC module. The TAC module achieves the desired throttle position by commanding the throttle control motor to position the throttle valve at the target value. The TAC module then compares the TP sensor 1 value to the desired value. If necessary, the throttle control motor is moved slightly in order to obtain the exact target value position. The TAC module is not serviced separately and must be replaced with the throttle body assembly. For additional information on the operation of the TAC system refer to **Throttle Actuator Control (TAC) System Description** .

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P2100 Throttle Actuator Control (TAC) Motor Control Circuit

Conditions for Running the DTC

- DTCs P0122, P0123, P0222, P0223, P0641, P0651, P2101, P2108, P2122, P2123, P2127, P2128, P2135, P2138, P2176, or U0107 are not set.
- The ignition is ON.
- DTC P2100 runs continuously once the above conditions are met.

Conditions for Setting the DTC

The throttle actuator control motor output current is more than 8 amps for less than 1 second.

Or

The temperature of the throttle actuator control motor driver circuit is more than 175°C (347°F) for less than 1 second.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Use the **J-35616** Connector Test Adapter Kit for any test that requires probing the PCM harness connector or a component harness connector.
- Inspect for a condition in which the throttle valve may have been held open. For example, ice may have formed in the throttle bore causing the throttle valve not to close. Observe the Freeze Frame/Failure Records.
- The throttle valve is spring loaded to a slightly open position. The throttle valve should be open approximately 11-15 percent. This is referred to as the rest position.
- The throttle valve should not be completely closed or open any more than a specified amount.
- The throttle valve should move open and to the closed position without binding under the normal spring pressure.
- The throttle should NOT be free to move open or closed WITHOUT spring pressure.
- The scan tool has the ability to operate the throttle control system using the throttle actuator control located in the throttle control menu. This function operates the throttle valve through the entire range in

order to determine if the throttle actuator control (TAC) system operates correctly. Additional DTCs may set using this function. Refer to **Scan Tool Output Controls** for more information.

- For an intermittent condition, refer to **Intermittent Conditions** .

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step determines if the condition exists.

DTC P2100 Circuit

Step	Action	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Move the accelerator pedal from the rest position to the wide open position a couple of times. 6. Observe the DTC Information with a scan tool. Did the DTC fail this ignition?	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition cycle?	Go to **Step 4**	Go to Diagnostic Aids
4	Is DTC U0107 also set?	Go to **DTC U0107**	Go to **Step 5**
5	Test for an intermittent and for a poor connection at the throttle body harness connector and at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 7**	Go to **Step 6**

6	1. Replace the throttle body. Refer to **Throttle Body Assembly Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	Go to **Step 7**	-
7	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 8**
8	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2101

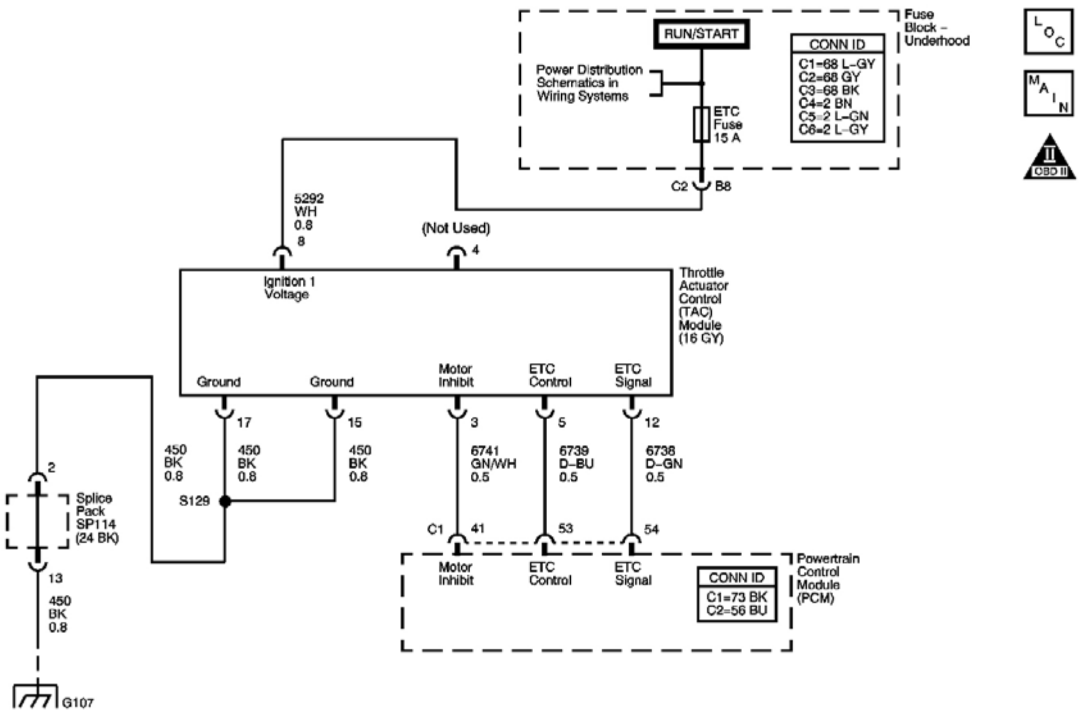


Fig. 8: DTC P2101 Circuit

Courtesy of GENERAL MOTORS CORP.

Description

This DTC monitors the ability of the TAC system to successfully position the throttle valve at the desired throttle position. The powertrain control module (PCM) receives accelerator pedal position (APP) sensor information and calculates the desired throttle position. The PCM sends this desired throttle position or target value to the TAC module. The TAC module achieves the desired throttle position by commanding the throttle control motor to position the throttle valve at the target value. The TAC module then compares the TP sensor 1 value to the target value. If necessary, the throttle control motor is moved slightly in order to obtain the exact target value position. The TAC motor and TP sensors are integral parts of the TAC module and are not serviced separately. The TAC module is not serviceable and must be replaced with the throttle body assembly. For additional information on the operation of the TAC system refer to **Throttle Actuator Control (TAC) System Description** .

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P2101 Throttle Actuator Position Performance

Conditions for Running the DTC

- DTCs P0122, P0123, P0222, P0223, P0641, P0651, P2100, P2108, P2122, P2123, P2127, P2128, P2135, P2138, P2176, or U0107 are not set.
- The ignition is ON.
- The battery voltage is more than 7.0 volts.
- DTC P2101 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The difference between the desired throttle valve position and the actual throttle valve position is more than 5 degrees.
- The above conditions is present for less than 1 second.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.

- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Use the **J-35616** Connector Test Adapter Kit for any test that requires probing the PCM harness connector or a component harness connector.
- Inspect for a condition in which the throttle valve may have been held open. For example, ice may have formed in the throttle bore causing the throttle valve not to close. Observe the Freeze Frame/Failure Records.
- The throttle valve is spring loaded to a slightly open position. The throttle valve should be open approximately 11-15 percent. This is referred to as the rest position.
- The throttle valve should not be completely closed or open any more than a specified amount.
- The throttle valve should move open and to the closed position without binding under the normal spring pressure.
- The throttle should NOT be free to move open or closed WITHOUT spring pressure.
- The scan tool has the ability to operate the throttle control system using the throttle actuator control located in the throttle control menu. This function operates the throttle valve through the entire range in order to determine if the throttle actuator control (TAC) system operates correctly. Additional DTCs may set using this function. Refer to **Scan Tool Output Controls** for more information.
- For an intermittent condition, refer to **Intermittent Conditions** .

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step determines if the condition exists.

5: Coking on the throttle bore or valve may cause this DTC to set.

6: This step determines if the coking was the cause of the DTC.

DTC P2101 Circuit

Step	Action	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine.		

	5. Move the accelerator pedal from the rest position to the wide open position a couple of times. 6. Observe the DTC Information with a scan tool. Did the DTC fail this ignition?	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition cycle?	Go to **Step 4**	Go to Diagnostic Aids
4	Is DTC U0107 also set?	Go to **DTC U0107**	Go to **Step 5**
5	1. Turn OFF the ignition. 2. Disconnect the air cleaner resonator outlet duct from the throttle body. 3. Inspect the throttle body valve and bore for the following conditions: • For foreign accumulation in the throttle bore • For coking on the throttle valve • For coking on the throttle shaft Did you find a condition with the throttle body?	Go to **Step 6**	Go to **Step 7**
6	1. Clean the throttle body valve and bore. Refer to **Throttle Body Service** . 2. Turn ON the ignition, with the engine OFF. 3. Clear the DTCs with a scan tool. 4. Turn OFF the ignition for 30 seconds. 5. Start the engine. 6. Move the accelerator pedal from the rest position to the wide open position a couple of times. 7. Observe the DTC Information with a scan tool. Did the DTC fail this ignition?	Go to **Step 7**	Go to **Step 9**
7	Test for an intermittent and for a poor connection at the throttle body harness connector and at the PCM. Refer to **Testing for Intermittent Conditions and Poor**		

	Connections and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 8**
8	1. Replace the throttle body. Refer to **Throttle Body Assembly Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	Go to **Step 9**	-
9	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 10**
10	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2108

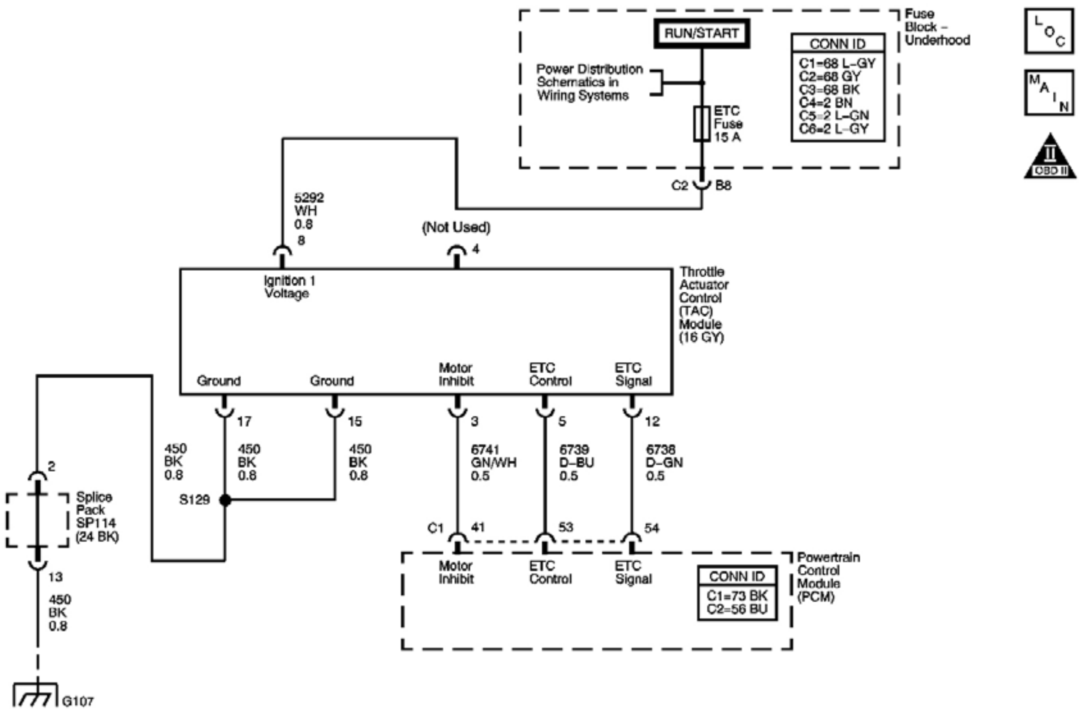


Fig. 9: DTC P2108 Circuit
Courtesy of GENERAL MOTORS CORP.

Description

This DTC detects numerous internal faults in the TAC module. The powertrain control module (PCM) receives accelerator pedal position (APP) sensor information and calculates the desired throttle position. The PCM sends this desired throttle position or target value to the TAC module. The TAC module achieves the desired throttle position by commanding the throttle control motor to position the throttle valve at the target value. The TAC module then compares the TP sensor 1 value to the target value. If necessary, the throttle control motor is moved slightly in order to obtain the exact target value position. The TAC motor and TP sensors are integral parts of the TAC module and are not serviced separately. The TAC module is not serviceable and must be replaced with the throttle body assembly. For additional information on the operation of the TAC system refer to **Throttle Actuator Control (TAC) System Description** .

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P2108 Throttle Actuator Control (TAC) Module Performance

Conditions for Running the DTC

- DTCs P0122, P0123, P0222, P0223, P0641, P0651, P2100, P2122, P2123, P2127, P2128, P2135, P2138,

P2176, or U0107 are not set.
- The ignition is ON.
- The battery voltage is more than 8.0 volts.
- DTC P2108 runs continuously once the above conditions are met.

Conditions for Setting the DTC

Any of the following conditions are detected:

- The TAC module determines that the read only memory (ROM) data is incorrect.
- The TAC module determines that the random access memory (RAM) data is incorrect.
- The PCM determines that the serial data received from the TAC module is not rational.
- The voltage of the A/D converter located inside the TAC module is not within the specified value.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Use the **J-35616** Connector Test Adapter Kit for any test that requires probing the PCM harness connector or a component harness connector.
- Inspect for a condition in which the throttle valve may have been held open. For example, ice may have formed in the throttle bore causing the throttle valve not to close. Observe the Freeze Frame/Failure Records.
- The throttle valve is spring loaded to a slightly open position. The throttle valve should be open approximately 11-15 percent. This is referred to as the rest position.
- The throttle valve should not be completely closed or open any more than a specified amount.
- The throttle valve should move open and to the closed position without binding under the normal spring pressure.
- The throttle should NOT be free to move open or closed WITHOUT spring pressure.
- The scan tool has the ability to operate the throttle control system using the throttle actuator control

located in the throttle control menu. This function operates the throttle valve through the entire range in order to determine if the throttle actuator control (TAC) system operates correctly. Additional DTCs may set using this function. Refer to **Scan Tool Output Controls** for more information.

- For an intermittent condition, refer to **Intermittent Conditions** .

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step determines if the condition exists.

DTC P2108 Circuit

<table>
<tr><th>Step</th><th>Action</th><th>Yes</th><th>No</th></tr>
<tr><td colspan="4">Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views</td></tr>
<tr><td>1</td><td>Did you perform the Diagnostic System Check-Engine Controls?</td><td>Go to Step 2</td><td>Go to Diagnostic System Check - Engine Controls</td></tr>
<tr><td>2</td><td>1. Turn ON the ignition, with the engine OFF.
2. Clear the DTCs with a scan tool.
3. Turn OFF the ignition for 30 seconds.
4. Start the engine.
5. Move the accelerator pedal from the rest position to the wide open position a couple of times.
6. Observe the DTC Information with a scan tool.

Did the DTC fail this ignition?</td><td>Go to Step 4</td><td>Go to Step 3</td></tr>
<tr><td>3</td><td>1. Observe the Freeze Frame/Failure records data for this DTC.
2. Turn OFF the ignition for 30 seconds.
3. Start the engine.
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.

Did the DTC fail this ignition cycle?</td><td>Go to Step 4</td><td>Go to Diagnostic Aids</td></tr>
<tr><td>4</td><td>Is DTC U0107 also set?</td><td>Go to DTC U0107</td><td>Go to Step 5</td></tr>
<tr><td>5</td><td>Test for an intermittent and for a poor connection at the throttle body harness connector and at the PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.</td><td></td><td></td></tr>
</table>

	Did you find and correct the condition?	Go to **Step 7**	Go to **Step 6**
6	1. Replace the throttle body. Refer to **Throttle Body Assembly Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	Go to **Step 7**	-
7	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 8**
8	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2111

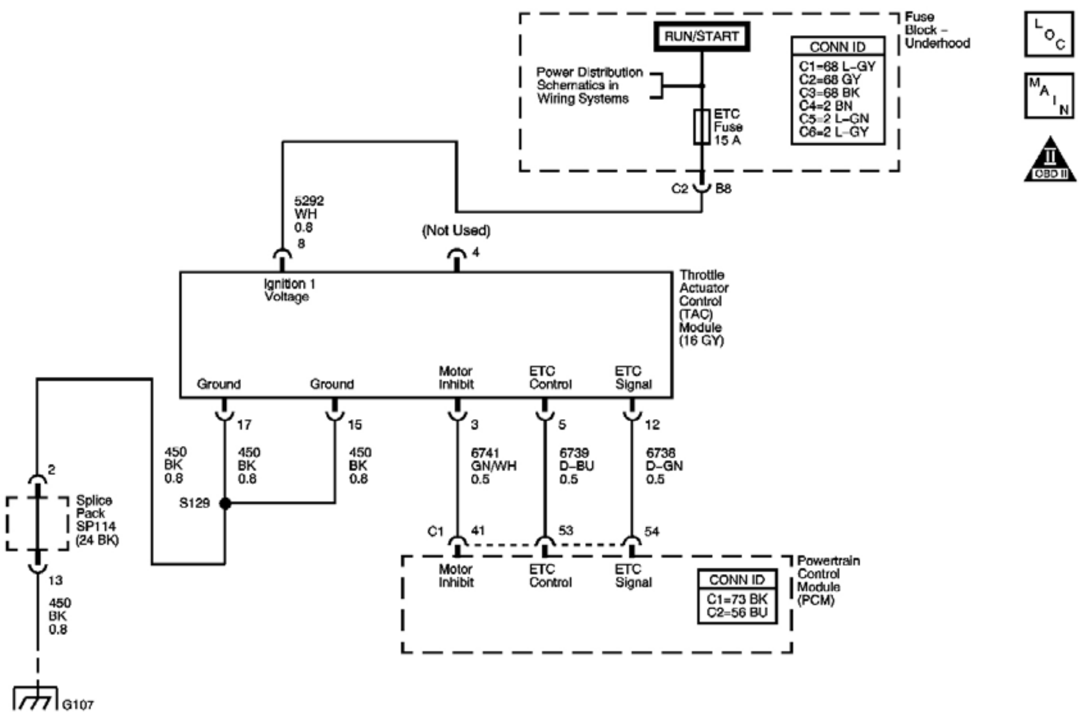


Fig. 10: DTC P2111 Circuit
Courtesy of GENERAL MOTORS CORP.

Description

This DTC detects a faulty throttle valve position. The throttle valve in the throttle body utilizes a throttle return spring to assist in positioning the throttle valve at a resting or default position. The powertrain control module (PCM) uses driver input from the accelerator pedal position (APP) sensor in order to calculate the desired throttle position. The PCM sends the desired throttle position or target value to the TAC module. The TAC module achieves the desired throttle position by commanding the throttle control motor to position the throttle valve at the target value. The TAC module then compares the TP sensor 1 value to the target value. If necessary, the throttle control motor is moved slightly in order to obtain the exact target value position. If the TP sensor indicates that the throttle valve has failed to reach the default position a DTC P2111 sets. For additional information on the operation of the TAC system refer to **Throttle Actuator Control (TAC) System Description** .

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P2111 Throttle Actuator Control (TAC) Throttle Valve Stuck Open

Conditions for Running the DTC

- DTCs P0117, P0118, P0122, P0123, P0222, P0223, P0641, P0651, P2100, P2101, P2108, P2122, P2123, P2127, P2128, P2135, P2138, P2176, or U0107 are not set.
- The engine coolant temperature (ECT) is more than 70°C (158°F).
- The ignition is ON, with the engine OFF.
- DTC P2111 runs once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

The throttle position (TP) is not between 4.9-7.9 degrees when the throttle valve is expected to be at the default position.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.

- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Use the **J-35616** Connector Test Adapter Kit for any test that requires probing the PCM harness connector or a component harness connector.
- Inspect for a condition in which the throttle valve may have been held open. For example, ice may have formed in the throttle bore causing the throttle valve not to close. Observe the Freeze Frame/Failure Records.
- The throttle valve is spring loaded to a slightly open position. The throttle valve should be open approximately 11-15 percent. This is referred to as the rest position.
- The throttle valve should not be completely closed or open any more than a specified amount.
- The throttle valve should move open and to the closed position without binding under the normal spring pressure.
- The throttle should NOT be free to move open or closed WITHOUT spring pressure.
- The scan tool has the ability to operate the throttle control system using the throttle actuator control located in the throttle control menu. This function operates the throttle valve through the entire range in order to determine if the throttle actuator control (TAC) system operates correctly. Additional DTCs may set using this function. Refer to **Scan Tool Output Controls** for more information.
- For an intermittent condition, refer to **Intermittent Conditions** .

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step determines if the condition exists.

5: Coking on the throttle bore or valve may cause this DTC to set.

6: This step determines if the coking was the cause of the DTC.

DTC P2111 Circuit

Step	Action	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine.		

	5. Move the accelerator pedal from the rest position to the wide open position a couple of times. 6. Observe the DTC Information with a scan tool. Did the DTC fail this ignition?	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition cycle?	Go to **Step 4**	Go to Diagnostic Aids
4	Is DTC U0107 also set?	Go to **DTC U0107**	Go to **Step 5**
5	1. Turn OFF the ignition. 2. Disconnect the air cleaner resonator outlet duct from the throttle body. 3. Inspect the throttle body valve and bore for the following conditions: • For foreign accumulation in the throttle bore • For coking on the throttle valve • For coking on the throttle shaft Did you find a condition with the throttle body?	Go to **Step 6**	Go to **Step 7**
6	1. Clean the throttle body valve and bore. Refer to **Throttle Body Service** . 2. Turn ON the ignition, with the engine OFF. 3. Clear the DTCs with a scan tool. 4. Turn OFF the ignition for 30 seconds. 5. Start the engine. 6. Move the accelerator pedal from the rest position to the wide open position a couple of times. 7. Observe the DTC Information with a scan tool. Did the DTC fail this ignition?	Go to **Step 7**	Go to **Step 9**
7	Test for an intermittent and for a poor connection at the throttle body harness connector and at the PCM. Refer to **Testing for Intermittent Conditions and Poor**		

	Connections and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 8**
8	1. Replace the throttle body. Refer to **Throttle Body Assembly Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	Go to **Step 9**	-
9	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 10**
10	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2112

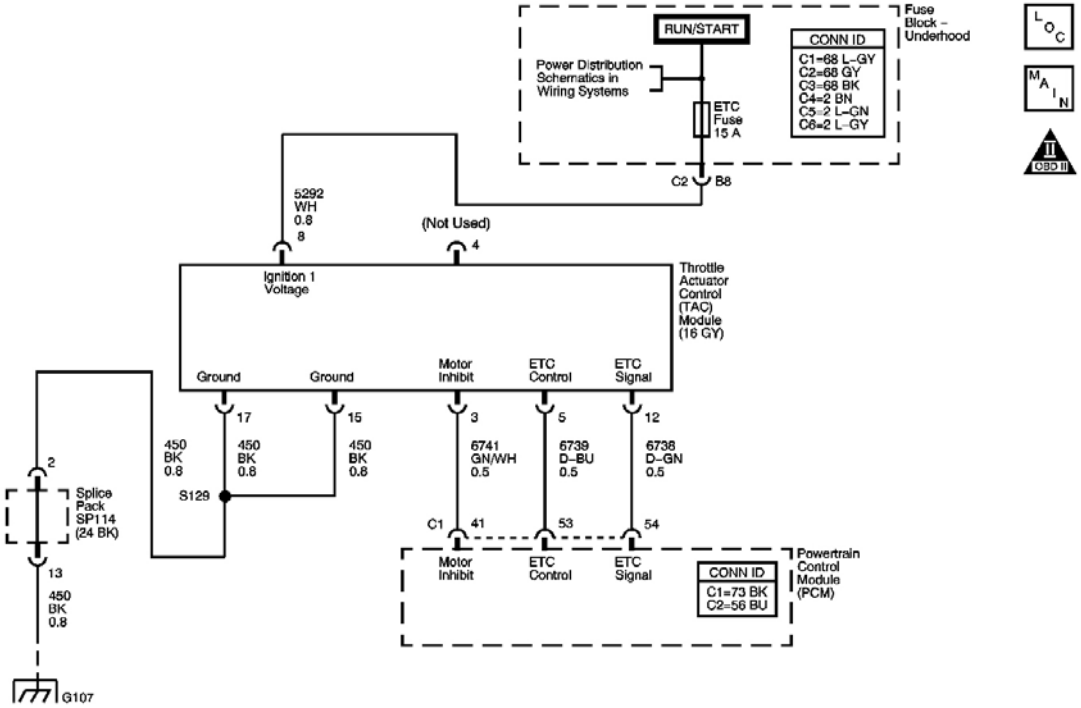


Fig. 11: DTC P2112 Circuit
Courtesy of GENERAL MOTORS CORP.

Description

This DTC detects a faulty throttle valve position. The throttle valve in the throttle body utilizes a throttle return spring to assist in positioning the throttle valve at a resting or default position. The powertrain control module (PCM) uses driver input from the accelerator pedal position (APP) sensor in order to calculate the desired throttle position. The PCM sends the desired throttle position or target value to the TAC module. The TAC module achieves the desired throttle position by commanding the throttle control motor to position the throttle valve at the target value. The TAC module then compares the TP sensor 1 value to the target value. If necessary, the throttle control motor is moved slightly in order to obtain the exact target value position. If the TP sensor indicates that the throttle valve has failed to reach the default position a DTC P2112 sets. For additional information on the operation of the TAC system refer to **Throttle Actuator Control (TAC) System Description** .

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P2112 Throttle Actuator Control (TAC) Throttle Valve Stuck Closed

Conditions for Running the DTC

- DTCs P0117, P0118, P0122, P0123, P0222, P0223, P0641, P0651, P2100, P2101, P2108, P2122, P2123, P2127, P2128, P2135, P2138, P2176, or U0107 are not set.
- The engine coolant temperature (ECT) is more than 70°C (158°F).
- The ignition is ON, with the engine OFF.
- DTC P2112 runs once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

The throttle position (TP) is not between 4.9-7.9 degrees or less when the throttle valve is expected to be at the default position.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Use the **J-35616** Connector Test Adapter Kit for any test that requires probing the PCM harness connector or a component harness connector.
- Inspect for a condition in which the throttle valve may have been held open. For example, ice may have formed in the throttle bore causing the throttle valve not to close. Observe the Freeze Frame/Failure Records.
- The throttle valve is spring loaded to a slightly open position. The throttle valve should be open approximately 11-15 percent. This is referred to as the rest position.
- The throttle valve should not be completely closed or open any more than a specified amount.
- The throttle valve should move open and to the closed position without binding under the normal spring pressure.
- The throttle should NOT be free to move open or closed WITHOUT spring pressure.
- The scan tool has the ability to operate the throttle control system using the throttle actuator control located in the throttle control menu. This function operates the throttle valve through the entire range in order to determine if the throttle actuator control (TAC) system operates correctly. Additional DTCs may set using this function. Refer to **Scan Tool Output Controls** for more information.

- For an intermittent condition, refer to **Intermittent Conditions** .

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step determines if the condition exists.
5: Coking on the throttle bore or valve may cause this DTC to set.
6: This step determines if the coking was the cause of the DTC.

DTC P2112 Circuit

Step	Action	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Move the accelerator pedal from the rest position to the wide open position a couple of times. 6. Observe the DTC Information with a scan tool. Did the DTC fail this ignition?	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition cycle?	Go to **Step 4**	Go to Diagnostic Aids
4	Is DTC U0107 also set?	Go to **DTC U0107**	Go to **Step 5**
	1. Turn OFF the ignition. 2. Disconnect the air cleaner resonator outlet duct from the throttle body. 3. Inspect the throttle body valve and bore for the		

5	following conditions: • For an accumulation of foreign material deposits in the throttle bore • For coking on the throttle valve • For coking on the throttle shaft Did you find a condition with the throttle body?	Go to **Step 6**	Go to **Step 7**
6	1. Clean the throttle body valve and bore. Refer to **Throttle Body Service** . 2. Turn ON the ignition, with the engine OFF. 3. Clear the DTCs with a scan tool. 4. Turn OFF the ignition for 30 seconds. 5. Start the engine. 6. Move the accelerator pedal from the rest position to the wide open position a couple of times. 7. Observe the DTC Information with a scan tool. Did the DTC fail this ignition?	Go to **Step 7**	Go to **Step 9**
7	Test for an intermittent and for a poor connection at the throttle body harness connector and at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 8**
8	1. Replace the throttle body. Refer to **Throttle Body Assembly Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	Go to **Step 9**	-
9	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 10**
10	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2122

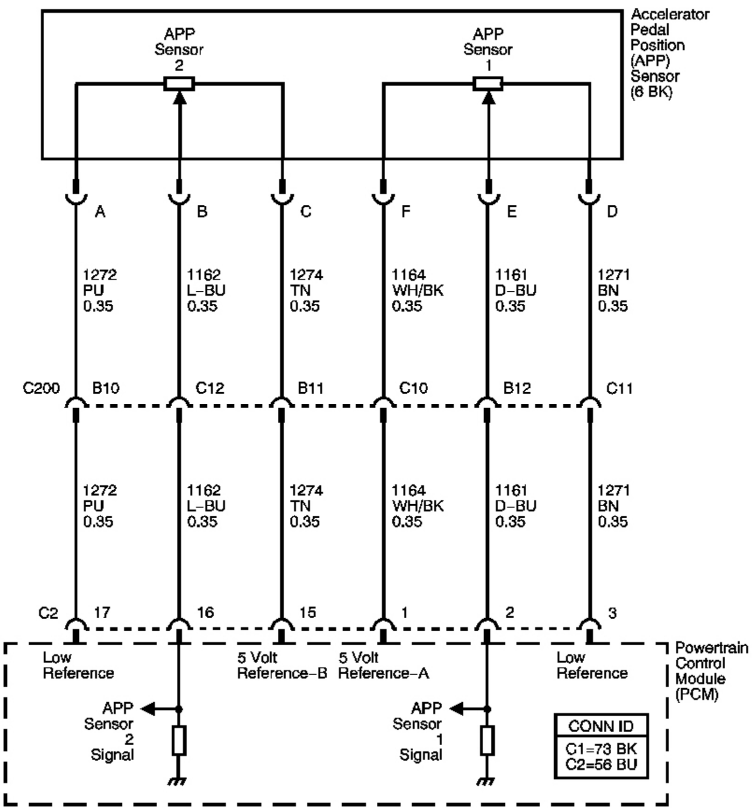


Fig. 12: DTC P2122 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The accelerator pedal assembly contains two accelerator pedal position (APP) sensors. The APP sensors are mounted in the pedal assembly and are not serviceable. The APP sensors provide a signal voltage that changes relative to the position of the accelerator pedal. The powertrain control module (PCM) supplies a separate 5-volt reference and low reference circuit for each of the APP sensors.

The APP sensor 1 signal voltage increases as the pedal is depressed, from approximately 1.0 volt at rest to above 4 volts when fully depressed. The APP sensor 2 signal voltage increases as the pedal is depressed, from approximately 0.5 volts at rest to more than 2 volts with the accelerator pedal fully depressed.

If the PCM detects that the APP sensor 1 signal voltage is too low, this DTC sets.

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P2122 Accelerator Pedal Position (APP) Sensor 1 Circuit Low Voltage

Conditions for Running the DTC

- The ignition is ON.
- DTC P2122 runs continuously.

Conditions for Setting the DTC

The APP sensor 1 voltage is less than 0.20 volts for less than 1 second.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

5: This step tests signal and 5-volt reference circuits.

12: After replacing the PCM, a new minimum throttle position and idle speed must be established.

DTC P2122 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Is DTC P0641 also set?	-	Go to **DTC P0641**	Go to **Step 3**

3	1. Turn ON the ignition, with the engine OFF. 2. Observe the APP Sensor 1 parameter with a scan tool. Is the APP sensor 1 parameter less than the specified value?	0.15 V	Go to **Step 5**	Go to **Step 4**
4	1. Observe the Freeze Frame/Failure Records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 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. Did the DTC fail this ignition?	-	Go to **Step 5**	Go to **Intermittent Conditions**
5	1. Connect a 3-amp fused jumper wire between the 5-volt reference circuit of the APP sensor 1 and the sensor signal circuit. 2. Observe the APP sensor 1 parameter on the scan tool. Is the APP sensor 1 voltage within the specified range?	4.8-5.2 V	Go to **Step 9**	Go to **Step 6**
6	Connect a DMM between the 5-volt reference circuit of the APP sensor 1 and a good ground. Is the measured voltage within the specified range?	4.8-5.2 V	Go to **Step 7**	Go to **Step 8**
7	Test the APP sensor 1 signal circuit for the following conditions: • An open • A short to ground Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 10**
8	1. Test the 5-volt reference circuit of the APP sensor 1 for an open circuit. 2. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 10**

9	Test for an intermittent and for a poor connection at the APP sensor 1. Refer to **Testing for Intermittent Conditions and Poor ConnectionsConnector Repairs** and in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 11**
10	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
11	Replace the APP sensor 1. Refer to **Accelerator Pedal Position (APP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
12	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 13**	-
13	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 14**
14	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2123

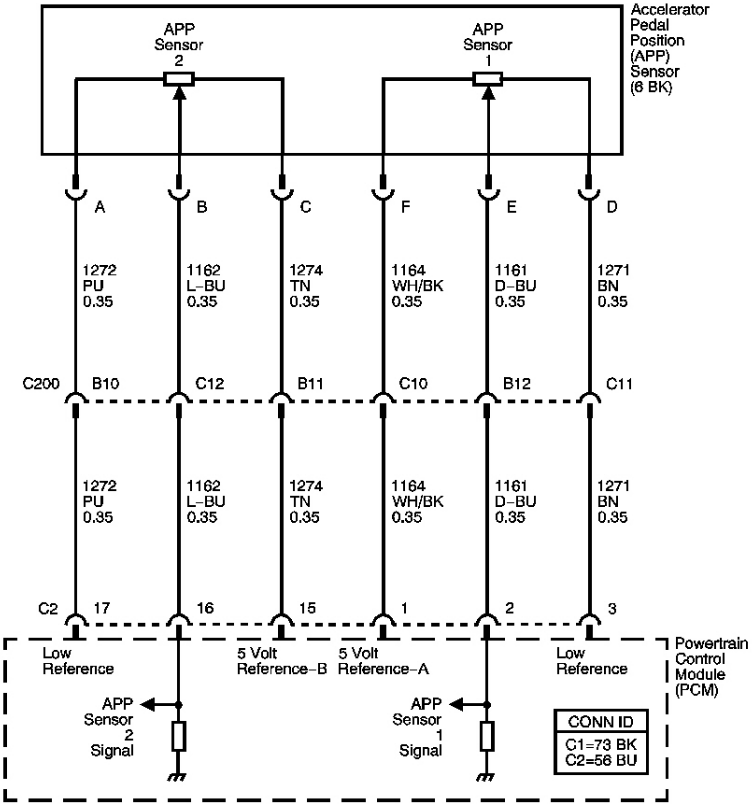


Fig. 13: DTC P2123 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The accelerator pedal assembly contains two accelerator pedal position (APP) sensors. The APP sensors are mounted in the pedal assembly and are not serviceable. The APP sensors provide a signal voltage that changes relative to the position of the accelerator pedal. The powertrain control module (PCM) supplies a separate 5-volt reference and low reference circuit for each of the APP sensors.

The APP sensor 1 signal voltage increases as the pedal is depressed, from approximately 1.0 volt at rest to above 4 volts when fully depressed. The APP sensor 2 signal voltage increases as the pedal is depressed, from approximately 0.5 volts at rest to more than 2 volts with the accelerator pedal fully depressed.

If the PCM detects that the APP 1 signal voltage is too high, this DTC sets.

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P2123 Accelerator Pedal Position (APP) Sensor 1 Circuit High Voltage

Conditions for Running the DTC

- The ignition is ON.
- DTC P2123 runs continuously.

Conditions for Setting the DTC

The APP sensor 1 voltage is more than 4.85 volts for less than 1 second.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

4: This step tests for a short to voltage on the APP sensor 1 signal circuit. With the sensor disconnected, the signal circuit should be near zero volts.

11: After replacing the PCM a new minimum throttle position and idle speed must be established.

DTC P2123 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	Is a DTC P0641also set?		Go to **DTC**	

2		-	**P0641**	Go to **Step 3**
3	1. Turn ON the ignition, with the engine OFF. 2. Observe the APP Sensor 1 parameter with a scan tool. Is the APP sensor 1 parameter more than the specified value?	4.88 V	Go to **Step 5**	Go to **Step 4**
4	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 90 seconds. 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. Did the DTC fail this ignition?	-	Go to **Step 5**	Go to **Intermittent Conditions**
5	1. Disconnect the APP sensor. 2. Turn ON the ignition with the engine OFF. 3. Observe the APP sensor 1 parameter with a scan tool. Is the voltage more than the specified value?	0 V	Go to **Step 7**	Go to **Step 6**
6	1. Connect a test lamp between the low reference circuit of the APP sensor 1 and B+. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	-	Go to **Step 10**	Go to **Step 8**
7	Test the signal circuit of the APP sensor 1 for short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
8	Test the low reference circuit of the APP sensor 1 for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
9	Test for an intermittent and for a poor connection at the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
	Replace the APP sensor 1. Refer to **Accelerator**			

10	**Pedal Position (APP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
11	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 13**
13	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2127

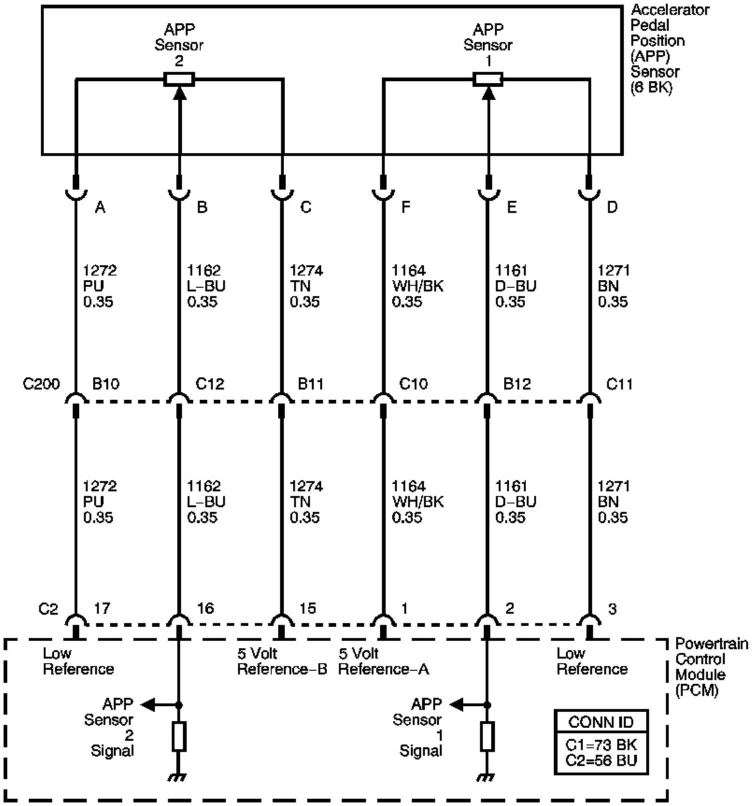


Fig. 14: DTC P2127 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The accelerator pedal assembly contains two accelerator pedal position (APP) sensors. The APP sensors are mounted in the pedal assembly and are not serviceable. The APP sensors provide a signal voltage that changes relative to the position of the accelerator pedal. The powertrain control module (PCM) supplies a separate 5-volt reference and low reference circuit for each of the APP sensors.

The APP sensor 1 signal voltage increases as the pedal is depressed, from approximately 1.0 volt at rest to above 4 volts when fully depressed. The APP sensor 2 signal voltage increases as the pedal is depressed, from approximately 0.5 volts at rest to more than 2 volts with the accelerator pedal fully depressed.

If the PCM detects that the APP sensor 2 signal voltage is too low, this DTC sets.

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P2127 Accelerator Pedal Position (APP) Sensor 2 Circuit Low Voltage

Conditions for Running the DTC

- The ignition is ON.
- DTC P2127 runs continuously.

Conditions for Setting the DTC

The APP sensor 2 voltage is less than 0.20 volts for less than 1 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

5: This step tests signal and 5-volt reference circuits.

12: After replacing the PCM, a new minimum throttle position and idle speed must be established.

DTC P2127 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Is DTC P0651 also set?	-	Go to **DTC P0651**	Go to **Step 3**
	1. Turn ON the ignition, with the engine OFF. 2. Observe the APP Sensor 2 parameter with a			

3	scan tool. Is the APP sensor 2 parameter less than the specified value?	0.15 V	Go to **Step 5**	Go to **Step 4**
4	1. Observe the Freeze Frame/Failure Records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 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. Did the DTC fail this ignition?	-	Go to **Step 5**	Go to **Intermittent Conditions**
5	1. Connect a 3-amp fused jumper wire between the 5-volt reference circuit of the APP sensor 2 and the sensor signal circuit. 2. Observe the APP sensor 2 parameter on the scan tool. Is the APP sensor 2 voltage within the specified range?	4.8-5.2 V	Go to **Step 9**	Go to **Step 6**
6	Connect a DMM between the 5-volt reference circuit of the APP sensor 2 and a good ground. Is the measured voltage within the specified range?	4.8-5.2 V	Go to **Step 7**	Go to **Step 8**
7	Test the APP sensor 2 signal circuit for the following conditions: • An open • A short to ground Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 10**
8	1. Test the 5-volt reference circuit of the APP sensor 2 for an open circuit. 2. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 10**
	Test for an intermittent and for a poor connection at the APP sensor 2. Refer to **Testing for Intermittent Conditions and Poor**			

9	**ConnectionsConnector Repairs** and in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 11**
10	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
11	Replace the APP sensor 2. Refer to **Accelerator Pedal Position (APP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
12	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 13**	-
13	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 14**
14	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2128

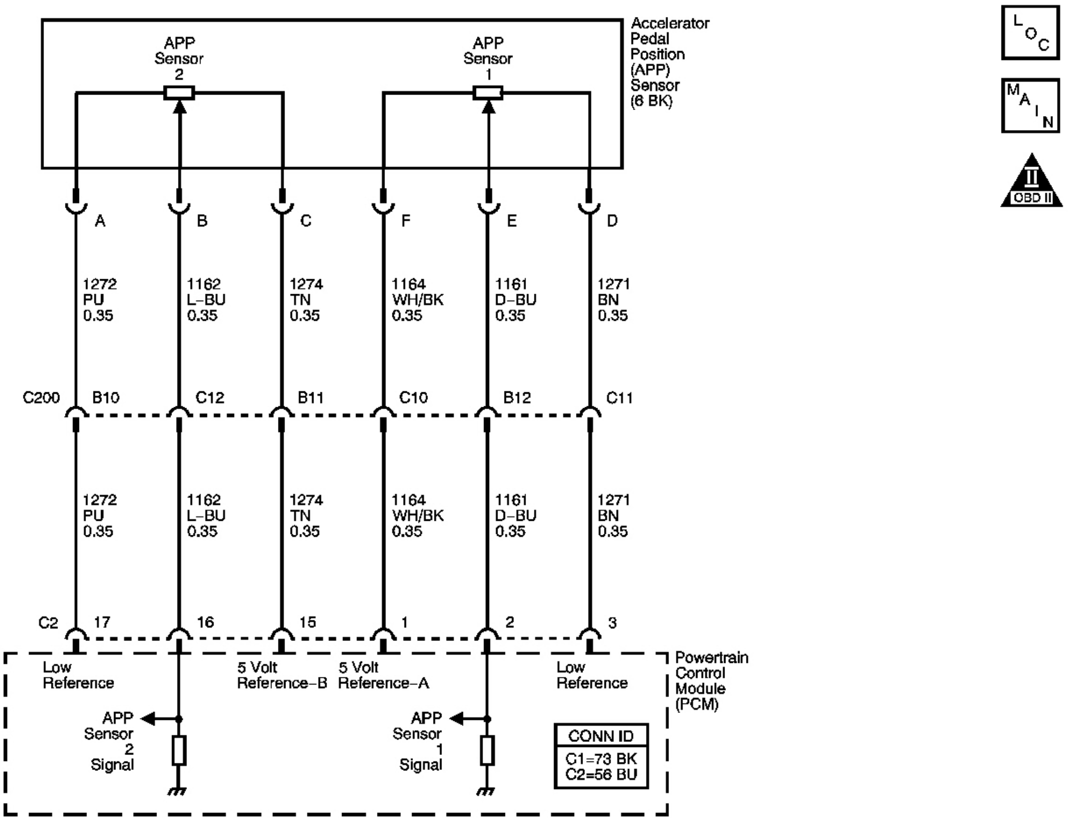


Fig. 15: DTC P2128 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The accelerator pedal assembly contains two accelerator pedal position (APP) sensors. The APP sensors are mounted in the pedal assembly and are not serviceable. The APP sensors provide a signal voltage that changes relative to the position of the accelerator pedal. The powertrain control module (PCM) supplies a separate 5-volt reference and low reference circuit for each of the APP sensors.

The APP sensor 1 signal voltage increases as the pedal is depressed, from approximately 1.0 volt at rest to above 4 volts when fully depressed. The APP sensor 2 signal voltage increases as the pedal is depressed, from approximately 0.5 volts at rest to more than 2 volts with the accelerator pedal fully depressed.

If the PCM detects that the APP sensor 2 signal voltage is too high, this DTC sets.

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P2128 Accelerator Pedal Position (APP) Sensor 2 Circuit High Voltage

Conditions for Running the DTC

- The ignition is ON.
- DTC P2128 runs continuously.

Conditions for Setting the DTC

The APP sensor 2 voltage is more than 4.85 volts for less than 1 second.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

4: This step tests for a short to voltage on the APP sensor 2 signal circuit. With the sensor disconnected, the signal circuit should be near zero volts.

11: After replacing the PCM a new minimum throttle position and idle speed must be established.

DTC P2128 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	Is a DTC P0651also set?		Go to **DTC**	

2		-	**P0651**	Go to **Step 3**
3	1. Turn ON the ignition, with the engine OFF. 2. Observe the APP Sensor 2 parameter with a scan tool. Is the APP sensor 2 parameter more than the specified value?	4.0 V	Go to **Step 5**	Go to **Step 4**
4	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 90 seconds. 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. Did the DTC fail this ignition?	-	Go to **Step 5**	Go to **Intermittent Conditions**
5	1. Disconnect the APP sensor. 2. Turn ON the ignition with the engine OFF. 3. Observe the APP sensor 2 parameter with a scan tool. Is the voltage more than the specified value?	0 V	Go to **Step 7**	Go to **Step 6**
6	1. Connect a test lamp between the low reference circuit of the APP sensor 2 and B+. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	-	Go to **Step 10**	Go to **Step 8**
7	Test the signal circuit of the APP sensor 2 for short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
8	Test the low reference circuit of the APP sensor 2 for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
9	Test for an intermittent and for a poor connection at the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
	Replace the APP sensor 2. Refer to **Accelerator**			

10	**Pedal Position (APP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
11	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 13**
13	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2135

Description

This DTC compares the TP sensor 1 input with the TP sensor 2 input. There are two TP sensors located on the throttle body inside of the throttle actuator control (TAC) module. The TP sensors are used to determine the throttle plate angle. The TAC module expects the output of the two TP sensors to follow the same linear path. If the two sensors report conflicting information to the TAC module a DTC P2135 can set. The TP sensor is an integral part of the TAC module is not serviced separately. Installing a new TP sensor requires the replacement of the throttle body assembly. For additional information on the operation of the TP sensor and the TAC system refer to **Throttle Actuator Control (TAC) System Description** .

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P2135 Throttle Position (TP) Sensor 1/2 Correlation

Conditions for Running the DTC

- DTCs P0122, P0123, P0222, P0223, P0641, P0651, P2100, P2101, P2108, P2122, P2123, P2127, P2128, P2138, P2176, or U0107 are not set.

- The ignition is ON.
- The Idle Learn Procedure has been performed ensuring that the minimum TP value is stored in the PCM memory.
- DTC P2135 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The throttle angle between TP sensor 1 and TP sensor 2 is 5 percent or more.
- The above condition is present for at least 135 milliseconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

> **1:** The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool, if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.
>
> **2:** This step determines if a fault is present.

DTC P2135 Circuit

Step	Action	Value (s)	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	1. Turn ON the ignition, leaving the engine			

2	OFF. 2. Use the scan tool in order to clear the DTCs. 3. Leave the ignition ON for 30 seconds. Did DTC P2135 set?	-	Go to **Step 4**	Go to **Step 3**
3	1. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . 2. Check for DTCs. Did DTC P2135 set?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. The relationship between the TP sensors is faulty. Replace the TAC module. Refer to **Throttle Body Assembly Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 5**	-
5	1. Use the scan tool in order to clear the DTCs. 2. Start the engine. 3. Operate the vehicle within the Freeze Frame conditions as specified or until the DTC P2135 diagnostic test has run. Refer to the Test Description. Does the DTC run and pass?	-	Go to **Step 6**	Go to **Step 2**
6	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2138

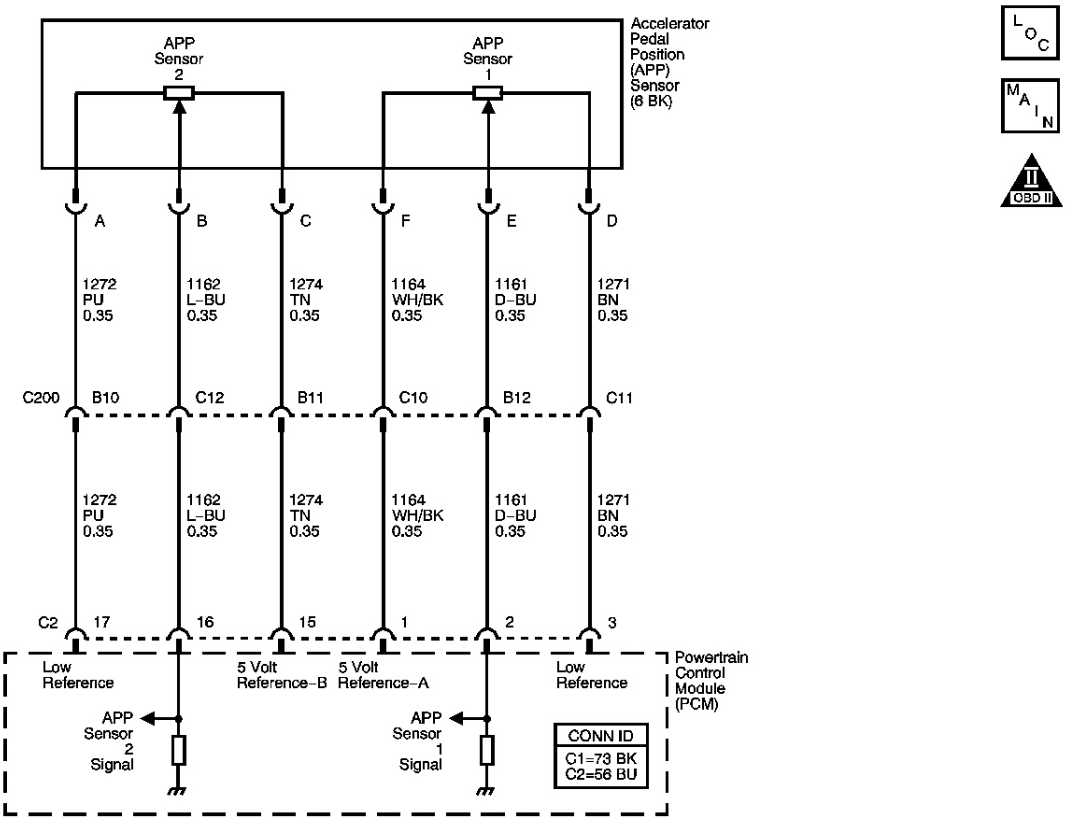


Fig. 16: DTC P2138 Circuit
Courtesy of GENERAL MOTORS CORP.

Description

This diagnostic compares the APP sensor 1 input with the APP sensor 2 input. There are two APP sensors located at the accelerator pedal that are an integral component of the throttle actuator control (TAC) system. The APP sensors obtain driver input through the accelerator pedal angle. The powertrain control module (PCM) receives the APP sensor input and uses that information to determine the necessary throttle opening. The PCM expects the output of the two APP sensors to follow the same linear path. If the two sensors report conflicting information to the PCM, this DTC sets. For additional information on the operation of the APP sensor and the TAC system refer to **Throttle Actuator Control (TAC) System Description** .

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P2138 Accelerator Pedal Position (APP) Sensor 1/2 Correlation

Conditions for Running the DTC

- DTCs P2122, P2123, P2127, and P2128 are not set.
- The ignition is ON.
- DTC P2138 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The APP sensor 2 output voltage is 0.18 volts more or less than the expected voltage based on the APP sensor 1 input.
- The above condition is present for at least 300 milliseconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool, if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step determines if a fault is current.

3: This step tests the circuits of the APP sensor throughout its range of motion. A condition may not be present with the throttle in the closed position. Working the APP through its complete range may reveal an intermittent condition.

4: A high resistance in any of the APP circuits will cause this DTC to set. Test any circuit that measured more than the specified value for a high resistance.

5: This step tests the signal circuits of the APP sensors for a wire to wire short.

DTC P2138 Circuit

Step	Action	Value (s)	Yes	No
Schematic Reference: Engine Controls Schematics				

Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views

1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Leave the ignition ON for 30 seconds. 3. Observe the DTC information, with a scan tool. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Step 3**
3	1. Clear the DTC information, with a scan tool. 2. Observe the DTC information, with a scan tool. 3. Slowly depress the accelerator pedal to wide open throttle (WOT), then slowly return the accelerator pedal to the closed position. 4. Repeat this action several times. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal position (APP) sensor connector. 3. Disconnect the powertrain control module (PCM). 4. Measure the resistance of the following circuits with a DMM for each APP sensor: • The signal circuit • The 5-volt reference circuit • The low reference circuit Is the resistance more than the specified value for any circuit?	5 ohm	Go to **Step 8**	Go to **Step 5**
5	Test the signal circuit of APP sensor 1 for a short to the signal circuit of APP sensor 2. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring System. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 6**
6	Test for an intermittent and for a poor connection at the APP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 7**

7	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 9**
8	Repair the high resistance in the APP circuit that measured above the specified value. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 10**	-
9	Replace the APP sensor. Refer to **Accelerator Pedal Position (APP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 10**	-
10	1. Use the scan tool in order to clear the DTCs. 2. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 11**
11	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2176

Circuit Description

The powertrain control module (PCM) controls the throttle valve by applying a varying voltage to the throttle actuator control motor. The PCM monitors the actual throttle valve position using throttle position (TP) sensor 1 and 2. The PCM commands the throttle closed after the ignition is switched to the ON position. If the PCM detects that TP angle is not within a specified range, after the ignition is switched ON, or during the throttle learn procedure, or the minimum throttle position is not learned, this DTC sets.

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P2176 Minimum Throttle Position Not Learned

Conditions for Running the DTC

- Before the PCM can report DTC P2176 failed, DTC P0122, P0123, P0222, P0223, P2100, P2108, P2135, and U0107 must run and pass.

- The ignition is ON.
- DTC P2176 runs once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

- The PCM detects that the TP Angle is more than 3 percent when the throttle valve is commanded closed.
- The PCM detects that the TP angle is not within 5 percent of the learned minimum throttle angle.
- The minimum throttle position is not learned after an PCM replacement.
- Any of the above conditions are met for less than 1 second.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Inspect for a condition in which the throttle valve may have been held open.
- Inspect for conditions in which ice may have formed in the throttle bore.
- The throttle valve is spring loaded to a slightly open position. The throttle valve should be open approximately 2-5 percent. This is referred to as the rest position. The throttle valve should not be completely closed, nor should the throttle valve be open any more than the specified amount. The throttle valve should move open and to the closed position without binding under normal spring pressure. The throttle should NOT be free to move open or closed WITHOUT spring pressure. Replace the throttle body if any of these conditions are found.
- For an intermittent condition, refer to **Intermittent Conditions** .

Test Description

The numbers below refer to the step numbers on the diagnostic table.

> **4:** The throttle valve is spring loaded in a slightly open position and should move in either direction without binding. The throttle valve should always be under spring pressure.
>
> **7:** When the ignition is turned ON, the PCM operates the throttle control motor to verify the integrity of

the system prior to start-up. This can be seen by the momentary flash of the test lamp as the ignition is turned ON.

DTC P2176 Minimum Throttle Position Not Learned

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the DTC information with a scan tool. Are DTCs P0121, P0122, P0123, P0221, P0222, P0223 set?	-	Go to **Scan Tool Data List**	Go to **Step 3**
3	Is DTC P2108 set?	-	Go to **DTC P2108**	Go to **Step 4**
4	Is DTC P2100 or P2101 set?	-	Go to **DTC P2100** or **DTC P2101**	Go to **Step 5**
5	1. Turn OFF the ignition for 30 seconds. 2. Turn ON the ignition, with the engine OFF for 1.0 minute. 3. Clear the DTCs with a scan tool. 4. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . 5. Turn ON the ignition, with the engine OFF. Does the DTC reset?	-	Go to **Step 6**	Go to **Step 8**
6	Replace the throttle body assembly. Refer to **Throttle Body Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 7**	-
7	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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.	-		

	Did the DTC fail this ignition?		Go to **Step 2**	Go to **Step 8**
8	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2199

Description

The DTC P2199 Intake Air Temperature (IAT) Sensor 1/2 Correlation diagnostic compares the IAT sensor 1 input with the IAT sensor 2 input. There are two IAT sensors on the 3.5L engine. IAT sensor 1 is located in the intake air duct and IAT sensor 2 is located in the intake manifold. The IAT sensor is a thermistor. A thermistor is a resistor whose value varies with temperature. The IAT sensors resistance is high when the coolant temperature is cold, and the IAT sensors resistance is low when the coolant temperature is warm. The IAT sensor is wired in series with a fixed resistor in the powertrain control module (PCM). The PCM applies 5 volts to the IAT sensor. The PCM monitors the voltage across the IAT sensor and converts the voltage into a temperature reading. The PCM expects the output of the two IAT sensors to follow the same linear path. If the two sensors report conflicting information to the PCM a DTC P2199 can set.

DTC Descriptor

This diagnostic supports the following DTC.

P2199 Intake Air temperature (IAT) Sensor 1/2 Correlation.

The following table illustrates the difference between temperature, resistance, and voltage:

DTC P2199 Circuit

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

Conditions for Running the DTC

- DTCs P0097, P0098, and P2610 are not set.
- The ignition is ON.
- The engine has been OFF for at least 8 hours.
- DTC P2199 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The temperature difference between IAT sensor 1 and IAT sensor 2 is 25°C (77°F) or more.
- The above condition is present for at least 7 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) after 2 consecutive ignition cycles in which the diagnostic fails.
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Freeze Frame buffer.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL after 3 consecutive trips without a fault.
- The PCM clears a History DTC after 40 consecutive warm-up cycles without a fault.
- Use the scan tool Clear DTC Information function.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step determines if a condition is present.

7: After replacing the PCM a new minimum throttle position and idle speed must also be established.

DTC P2199 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **The IAT sensors should be cooled to ambient temperature.** 2. Observe the IAT sensor 1 and the IAT sensor 2 parameters with a scan tool. Does the scan tool indicate that the IAT sensor 1 and IAT sensor 2 are within the specified value of each other?	5°C (9° F)	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame and/or the Failure records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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 and/or the Failure Records data. Does the DTC fail this ignition cycle?		Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the electrical connector of the IAT sensor 1, and the IAT sensor 2. 3. Measure the resistance of the IAT sensors, and compare to the Temperature vs Resistance table. Refer to **Temperature vs Resistance - Intake Air Temperature (IAT) Sensor** Did you locate and out of range sensor?	-	Go to **Step 6**	Go to **Step 5**
5	Test the IAT sensor circuits for high resistance. Refer to **Circuit Testing** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 8**	Go to **Step 7**
6	Replace the IAT sensor. Refer to **Intake Air Temperature (IAT) Sensor 1 Replacement** , or **Intake Air Temperature (IAT) Sensor 2 Replacement** . Did you complete the replacement?	-	Go to **Step 8**	-
7	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 8**	-
8	1. Use the scan tool in order to clear the DTCs. 2. Turn the ignition OFF for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. Does the DTC run and pass?	-	Go to **Step 9**	Go to **Step 2**
9	With a scan tool, select Capture Info in order to observe the stored information. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2227

Description

The DTC P2227 Barometric Pressure (BARO) Sensor Performance diagnostic checks the accuracy of the BARO sensor signal. The BARO sensor and circuitry are located inside of the powertrain control module (PCM). Barometric pressure varies with weather conditions and changes in the altitude from sea level. The PCM modifies fuel and spark delivery in response to barometric pressure changes. The PCM compares the BARO sensor reading with the manifold absolute pressure (MAP) sensor reading when running the DTC P2227 diagnostic.

DTC Descriptor

This diagnostic supports the following DTC. DTC P2227 Barometric Pressure (BARO) Sensor Performance.

Conditions for Running the DTC

- DTCs P0107, P0108, P0117, P0118, P0122, P0123, P0171, P0172, P0174, P0175, P0222, P0223, P0300-P0306, P0401, P0404, P0506, P0507, P1128, P1129, P2100, P2101, P2108, P2122, P2123, P2127, P2128, P2135, P2138, P2176, P2228, P2229, P2282, P2413 and U0107 are not set.
- The throttle position (TP) is at least 22.3 degrees at 1,000 RPM or 34.6 degrees at 3,000 RPM.
- DTC P2227 runs once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

- The difference between the BARO reading and the MAP reading is 26 kPa or more.
- The above conditions are met for 3 seconds or more.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) after 2 consecutive ignition cycles in which the diagnostic runs with the fault active.
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Freeze Frame buffer.
- The PCM enters the Fail Safe Function and uses default BARO values.

Conditions for Clearing the MIL/DTC

- The MIL turns OFF after 3 consecutively passing trips without a fault present.
- A history DTC clears after 40 consecutive warm-up cycles without a fault.
- Perform the scan tool Clear DTC Information function.

Diagnostic Aids

- A malfunctioning or skewed MAP sensor may cause DTC P2227 to set.
- The barometric pressure varies depending on the weather conditions and the altitude. Typical barometric pressure at sea level is 100 kPa (29-30 in Hg).

- If a DTC P2227 cannot be duplicated, the information included in the Freeze Frame data can be useful in determining the vehicle operating conditions when the DTC was first set.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step checks for a MAP sensor fault.

3: This step checks the accuracy of the MAP sensor. The MAP sensor should indicate atmospheric pressure when the ignition is ON and the engine is not running.

4: This step checks for a faulty BARO sensor. The BARO sensor and the MAP sensor should indicate approximately the same pressure when the ignition is ON and the engine is not running.

8: After replacing the PCM a new minimum throttle position and idle speed must also be established.

DTC P2227 Circuit

Step	Action	Value(s)	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Is there a Current or Pending DTC P0107 or DTC P0108 set?	-	Go to **DTC P0107** or **DTC P0108**	Go to **Step 3**
3	1. Turn ON the ignition, leaving the engine OFF. 2. Clear the scan tool information. 3. Select the MAP sensor parameter on the scan tool. Is the MAP sensor pressure reading near the specified value?	97-100 kPa at sea level	Go to **Step 4**	Go to **Step 7**
4	1. Turn ON the ignition, leaving the engine OFF. 2. Compare the pressure readings of the BARO sensor and the MAP sensor on the scan tool. Is the difference between the BARO pressure and	3 kPa		

	the MAP pressure more than the specified value?		Go to **Step 8**	Go to **Step 5**
5	1. Use the scan tool in order to clear the DTCs. 2. Start the engine. 3. Operate the vehicle within the Freeze Frame conditions as specified or until the DTC P2227 diagnostic test has run. Refer to the Test Description. Is DTC P2227 set?	-	Go to **Step 6**	Go to Diagnostic Aids
6	1. Select the Freeze Frame/Failure Record for the current DTC P2227 on the scan tool. 2. Review the MAP sensor readings in the Freeze Frame/Failure Record. Were the recorded MAP sensor readings normal?	-	Go to **Step 8**	Go to **Step 7**
7	1. Inspect the MAP sensor for the following conditions: • A skewed or incorrectly calibrated MAP sensor • A blockage or restriction in the MAP sensor vacuum supply • Electrical resistance in the MAP sensor signal circuit 2. Repair as necessary. Did you complete the action?	-	Go to **Step 9**	-
8	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 9**	-
9	1. Use the scan tool in order to clear the DTCs. 2. Turn the ignition OFF for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text or until the DTC P2227 diagnostic test has run.	-		

	Does the DTC run and pass?		Go to **Step 10**	Go to **Step 2**
10	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2228

Description

The DTC P2228 Barometric Pressure (BARO) Sensor Circuit diagnostic monitors the BARO sensor output. The barometric pressure (BARO) sensor and circuitry are located inside of the powertrain control module (PCM). The PCM uses the barometric pressure information in order to compensate for altitude changes. The BARO sensor reading is displayed on a scan tool when the ignition switch is ON and the engine is OFF.

DTC Descriptor

This diagnostic supports the following DTC. DTC P2228 Barometric Pressure (BARO) Sensor Circuit Low Voltage.

Conditions for Running the DTC

- The ignition is ON.
- DTC P2228 runs continuously once the above conditions are met

Conditions for Setting the DTC

The BARO is less than 1.58 volts for at least 2 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame buffer.
- The PCM enters the Fail Safe Function and uses default BARO values.

Conditions for Clearing the MIL/DTC

- The MIL turns OFF after 3 consecutively passing trips without a fault present.
- A history DTC clears after 40 consecutive warm-up cycles without a fault.
- Perform the scan tool Clear DTC Information function.

Diagnostic Aids

The barometric pressure varies depending on the weather conditions and the altitude. Typical barometric pressure at sea level is 100 kPa (29-30 in Hg).

If DTC P2228 cannot be duplicated, the information included in the Freeze Frame data can be useful in determining the vehicle operating conditions when the DTC was first set.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool, if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step determines if a fault is present.

3: This step checks for a short to ground in the PCM 5-volt reference circuit. The BARO sensor shares the 5-volt reference supply from the PCM with the MAP sensor, the TP sensor, and the fuel tank pressure sensor. A short in any branch of the reference voltage circuit will cause a DTC P2228 to set.

4: After replacing the PCM a new minimum throttle position and idle speed must also be established.

DTC P2228 Circuit

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, leaving the engine OFF. 2. Clear the scan tool information. 3. Operate the vehicle within the Freeze Frame conditions as specified. Is DTC P2228 set?	Go to **Step 3**	Go to Diagnostic Aids
3	1. Test the 5-volt reference circuit of the following sensors for a short to ground: • The manifold absolute pressure (MAP) sensor • The throttle position (TP) sensor • The fuel tank pressure sensor 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Was a repair necessary?	Go to **Step 5**	Go to **Step 4**
4	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	Go to **Step 5**	-

5	1. Turn ON the ignition, with the engine OFF. 2. Perform the scan tool Clear DTC Information function. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text or until the DTC P2228 diagnostic test has run. Does the DTC run and pass?	Go to **Step 6**	Go to **Step 2**
6	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2229

Description

The DTC P2229 Barometric Pressure (BARO) Sensor Circuit High Voltage diagnostic monitors the BARO sensor output. The BARO sensor and circuitry are located inside of the powertrain control module (PCM). Barometric pressure varies with weather conditions and changes in the altitude from sea level. The PCM modifies fuel and spark delivery in response to barometric pressure changes.

DTC Descriptor

This diagnostic supports the following DTC. DTC P2229 Barometric Pressure (BARO) Sensor Circuit High Voltage.

Conditions for Running the DTC

- The ignition is ON.
- DTC P2229 runs continuously once the above conditions are met

Conditions for Setting the DTC

The BARO is more than 4.49 volts for at least 2 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame buffer.
- The PCM enters the Fail Safe Function and uses default BARO values.

Conditions for Clearing the MIL/DTC

- The MIL turns OFF after 3 consecutively passing trips without a fault present.
- A history DTC clears after 40 consecutive warm-up cycles without a fault.
- Perform the scan tool Clear DTC Information function.

Diagnostic Aids

The barometric pressure varies depending on the weather conditions and the altitude. Typical barometric pressure at sea level is 100 kPa (29-30 in Hg).

If DTC P2229 cannot be duplicated, the information included in the Freeze Frame data can be useful in determining the vehicle operating conditions when the DTC was first set.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool, if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step determines if a fault is present.

3: This step checks for a short to ground in the PCM 5-volt reference circuit. The BARO sensor shares the 5-volt reference supply from the PCM with the MAP sensor, the TP sensor, and the fuel tank pressure sensor. A short in any branch of the reference voltage circuit will cause a DTC P2229 to set.

4: After replacing the PCM a new minimum throttle position and idle speed must also be established.

DTC P2229 Circuit

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, leaving the engine OFF. 2. Clear the scan tool information. 3. Operate the vehicle within the Freeze Frame conditions as specified. Is DTC P2229 set?	Go to **Step 3**	Go to Diagnostic Aids
3	1. Test the 5-volt reference circuit of the following sensors for a short to ground: • The manifold absolute pressure (MAP) sensor • The throttle position (TP) sensor		

	• The fuel tank pressure sensor 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Was a repair necessary?	Go to **Step 5**	Go to **Step 4**
4	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	Go to **Step 5**	-
5	1. Turn ON the ignition, with the engine OFF. 2. Perform the scan tool Clear DTC Information function. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text or until the DTC P2229 diagnostic test has run. Does the DTC run and pass?	Go to **Step 6**	Go to **Step 2**
6	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DIAGNOSTIC INFORMATION & PROCEDURES

DTC P2238 OR P2241

Circuit Description

The wide band heated oxygen sensor (HO2S) measures the amount of oxygen in the exhaust system and provides more information than the switching style HO2S. The wide band sensor consists of an oxygen sensing cell, an oxygen pumping cell, and a heater. The exhaust gas sample passes through a diffusion gap between the sensing cell and the pumping cell. The powertrain control module (PCM) supplies a voltage to the HO2S and uses this voltage as a reference to the amount of oxygen in the exhaust system. An electronic circuit within the PCM controls the pump current through the oxygen pumping cell in order to maintain a constant voltage in the oxygen sensing cell. The PCM monitors the voltage variation in the sensing cell and attempts to keep the voltage constant by increasing or decreasing the amount of current flow, or oxygen ion flow, to the pumping cell. By measuring the amount of current required to maintain the voltage in the sensing cell, the PCM can determine the concentration of oxygen in the exhaust. The HO2S voltage is displayed as a lambda value. A lambda value of 1 is equal to a stoichiometric air fuel ratio of 14.7:1. Under normal operating conditions, the lambda value will remain around 1. When the fuel system is lean, the oxygen level will be high and the lambda signal will be high or more than 1. When the fuel system is rich, the oxygen level will be low, and the lambda signal will be low or less than 1. The PCM uses this information to maintain the correct air/fuel ratio. If the PCM detects that the pumping current control circuit voltage is less than a predetermined value, this DTC sets.

DTC Descriptors

This diagnostic procedure supports the following DTCs.

- DTC P2238 HO2S Pumping Current Control Circuit Low Voltage Bank 1 Sensor 1
- DTC P2241 HO2S Pumping Current Control Circuit Low Voltage Bank 2 Sensor 1

Conditions for Running the DTC

- The engine is operating for more than 85 seconds.
- The HO2S heater is commanded ON.
- The DTCs P2238 and DTC P2241 run continuously once the above condition is met.

Conditions for Setting the DTC

- The HO2S pumping cell voltage is 1.0 volt or less.
- The above condition is present for less than 1 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

- Use the **J-35616** Connector Test Adapter Kit for any test that requires probing the PCM harness connector or a component harness connector.
- The Loop Status for the respective bank will default to Open when the DTC is current.
- The wide band sensors do not toggle or switch like a switching HO2S. The HO2S signals will be relatively stable for an idling engine.
- For an intermittent condition, refer to **Intermittent Conditions** .
- The following table illustrates the typical voltages for the HO2S circuits:

HO2S Voltages

• Ignition On, Engine Off • HO2S Disconnected	
HO2S Circuit	**Voltage**
Heater Control	Less than 0.5 V
Heater Supply Voltage	B+
Reference Voltage	3.3-3.8 V
Low Reference	5.9-6.4 V
Pump Current	4.8-5.3 V
Input Pump Current	3.3-3.8 V

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step determines whether a condition currently exists. If the Lambda value fluctuates near 1.00 and Loop Status is Closed, the HO2S is operating correctly.

4: This step tests the input pump current circuit. Test the input pump current circuit for a short to ground if the voltage is less the specified value.

5: This step tests for a condition in the pump current circuit. If the voltage is less than 4.8 volts, test for a wire to wire short to the heater control circuit.

6: This step isolates the condition. Test for a wire to wire short between the heater control circuit and the input pump current circuit of the HO2S if the voltage on the heater control circuit is more than 1.0 volt.

10: Inspect the HO2S connector for water intrusion, corrosion, and bent or damaged terminals.

11: Inspect the PCM connectors for water intrusion, corrosion, and bent or damaged terminals.

13: After replacing the PCM, a new minimum throttle position and idle speed must also be established.

DTC P2238 or P2241 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **DTC P2238 is for bank 1 sensor 1 - Rear and DTC P2241 is for bank 2 sensor 1 - Front** 1. Allow the engine to reach operating temperature. 2. Observe the Loop Status Bank 1 or Loop Status Bank 2 with a scan tool. Does the scan tool display Closed Loop?	-	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the affected HO2S. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage between the HO2S input pump current circuit and a good ground with a	3.3-3.8 V		

	DMM. Is the voltage within the specified range?		Go to **Step 5**	Go to **Step 7**
5	Measure the voltage between the HO2S pump current circuit and a good ground with a DMM. Is the voltage more than the specified value?	4.8 V	Go to **Step 6**	Go to **Step 9**
6	Measure the voltage between the HO2S heater control circuit and a good ground with a DMM. Is the voltage more than the specified value?	1.0 V	Go to **Step 8**	Go to **Step 10**
7	Test the input pump current circuit of the HO2S for a short to ground or a short to the reference ground circuit of the HO2S. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 11**
8	Test the input pump current circuit of the HO2S for a short to the heater control circuit of the HO2S. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 11**
9	Test the pump current circuit of the HO2S for a short to the heater control circuit of the HO2S. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 11**
10	Test for shorted terminals and for poor connections at the HO2S sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 12**
11	Test for shorted terminals and for poor connections at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 13**
12	Replace the HO2S sensor. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** or **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1** . Did you complete the replacement?	-	Go to **Step 14**	-
13	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 14**	-

14	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 15**
15	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2239 OR P2242

Circuit Description

The wide band heated oxygen sensor (HO2S) measures the amount of oxygen in the exhaust system and provides more information than the switching style HO2S. The wide band sensor consists of an oxygen sensing cell, an oxygen pumping cell, and a heater. The exhaust gas sample passes through a diffusion gap between the sensing cell and the pumping cell. The powertrain control module (PCM) supplies a voltage to the HO2S and uses this voltage as a reference to the amount of oxygen in the exhaust system. An electronic circuit within the PCM controls the pump current through the oxygen pumping cell in order to maintain a constant voltage in the oxygen sensing cell. The PCM monitors the voltage variation in the sensing cell and attempts to keep the voltage constant by increasing or decreasing the amount of current flow, or oxygen ion flow, to the pumping cell. By measuring the amount of current required to maintain the voltage in the sensing cell, the PCM can determine the concentration of oxygen in the exhaust. The HO2S voltage is displayed as a lambda value. A lambda value of 1 is equal to a stoichiometric air fuel ratio of 14.7:1. Under normal operating conditions, the lambda value will remain around 1. When the fuel system is lean, the oxygen level will be high and the lambda signal will be high or more than 1. When the fuel system is rich, the oxygen level will be low, and the lambda signal will be low or less than 1. The PCM uses this information to maintain the correct air/fuel ratio. If the PCM detects that the pumping current control circuit voltage is more than a predetermined value, this DTC sets.

DTC Descriptors

This diagnostic procedure supports the following DTCs.

- DTC P2239 HO2S Pumping Current Control Circuit High Voltage Bank 1 Sensor 1
- DTC P2242 HO2S Pumping Current Control Circuit High Voltage Bank 2 Sensor 1

Conditions for Running the DTC

- The engine is operating.
- The HO2S heater is commanded ON.

- The HO2S sensing cell voltage is between 3.4 volts and 4.7 volts.
- DTC P2239 and DTC P2242 both run continuously once the above condition has been met.

Conditions for Setting the DTC

- The HO2S pumping cell voltage is 2.0 volts or less, or 5.6 volts or more.
- The above condition is met for at least 15 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

- Use the **J-35616** Connector Test Adapter Kit for any test that requires probing the PCM harness connector or a component harness connector.
- The Loop Status for the respective bank will default to Open when the DTC is current.
- The wide band sensors do not toggle or switch like a switching HO2S. The HO2S signals will be relatively stable for an idling engine.
- For an intermittent condition, refer to **Intermittent Conditions** .
- The following table illustrates the typical voltages for the HO2S circuits:

HO2S Voltages

• **Ignition On, Engine Off** • **HO2S Disconnected**	
HO2S Circuit	**Voltage**
Heater Control	Less than 0.5 V
Heater Supply Voltage	B+
Reference Voltage	3.3-3.8 V
Low Reference	5.9-6.4 V
Pump Current	4.8-5.3 V

Input Pump Current	3.3-3.8 V

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step determines whether a condition currently exists. If the Lambda value fluctuates near 1.00 and Loop Status is Closed, the HO2S is operating correctly.

5: This step tests for a condition in the input pump current circuit of the HO2S. Test the circuit for an open or a high resistance, if the voltage measures less than 0.10 volt.

6: This step tests for a condition in the pump current circuit of the HO2S. Test the circuit for an open, a high resistance, or a short to ground, if the voltage measures less than 0.10 volt.

7: This step tests for a condition in the low reference circuit of the HO2S. Test the circuit for a wire to wire short to the reference ground circuit, or a short to ground, if the voltage measures less than 0.10 volt.

11: Inspect the HO2S connector for water intrusion, corrosion, and bent or damaged terminals.

12: Inspect the PCM connectors for water intrusion, corrosion, and bent or damaged terminals.

14: After replacing the PCM a new minimum throttle position and idle speed must also be established.

DTC P2239 or P2242 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **DTC P2239 is for bank 1 sensor 1 - Rear and DTC P2242 is for bank 2 sensor 1 - Front.** 1. Allow the engine to reach operating temperature. 2. Observe the Loop Status Bank 1 or Loop Status Bank 2 with a scan tool. Does the scan tool display Closed Loop?	-	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?		Go to **Step 4**	Go to Diagnostic Aids
4	Observe the DTC information with a scan tool. Is DTC P0135 or P0155 also set?	-	Go to **DTC P0135 or P0155**	Go to **Step 5**
5	1. Turn OFF the ignition. 2. Disconnect the appropriate HO2S sensor connector. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage between the HO2S input pump circuit and a good ground with a DMM. Is the voltage more than the specified value?	1.0 V	Go to **Step 6**	Go to **Step 8**
6	Measure the voltage between the HO2S pump circuit and a good ground with a DMM. Is the voltage more than the specified value?	1.0 V	Go to **Step 7**	Go to **Step 9**
7	Measure the voltage between the HO2S low reference circuit and a good ground with a DMM. Is the voltage less than the specified value?	1.0 V	Go to **Step 10**	Go to **Step 11**
8	Test the input pump current circuit of the HO2S for an open or a high resistance. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
9	Test the pump current circuit of the HO2S for an open, a high resistance, or a short to ground. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
10	Test the low reference circuit of the HO2S for a short to ground or a short to the reference ground circuit of the HO2S. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
11	Test for shorted terminals and for poor connections at the HO2S sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 13**
12	Test for shorted terminals and for poor connections at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 14**

13	Replace the HO2S sensor. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** or **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1** . Did you complete the replacement?	-	Go to **Step 15**	-
14	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 15**	-
15	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 16**
16	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2243 OR P2247

Circuit Description

The wide band heated oxygen sensor (HO2S) measures the amount of oxygen in the exhaust system and provides more information than the switching style HO2S. The wide band sensor consists of an oxygen sensing cell, an oxygen pumping cell, and a heater. The exhaust gas sample passes through a diffusion gap between the sensing cell and the pumping cell. The powertrain control module (PCM) supplies a voltage to the HO2S and uses this voltage as a reference to the amount of oxygen in the exhaust system. An electronic circuit within the PCM controls the pump current through the oxygen pumping cell in order to maintain a constant voltage in the oxygen sensing cell. The PCM monitors the voltage variation in the sensing cell and attempts to keep the voltage constant by increasing or decreasing the amount of current flow, or oxygen ion flow, to the pumping cell. By measuring the amount of current required to maintain the voltage in the sensing cell, the PCM can determine the concentration of oxygen in the exhaust. The HO2S voltage is displayed as a lambda value. A lambda value of 1 is equal to a stoichiometric air fuel ratio of 14.7:1. Under normal operating conditions, the lambda value will remain around 1. When the fuel system is lean, the oxygen level will be high and the lambda signal will be high or more than 1. When the fuel system is rich, the oxygen level will be low, and the lambda signal will be low or less than 1. The PCM uses this information to maintain the correct air/fuel ratio. If the PCM detects that the sensing cell voltage fluctuates above and below predetermined values for a fixed amount of time this DTC sets.

DTC Descriptors

This diagnostic procedure supports the following DTCs.

- DTC P2243 HO2S Reference Voltage Circuit Bank 1 Sensor 1
- DTC P2247 HO2S Reference Voltage Circuit Bank 2 Sensor 1

Conditions for Running the DTC

- The engine is operating.
- The HO2S heater is commanded ON.
- DTC P2243 and DTC P2247 both run continuously once the above conditions have been met.

Conditions for Setting the DTC

- The HO2S sensing cell voltage fluctuates between 4.8 volts or more and 3.4 volts or less.
- The voltage oscillations occur 50 consecutive times or more.
- The condition exists for 7 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

- Use the **J-35616** Connector Test Adapter Kit for any test that requires probing the PCM harness connector or a component harness connector.
- The Loop Status for the respective bank will default to Open when the DTC is current.
- The wide band sensors do not toggle or switch like a switching HO2S. The HO2S signals will be relatively stable for an idling engine.
- For an intermittent condition, refer to **Intermittent Conditions** .
- The following table illustrates the typical voltages for the HO2S circuits:

HO2S Voltages

• **Ignition On, Engine Off** • **HO2S Disconnected**	
HO2S Circuit	**Voltage**
Heater Control	Less than 0.5 V
Heater Supply Voltage	B+
Reference Voltage	3.3-3.8 V
Low Reference	5.9-6.4 V
Pump Current	4.8-5.3 V
Input Pump Current	3.3-3.8 V

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step determines weather a condition currently exists. If the Lambda value fluctuates near 1.00 and Loop Status is Closed, the HO2S is operating correctly.

4: This step tests for a condition in the reference voltage circuit. Test for an open or a high resistance if the voltage measures less than 0.1 volts.

5: This step tests for a condition in the HO2S low reference circuit. If the voltage measured on the HO2S heater control circuit is more than 1.0 volt, test for a wire to wire short between the low reference circuit and the heater control circuit.

8: Inspect the HO2S connector for water intrusion, corrosion, and bent or damaged terminals.

9: Inspect the PCM connectors for water intrusion, corrosion, and bent or damaged terminals.

DTC P2243 or P2247 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **DTC P2243 is for bank 1 sensor 1 - Rear and DTC P2247 is for bank 2 sensor 1 - Front.** 1. Allow the engine to reach operating temperature. 2. Observe the Loop Status Bank 1 or Loop Status Bank 2 with a scan tool. Does the scan tool display Closed Loop?	-	Go to **Step 3**	Go to **Step 4**

3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the appropriate HO2S sensor connector. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage between the HO2S reference voltage circuit and a good ground with a DMM. Is the voltage more than the specified value?	1.0 V	Go to **Step 5**	Go to **Step 6**
5	Measure the voltage between the HO2S heater control circuit and a good ground with a DMM. Is the voltage more than the specified value?	1.0 V	Go to **Step 7**	Go to **Step 8**
6	Test the reference voltage circuit of the HO2S for an open, or a high resistance. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
7	Test the low reference circuit of the HO2S for a short to the HO2S heater control circuit. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
8	Test for shorted terminals and for poor connections at the HO2S sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 10**
9	Test for shorted terminals and for poor connections at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
	Replace the HO2S sensor. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** or			

10	**Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1** . Did you complete the replacement?	-	Go to **Step 12**	-
11	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 13**
13	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2245 OR P2249

Circuit Description

The wide band heated oxygen sensor (HO2S) measures the amount of oxygen in the exhaust system and provides more information than the switching style HO2S. The wide band sensor consists of an oxygen sensing cell, an oxygen pumping cell, and a heater. The exhaust gas sample passes through a diffusion gap between the sensing cell and the pumping cell. The powertrain control module (PCM) supplies a voltage to the HO2S and uses this voltage as a reference to the amount of oxygen in the exhaust system. An electronic circuit within the PCM controls the pump current through the oxygen pumping cell in order to maintain a constant voltage in the oxygen sensing cell. The PCM monitors the voltage variation in the sensing cell and attempts to keep the voltage constant by increasing or decreasing the amount of current flow, or oxygen ion flow, to the pumping cell. By measuring the amount of current required to maintain the voltage in the sensing cell, the PCM can determine the concentration of oxygen in the exhaust. The HO2S voltage is displayed as a lambda value. A lambda value of 1 is equal to a stoichiometric air fuel ratio of 14.7:1. Under normal operating conditions, the lambda value will remain around 1. When the fuel system is lean, the oxygen level will be high and the lambda signal will be high or more than 1. When the fuel system is rich, the oxygen level will be low, and the lambda signal will be low or less than 1. The PCM uses this information to maintain the correct air/fuel ratio. If the PCM detects that pumping cell voltage is more than a predetermined value, this DTC sets.

DTC Descriptors

This diagnostic procedure supports the following DTCs.

- DTC P2245 HO2S Reference Voltage Circuit Low Voltage Bank 1 Sensor 1

- DTC P2249 HO2S Reference Voltage Circuit Low Voltage Bank 2 Sensor 1

Conditions for Running the DTC

- The engine is operating for more than 85 seconds.
- The HO2S heater is commanded ON.
- The HO2S signal voltage is between 0.3 volt and 1.5 volt.
- DTC P2245 and DTC P2249 both run continuously once the above conditions have been met.

Conditions for Setting the DTC

- The HO2S input pump current circuit voltage is 1.0 volt or more.
- The above condition is present for less than 1 second.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

- Use the **J-35616** Connector Test Adapter Kit for any test that requires probing the PCM harness connector or a component harness connector.
- The Loop Status for the respective bank will default to Open when the DTC is current.
- The wide band sensors do not toggle or switch like a switching HO2S. The HO2S signals will be relatively stable for an idling engine.
- For an intermittent condition, refer to **Intermittent Conditions** .
- The following table illustrates the typical voltages for the HO2S circuits:

HO2S Voltages

• Ignition On, Engine Off • HO2S Disconnected	
HO2S Circuit	**Voltage**

Heater Control	Less than 0.5 V
Heater Supply Voltage	B+
Reference Voltage	3.3-3.8 V
Low Reference	5.9-6.4 V
Pump Current	4.8-5.3 V
Input Pump Current	3.3-3.8 V

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step determines whether a condition currently exists. If the Lambda value fluctuates near 1.00 and Loop Status is Closed, the HO2S is operating correctly.

4: This step tests for a condition in the reference voltage circuit. Test for a short to ground or a wire to wire short to the HO2S reference ground circuit, if the voltage measures less than 1.0 volt.

5: This step isolates the condition. If the voltage measured on the HO2S heater control circuit is more than 1.0 volt, test for a wire to wire short between reference voltage circuit or low reference circuit and the heater control circuit.

8: Inspect the HO2S connector for water intrusion, corrosion, and bent or damaged terminals.

9: Inspect the PCM connectors for water intrusion, corrosion, and bent or damaged terminals.

11: After replacing the PCM, a new minimum throttle position and idle speed must be established.

DTC P2245 or P2249 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **DTC P2245 is for bank 1 sensor 1 - Rear and DTC P2249 is for bank 2 sensor 1 - Front.** 1. Allow the engine to reach operating temperature. 2. Observe the Loop Status Bank 1 or Loop Status Bank 2 with a scan tool. Does the scan tool display Closed Loop?	-	Go to **Step 3**	Go to **Step 4**
	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds.			

3	3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the appropriate HO2S sensor connector. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage between the HO2S reference voltage circuit and a good ground with a DMM. Is the voltage more than the specified value?	1.0 V	Go to **Step 5**	Go to **Step 6**
5	Measure the voltage between the HO2S heater control circuit and a good ground with a DMM. Is the voltage more than the specified value?	1.0 V	Go to **Step 7**	Go to **Step 8**
6	Test the reference voltage circuit of the HO2S for a short to ground. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
7	Test the HO2S heater control circuit for a short to one of the following circuits: • The HO2S reference voltage circuit • The HO2S low reference circuit, refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
8	Test for shorted terminals and for poor connections at the HO2S sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 10**
9	Test for shorted terminals and for poor connections at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**

10	Replace the HO2S sensor. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** or **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1** . Did you complete the replacement?	-	Go to **Step 12**	-
11	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 13**
13	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2252 OR P2255

Circuit Description

The wide band heated oxygen sensor (HO2S) measures the amount of oxygen in the exhaust system and provides more information than the switching style HO2S. The wide band sensor consists of an oxygen sensing cell, an oxygen pumping cell, and a heater. The exhaust gas sample passes through a diffusion gap between the sensing cell and the pumping cell. The powertrain control module (PCM) supplies a voltage to the HO2S and uses this voltage as a reference to the amount of oxygen in the exhaust system. An electronic circuit within the PCM controls the pump current through the oxygen pumping cell in order to maintain a constant voltage in the oxygen sensing cell. The PCM monitors the voltage variation in the sensing cell and attempts to keep the voltage constant by increasing or decreasing the amount of current flow, or oxygen ion flow, to the pumping cell. By measuring the amount of current required to maintain the voltage in the sensing cell, the PCM can determine the concentration of oxygen in the exhaust. The HO2S voltage is displayed as a lambda value. A lambda value of 1 is equal to a stoichiometric air fuel ratio of 14.7:1. Under normal operating conditions, the lambda value will remain around 1. When the fuel system is lean, the oxygen level will be high and the lambda signal will be high or more than 1. When the fuel system is rich, the oxygen level will be low, and the lambda signal will be low or less than 1. The PCM uses this information to maintain the correct air/fuel ratio. If the PCM detects that the low reference circuit voltage is less than a predetermined voltage, this DTC sets.

DTC Descriptors

This diagnostic procedure supports the following DTCs.

- DTC P2252 HO2S Reference Ground Circuit Low Voltage Bank 1 Sensor 1
- DTC P2255 HO2S Reference Ground Circuit Low Voltage Bank 2 Sensor 1

Conditions for Running the DTC

- The engine is operating for more than 85 seconds.
- The HO2S heater is commanded ON.
- DTC P2252 and DTC P2255 both run continuously once the above conditions have been met.

Conditions for Setting the DTC

- The HO2S sensing cell voltage is 0.3 volt or less, and the HO2S pumping cell voltage is 1.0 volt or more.
- The above condition is met for less than 1 second.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

- Use the **J-35616** Connector Test Adapter Kit for any test that requires probing the PCM harness connector or a component harness connector.
- The Loop Status for the respective bank will default to Open when the DTC is current.
- The wide band sensors do not toggle or switch like a switching HO2S. The HO2S signals will be relatively stable for an idling engine.
- For an intermittent condition, refer to **Intermittent Conditions** .
- The following table illustrates the typical voltages for the HO2S circuits:

HO2S Voltages

• **Ignition On, Engine Off** • **HO2S Disconnected**	
HO2S Circuit	**Voltage**
Heater Control	Less than 0.5 V
Heater Supply Voltage	B+
Reference Voltage	3.3-3.8 V
Low Reference	5.9-6.4 V
Pump Current	4.8-5.3 V
Input Pump Current	3.3-3.8 V

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step determines whether a condition currently exists. If the Lambda value fluctuates near 1.00 and Loop Status is Closed, the HO2S is operating correctly.

4: This step tests for a condition in the low reference circuit. Test for a short to ground, or a wire to wire short to the HO2S reference ground circuit, if the voltage measures less than 1.0 volt.

6: Inspect the HO2S connector for water intrusion, corrosion, and bent or damaged terminals.

7: Inspect the PCM connectors for water intrusion, corrosion, and bent or damaged terminals.

9: After replacing the PCM, a new minimum throttle position and idle speed must be established.

DTC P2252 or P2255 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **DTC P2252 is for bank 1 sensor 1 - Rear and DTC P2255 is for bank 2 sensor 1 - Front.** 1. Allow the engine to reach operating temperature. 2. Observe the Loop Status Bank 1 or Loop Status Bank 2 with a scan tool. Does the scan tool display Closed Loop?	-	Go to **Step 3**	Go to **Step 4**
	1. Observe the Freeze Frame/Failure Records for this DTC.			

<table>
<tr><td>3</td><td>2. Turn OFF the ignition for 30 seconds.
3. Start the engine.
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.

Did the DTC fail this ignition?</td><td>-</td><td>Go to Step 4</td><td>Go to Diagnostic Aids</td></tr>
<tr><td>4</td><td>1. Turn OFF the ignition.
2. Disconnect the appropriate HO2S sensor connector.
3. Turn ON the ignition, with the engine OFF.
4. Measure the voltage between the HO2S low reference circuit and a good ground with a DMM.

Is the voltage less than the specified value?</td><td>1.0 V</td><td>Go to Step 5</td><td>Go to Step 6</td></tr>
<tr><td>5</td><td>Test the low reference circuit of the HO2S for a short to ground, or a short to the reference ground circuit of the HO2S. Refer to Circuit Testing and Wiring Repairs in Wiring Systems.
Did you find and correct the condition?</td><td>-</td><td>Go to Step 10</td><td>Go to Step 7</td></tr>
<tr><td>6</td><td>Test for shorted terminals and for poor connections at the HO2S sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.
Did you find and correct the condition?</td><td>-</td><td>Go to Step 10</td><td>Go to Step 8</td></tr>
<tr><td>7</td><td>Test for shorted terminals and for poor connections at the PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems.
Did you find and correct the condition?</td><td>-</td><td>Go to Step 10</td><td>Go to Step 9</td></tr>
<tr><td>8</td><td>Replace the HO2S sensor. Refer to Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1 or Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1 .
Did you complete the replacement?</td><td>-</td><td>Go to Step 10</td><td>-</td></tr>
<tr><td>9</td><td>1. Replace the PCM. Refer to Powertrain Control Module (PCM) Replacement .
2. Perform the idle learn procedure. Refer to Idle Learn Procedure .

Did you complete the replacement?</td><td>-</td><td>Go to Step 10</td><td>-</td></tr>
</table>

10	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 11**
11	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2253 OR P2256

Circuit Description

The wide band heated oxygen sensor (HO2S) measures the amount of oxygen in the exhaust system and provides more information than the switching style HO2S. The wide band sensor consists of an oxygen sensing cell, an oxygen pumping cell, and a heater. The exhaust gas sample passes through a diffusion gap between the sensing cell and the pumping cell. The powertrain control module (PCM) supplies a voltage to the HO2S and uses this voltage as a reference to the amount of oxygen in the exhaust system. An electronic circuit within the PCM controls the pump current through the oxygen pumping cell in order to maintain a constant voltage in the oxygen sensing cell. The PCM monitors the voltage variation in the sensing cell and attempts to keep the voltage constant by increasing or decreasing the amount of current flow, or oxygen ion flow, to the pumping cell. By measuring the amount of current required to maintain the voltage in the sensing cell, the PCM can determine the concentration of oxygen in the exhaust. The HO2S voltage is displayed as a lambda value. A lambda value of 1 is equal to a stoichiometric air fuel ratio of 14.7:1. Under normal operating conditions, the lambda value will remain around 1. When the fuel system is lean, the oxygen level will be high and the lambda signal will be high or more than 1. When the fuel system is rich, the oxygen level will be low, and the lambda signal will be low or less than 1. The PCM uses this information to maintain the correct air/fuel ratio. If the PCM detects that the sensing cell voltage is more than a predetermined value, this DTC sets.

DTC Descriptors

This diagnostic procedure supports the following DTCs.

- DTC P2253 HO2S Reference Ground Circuit High Voltage Bank 1 Sensor 1
- DTC P2256 HO2S Reference Ground Circuit High Voltage Bank 2 Sensor 1

Conditions for Running the DTC

- The engine is operating.
- The HO2S heater is commanded ON.

Conditions for Setting the DTC

- The HO2S sensing cell voltage is more than 5.9 volts.
- The above condition is met for at least 5 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

- Use the **J-35616** Connector Test Adapter Kit for any test that requires probing the PCM harness connector or a component harness connector.
- The Loop Status for the respective bank will default to Open when the DTC is current.
- The wide band sensors do not toggle or switch like a switching HO2S. The HO2S signals will be relatively stable for an idling engine.
- For an intermittent condition, refer to **Intermittent Conditions** .
- The following table illustrates the typical voltages for the HO2S circuits:

HO2S Voltages

• Ignition On, Engine Off • HO2S Disconnected	
HO2S Circuit	**Voltage**
Heater Control	Less than 0.5 V
Heater Supply Voltage	B+
Reference Voltage	3.3-3.8 V
Low Reference	5.9-6.4 V
Pump Current	4.8-5.3 V
Input Pump Current	3.3-3.8 V

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step determines whether a condition currently exists. If the Lambda value fluctuates near 1.00 and Loop Status is Closed, the HO2S is operating correctly.

4: This step tests for a condition in the reference voltage circuit. Test for a short to voltage, if the voltage measures more than 4.0 volts.

5: This step tests for a condition in the low reference circuit. Test for an open, a high resistance, or a short to voltage, if the voltage measures more or less than the specified value.

6: This step tests for a condition in the input pump current circuit. Test for a short to voltage, if the voltage measures more than 4.0 volts.

10: Inspect the HO2S connector for water intrusion, corrosion, and bent or damaged terminals.

11: Inspect the PCM connectors for water intrusion, corrosion, and bent or damaged terminals.

13: After replacing the PCM, a new minimum throttle position and idle speed must be established.

DTC P2253 or P2256 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **DTC P2253 is for bank 1 sensor 1 - Rear and DTC P2256 is for bank 2 sensor 1 - Front.** 1. Allow the engine to reach operating temperature. 2. Observe the Loop Status Bank 1 or Loop Status Bank 2 with a scan tool. Does the scan tool display Closed Loop?	-	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to Diagnostic Aids

4	1. Turn OFF the ignition. 2. Disconnect the appropriate HO2S sensor connector. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage between the HO2S reference voltage circuit and a good ground with a DMM. Is the voltage less than the specified value?	4.0 V	Go to **Step 5**	Go to **Step 7**
5	Measure the voltage between the HO2S low reference circuit and a good ground with a DMM. Is the voltage within the specified range?	5.9-6.4 V	Go to **Step 6**	Go to **Step 8**
6	Measure the voltage between the HO2S input pump current circuit and a good ground with a DMM. Is the voltage more than the specified value?	4.0 V	Go to **Step 9**	Go to **Step 10**
7	Test the reference voltage circuit of the HO2S for a short to voltage. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 11**
8	Test the low reference circuit of the HO2S for an open, a high resistance, or a short to voltage. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 11**
9	Test the input pump current circuit of the HO2S for a short to voltage. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 11**
10	Test for shorted terminals and for poor connections at the HO2S sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 12**
11	Test for shorted terminals and for poor connections at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 13**
12	Replace the HO2S sensor. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** or **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1** . Did you complete the replacement?	-	Go to **Step 14**	-
	1. Replace the PCM. Refer to **Powertrain**			

13	**Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 14**	-
14	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 15**
15	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2282

Description

The DTC P2282 Intake Manifold Air Leak diagnostic monitors the volume of air consumed at idle speed. The powertrain control module (PCM) controls the throttle actuator control (TAC) motor in order to regulate the air flow through the throttle body. The amount of air flowing through the throttle body will normally determine the engine speed. If there is an intake air leak or a malfunction in the positive crankcase ventilation (PCV) system excess air can enter the intake manifold affecting engine speed. The PCM uses sensor input in order to determine an estimated volume of air that is used during normal idle conditions. If there is any excess air, the estimated volume of air will be more than the expected value and DTC P2282 will set.

DTC Descriptor

This diagnostic supports the following DTC.

DTC P2282 Intake Manifold Air Leak.

Conditions for Running the DTC

- DTCs P0107, P0108, P0112, P0113, P0117, P0118, P0122, P0123, P0171, P0172, P0174, P0175, P0222, P0223, P0300-P0306, P0401, P0404, P1128, P2100, P2101, P2108, P2122, P2123, P2127, P2128, P2135, P2138, P2176, P2227, P2228, P2229, P2413, and U0107 are not set.
- Battery voltage is at least 10.5 volts.
- Intake air temperature (IAT) is at least 69°C (156°F).

- Engine coolant temperature (ECT) is at least 0°C (32°F).
- The engine has been running at least 15 seconds.
- Engine is running in Closed Loop at idle.
- The throttle position sensor is less than 1.74 volts.
- The vehicle is in PARK with all engine accessories turned OFF.
- DTC P2282 runs once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

Either of the conditions below are present:

- The estimated volume of air is 150 L/min (39.65 gal/min) or more when the manifold absolute pressure (MAP) is 47 kPa.
- The estimated volume of air is 120 L/min (31.69 gal/min) or more when the manifold absolute pressure (MAP) is 65 kPa.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) after 2 consecutive ignition cycles in which the diagnostic runs with the fault active.
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Freeze Frame buffer.

Conditions for Clearing the MIL/DTC

- The MIL turns OFF after 3 consecutively passing trips without a fault present.
- A history DTC clears after 40 consecutive warm-up cycles without a fault.
- Perform the scan tool Clear DTC Information function.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step prompts the technician to check for any condition that can allow air to enter the engine. Any condition that can affect the idle speed of the engine must be repaired first, in order to enable proper diagnosis of the DTC P2282.

3: A dirty throttle valve can affect the air flow through the throttle body and into the engine. Clean the throttle valve is necessary before performing the Idle Learn Procedure.

DTC P2282 Circuit

Step	Action	Yes	No

1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Inspect the engine for any of the following conditions: • A stuck or damaged throttle valve or throttle body • A vacuum or intake air leak • An evaporative emission (EVAP) system malfunction • Faulty PCV system operation Refer to **Crankcase Ventilation System Inspection/Diagnosis** in Engine Mechanical - 3.5L. 2. Repair the condition as necessary. Did you find and correct a condition?	Go to **Step 5**	Go to **Step 3**
3	Inspect the throttle valve for excessive deposits. Clean as necessary. Refer to **Throttle Body Service** . Did you find and correct a condition?	Go to **Step 5**	Go to **Step 4**
4	1. Inspect the camshaft timing. Refer to **Timing Belt Replacement** in Engine Mechanical - 3.5L. 2. Repair the condition as necessary. Did you find and correct a condition?	Go to **Step 5**	Go to **Intermittent Conditions**
5	1. Use the scan tool in order to clear the DTCs. 2. Turn the ignition OFF for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC or until the DTC P2282 diagnostic has passed. Does the DTC run and pass?	Go to **Step 6**	Go to **Step 2**
6	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2297 OR P2298

Circuit Description

The wide band heated oxygen sensor (HO2S) measures the amount of oxygen in the exhaust system and provides more information than the switching style HO2S. The wide band sensor consists of an oxygen sensing cell, an oxygen pumping cell, and a heater. The exhaust gas sample passes through a diffusion gap between the sensing cell and the pumping cell. The powertrain control module (PCM) supplies a voltage to the HO2S and uses this voltage as a reference to the amount of oxygen in the exhaust system. An electronic circuit within the PCM controls the pump current through the oxygen pumping cell in order to maintain a constant voltage in the oxygen sensing cell. The PCM monitors the voltage variation in the sensing cell and attempts to keep the voltage constant by increasing or decreasing the amount of current flow, or oxygen ion flow, to the pumping cell. By measuring the amount of current required to maintain the voltage in the sensing cell, the PCM can determine the concentration of oxygen in the exhaust. The HO2S voltage is displayed as a lambda value. A lambda value of 1 is equal to a stoichiometric air fuel ratio of 14.7:1. Under normal operating conditions, the lambda value will remain around 1. When the fuel system is lean, the oxygen level will be high and the lambda signal will be high or more than 1. When the fuel system is rich, the oxygen level will be low, and the lambda signal will be low or less than 1. The PCM uses this information to maintain the correct air/fuel ratio. If the ECM detects an HO2S voltage that stays above or below an expected value during a fuel cutoff condition, this DTC sets.

DTC Descriptors

This diagnostic procedure supports the following DTCs.

- DTC P2297 HO2S Performance During Decel Fuel Cut-Off (DFCO) Bank 1 Sensor 1
- DTC P2298 HO2S Performance During Decel Fuel Cut-Off (DFCO) Bank 2 Sensor 1

Conditions for Running the DTC

- DTCs P0030, P0050, P0112, P0113, P0117, P0118, P0122, P0123, P0133, P0135, P0155, P0171, P0172, P0174, P0175, P0222, P0223, P0300-P0306, P0443, P0496, P0501, P0502, P0641, P2100, P2101, P2108, P2122, P2123, P2127, P2128, P2135, P2138, P2176, P2195, P2227, P2228, P2229, P2238, P2239, P2241, P2242, P2243, P2247, P2252, P2253, P2255, P2256, P2414, P2415, P2627, P2628, P2630, P2631, and U0107 are not set.
- Engine coolant temperature (ECT) at least 69°C (156°F).
- Intake air temperature (IAT) is at least -13°C (8°F).
- Engine speed is less than 2,600 RPM.
- Vehicle speed is at least 48 km/h (30 mph) at the start of engine decel.
- The EVAP monitor is not running.
- The HO2S heater has been commanded ON for more than 60 seconds.
- DTC P2297 and DTC P2298 run once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

- The HO2S signal voltage is more or less than the expected value during a closed throttle decel lasting at least 4 seconds.
- The above condition is met for at least 6 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Use the J 35616 Connector Test Adapter Kit for any test that requires probing the PCM harness connector or a component harness connector.
- The Loop Status for the respective bank will default to Open when the DTC is current.
- The wide band sensors do not toggle or switch like a switching HO2S. The HO2S signals will be relatively stable for an idling engine.
- Inspect for fuel contamination-Small amounts of water can be delivered to the fuel injectors and cause a lean exhaust indication. A lean exhaust indication can also be caused by too much alcohol in the fuel. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis** .
- Inspect the HO2S bank 1 or bank 2 sensor 1 for water intrusion into the wiring harness and the sensor housing. Water can create a short to voltage in the HO2S signal circuit causing a false rich indication.
- For an intermittent condition, refer to **Intermittent Conditions** .
- The following table illustrates the typical voltages for the HO2S circuits:

HO2S Voltages

• Ignition On, Engine Off • HO2S Disconnected	
HO2S Circuit	**Voltage**
Heater Control	Less than 0.5 V
Heater Supply Voltage	B+
Reference Voltage	3.3-3.8 V
Low Reference	5.9-6.4 V
Pump Current	4.8-5.3 V

Input Pump Current	3.3-3.8 V

Test Description

The numbers below refer to the step numbers on the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step determines weather a condition currently exists.

3: This step isolates the condition. If the DTC for only one bank sets, inspect and test for a condition that would affect only one bank of the engine.

DTC P2297 or P2298 Circuit

<table>
<tr><th>Step</th><th>Action</th><th>Values</th><th>Yes</th><th>No</th></tr>
<tr><td colspan="5">Schematic Reference: <u>Engine Controls Schematics</u>
Connector End View Reference: <u>Powertrain Control Module (PCM) Connector End Views</u> or <u>Engine Controls Connector End Views</u></td></tr>
<tr><td>1</td><td>Did you perform the Diagnostic System Check-Engine Controls?</td><td>-</td><td>Go to Step 2</td><td>Go to <u>Diagnostic System Check - Engine Controls</u></td></tr>
<tr><td>2</td><td>IMPORTANT:
• If any DTCs are set, except P2297 and P2298, refer to those DTCs before proceeding with this diagnostic.
• DTC P2297 is for bank 1 sensor 1 - Rear and DTC P2298 is for bank 2 sensor 1 - Front
1. Observe the Freeze Frame/Failure Records for this DTC.
2. Turn OFF the ignition for 90 seconds.
3. Start the engine.
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.
Did the DTC fail this ignition?</td><td>-</td><td>Go to Step 3</td><td>Go to Diagnostic Aids</td></tr>
<tr><td>3</td><td>Did a DTC for both banks set?</td><td>-</td><td>Go to Step 4</td><td>Go to Step 5</td></tr>
<tr><td></td><td>Visually and physically inspect for any of the following conditions:
• Inspect the vacuum hoses for splits, kinks, and proper connection. Refer to <u>Emission Hose</u></td><td></td><td></td><td></td></tr>
</table>

4	**Routing Diagram** . • Inspect the positive crankcase ventilation (PCV) valve and system for leaks. • Inspect for a collapsed air intake duct. • Inspect for a restricted air filter element. Refer to **Air Cleaner Element Replacement** . • Inspect for excessive fuel in the crankcase. Change the oil as necessary. • Test the fuel system for operating rich or lean. Refer to **Fuel System Diagnosis** . • Inspect for contaminated fuel. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis** . • Inspect the evaporative emission (EVAP) control system for the correct operation. Refer to **Evaporative Emission (EVAP) Control System Description** . • Inspect the exhaust gas recirculation (EGR) value for the correct operation. Refer to **Exhaust Gas Recirculation (EGR) System Description** . • Inspect the engine control grounds for being clean, tight, and in the correct locations. • Inspect for an engine mechanical condition. Refer to **Symptoms - Engine Mechanical** in Engine Mechanical - 3.5L (L66). Did you find and correct the condition?	-	Go to **Step 8**	Go to **Step 6**
5	Visually and physically inspect for any of the following conditions: • Test for restricted or leaking fuel injectors. Refer to **Fuel Injector Balance Test with Tech 2** ,**Fuel Injector Balance Test with Special Tool** and **Fuel Injector Coil Test** . • Inspect for exhaust leaks, missing or loose exhaust hardware. Refer to **Exhaust Leakage** in Engine Exhaust. • Inspect for a restricted exhaust. Refer to **Restricted Exhaust** in Engine Exhaust. • Inspect that the HO2S is installed securely and the electrical connector is not contacting the exhaust system. • Inspect for an engine mechanical condition.	-		

	Refer to **Symptoms - Engine Mechanical** in Engine Mechanical - 3.5L (L66). • Inspect for vacuum leaks that only affect one bank of the engine. For example, the intake manifold, the injector O-rings. Did you find and correct the condition?		Go to **Step 8**	Go to **Step 6**
6	Test for an intermittent and for a poor connection at the HO2S sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 8**	Go to **Step 7**
7	Replace the HO2S sensor. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** or **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1** . Did you complete the replacement?	-	Go to **Step 8**	-
8	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 9**
9	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2413

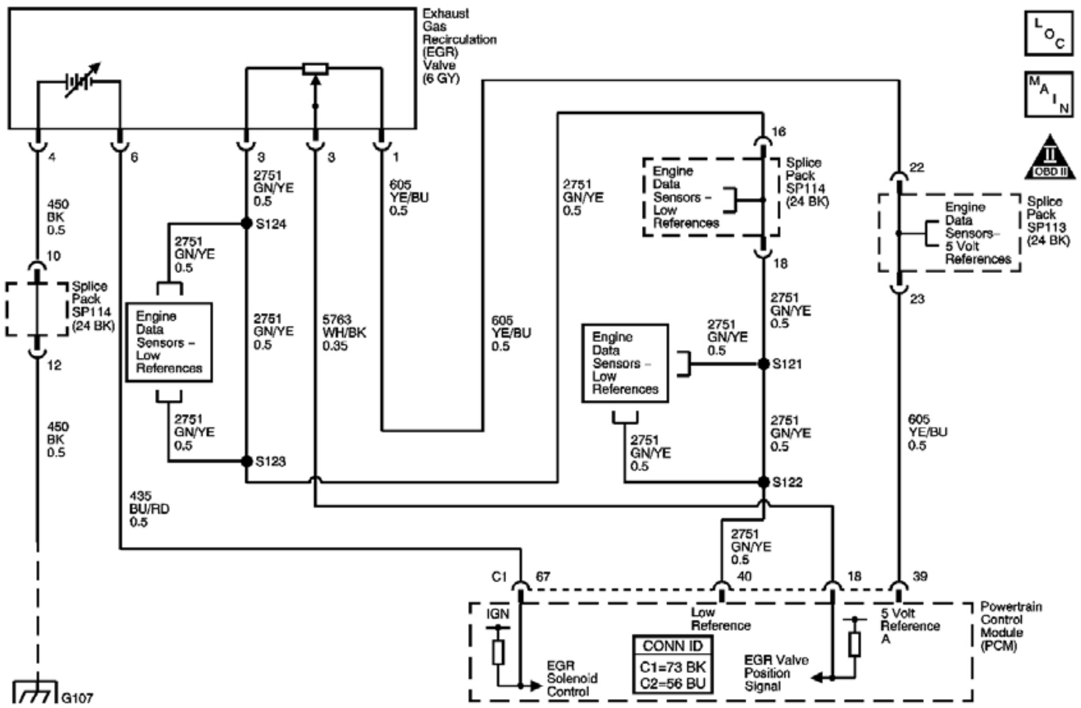


Fig. 1: DTC P2413 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P2413 Exhaust Gas Recirculation (EGR) System Performance diagnostic evaluates the operation of the EGR valve. The powertrain control module (PCM) monitors EGR valve movement with the EGR valve position sensor. The 5-volt reference circuit, low reference circuit and the EGR valve position signal circuit are used by the PCM to determine the EGR valve position. The PCM compares the EGR Position Sensor parameter with the desired EGR Position parameter when the valve is commanded open or closed. If the PCM detects a calibrated difference between the EGR Position Sensor parameter and desired EGR Position parameter for a calibrated amount of time, this DTC sets.

DTC Descriptors

This diagnostic procedure supports the following DTC.

DTC P2413 Exhaust Gas Recirculation (EGR) System Performance

Conditions for Running the DTC

- DTCs P0030, P0050, P0107, P0108, P0112, P0113, P0117, P0118, P0135, P0155, P0335, P0336, P0401, P0403, P0406, P0641, P0651, P1128, P1129, P2414, and P2415 are not set.
- The battery voltage is at least 10.5 volts

- The EGR valve is commanded open at least 1.08 mm (0.043 in).
- Engine speed is less than 4,000 RPM.
- DTC P2413 runs once per drive cycle. When the above conditions are met.

Conditions for Setting the DTC

- The PCM has determined, that the movement of the EGR valve from the closed position, is less than 0.15 mm (0.005 in).
- The above condition is met for more than 5 seconds

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

5: This step tests for high resistance in reference voltage circuit. If the test lamp does not illuminates at all, there is excessive resistance in the 5-volt reference circuit or low reference ground circuit.

8: This step tests for high resistance in the EGR solenoid control circuit and ground circuits. The PCM provides a 12 volt bias signal on the solenoid control circuit that is pulled low when the solenoid is OK and has a good ground. If the circuit resistance is OK, the DMM should measure ignition voltage.

18: After replacing the PCM a new minimum throttle position and idle speed must be established.

DTC P2413 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				

1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Is DTC P0403 or P0406 also set?	-	Go to **DTC P0403** or **DTC P0406**	Go to **Step 3**
3	1. Start the engine. 2. Run the engine until the engine coolant temperature is at least 85°C (185°F). 3. With the scan tool, command the EGR valve from 0 to 100 percent while observing the EGR Sensor data parameter. Refer to **Scan Tool Output Controls** . Did the EGR Sensor voltage increase from the first specified value at 0 percent to more than the second specified value when at 100 percent?	1.15 V 3.10 V	Go to **Step 4**	Go to **Step 6**
4	Command the EGR valve from 0 to 100 percent, while observing the idle speed and engine performance. Did the idle speed decrease or did the engine run rough as the EGR was commanded to 100 percent?	-	Go to **Step 5**	Go to **Step 8**
5	1. Observe the Freeze Frame/Failure Records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 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. Did the DTC fail this ignition?	-	Go to **Step 3**	Go to **Intermittent Conditions**
6	1. Turn OFF the ignition. 2. Disconnect the EGR valve electrical connector. 3. Connect a DMM between the 5-volt reference circuit of the EGR position sensor and ground. 4. Turn ON the ignition, with the engine OFF. Is the voltage near the specified value?	5.0 V	Go to **Step 7**	Go to **Step 12**
	1. Connect a 3-amp fused jumper wire between the 5-volt reference circuit of the EGR			

7	position sensor and the sensor signal circuit. 2. Observe the EGR Sensor parameter on the scan tool. Is the EGR sensor voltage within the specified range?	4.8-5.2 V	Go to **Step 15**	Go to **Step 11**
8	1. Turn OFF the ignition. 2. Disconnect the EGR valve electrical connector. 3. At the EGR valve electrical connector, connect a DMM between the EGR solenoid control circuit and the EGR solenoid ground circuit. 4. Turn ON the ignition, with the engine OFF. Is the voltage at the specified value?	B+	Go to **Step 10**	Go to **Step 9**
9	Connect the DMM between the EGR solenoid control circuit and a known good ground. Is the voltage at the specified value?	B+	Go to **Step 14**	Go to **Step 13**
10	1. Connect a test lamp between the EGR solenoid control circuit and ground. 2. With the scan tool, command the EGR valve from 0 to 100 percent while observing test lamp. Did the test lamp illuminate fully at 100 percent?	-	Go to **Step 17**	Go to **Step 18**
11	Test the EGR position sensor signal circuit for an open or a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 19**	Go to **Step 16**
12	Test the 5-volt reference circuit of the EGR position sensor for an open circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 16**
13	Test the control circuit of the EGR valve for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 16**
14	Repair the open in the ground circuit of the EGR valve. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 19**	-
	Test for an intermittent and for a poor connection at the EGR valve. Refer to **Circuit Testing** and			

15	**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 17**
16	Test for an intermittent and for a poor connection at the PCM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	Go to **Step 18**
17	Replace the EGR valve. Refer to **Exhaust Gas Recirculation (EGR) Valve Replacement** . Did you complete the replacement?	-	Go to **Step 19**	-
18	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 19**	-
19	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 20**
20	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2414

Circuit Description

This diagnostic detects a loose or un-installed sensor. When the heated oxygen (HO2S) sensor is not securely connected to the exhaust pipe, the HO2S feedback indicates normal atmosphere conditions. When the HO2S output stays out of normal range after the HO2S is active, the powertrain control (PCM) module detects the HO2S is disconnected from the exhaust pipe, and this DTC will set.

DTC Descriptors

This diagnostic procedure supports the following DTC.

DTC P2414 HO2S Exhaust Sample Bank 1 Sensor 1

Conditions for Running the DTC

- DTCs P0030, P0135, P2238, P2239< P2243, P2245, P2252, P2253, P2627, and P2628 are not set.
- The engine is running.
- Engine coolant temperature (ECT) at least -20°C (-4°F).
- A fuel cut-off condition has not occurred in more than 5 seconds.
- DTC P2414 runs once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

The HO2S output voltage is more than 2.2 volts.

The above condition is met for at least 7 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

- Use the **J-35616** Connector Test Adapter Kit for any test that requires probing the PCM harness connector or a component harness connector.
- The Loop Status for the respective bank will default to Open when the DTC is current.
- The wide band sensors do not toggle or switch like a switching HO2S. The HO2S signals will be relatively stable for an idling engine.
- For an intermittent condition, refer to **Intermittent Conditions** .
- The following table illustrates the typical voltages for the HO2S circuits:

HO2S Voltages

• Ignition On, Engine Off • HO2S Disconnected	
HO2S Circuit	**Voltage**
Heater Control	Less than 0.5 V

Heater Supply Voltage	B+
Reference Voltage	3.3-3.8 V
Low Reference	5.9-6.4 V
Pump Current	4.8-5.3 V
Input Pump Current	3.3-3.8 V

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step verifies that there is no other condition with the HO2S circuits.

4: This step verifies that a condition exists. If the HO2S is secure in the exhaust system and the DTC fails this ignition, replace the HO2S.

DTC P2414 Circuit

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the DTC information with a scan tool. Is DTC P2238, P2239, P2243, P2245, P2252, P2253, P2627, or P2628 set?	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	Inspect the condition of the appropriate HO2S. Is the HO2S loose in the exhaust pipe?	Go to **Step 5**	Go to **Step 4**
4	1. Observe the Freeze Frame/Failure records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition cycle?	Go to **Step 6**	Go to Diagnostic Aids
5	Reinstall the appropriate HO2S. Did you complete the repair?	Go to **Step 7**	-
6	Replace the HO2S sensor. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** . Did you complete the replacement?	Go to **Step 7**	-
	1. Use the scan tool in order to clear the DTCs.		

7	2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. Does the DTC run and pass?	Go to **Step 8**	Go to **Step 2**
8	With a scan tool, select Capture Info in order to observe the stored information. Does the scan tool display any DTCs that you have not diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2415

Circuit Description

This diagnostic detects a loose or un-installed sensor. When the heated oxygen (HO2S) sensor is not securely connected to the exhaust pipe, the HO2S feedback indicates normal atmosphere conditions. When the HO2S output stays out of normal range after the HO2S is active, the powertrain control (PCM) module detects the HO2S is disconnected from the exhaust pipe, and this DTC will set.

DTC Descriptors

This diagnostic procedure supports the following DTC.

DTC P2415 HO2S Exhaust Sample Bank 2 Sensor 1

Conditions for Running the DTC

- DTCs P0050, P0155, P2241, P2241, P2242, P2247, P2249, P2255, P2256, P2630 and P2631 are not set.
- The engine is running.
- A fuel cut-off condition has not occurred in more than 5 seconds.
- DTC P2415 runs once per drive cycle when the above conditions are met.

Conditions for Setting the DTC

The HO2S output voltage is more than 2.2 volts.

The above condition is met for at least 7 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

- Use the **J-35616** Connector Test Adapter Kit for any test that requires probing the PCM harness connector or a component harness connector.
- The Loop Status for the respective bank will default to Open when the DTC is current.
- The wide band sensors do not toggle or switch like a switching HO2S. The HO2S signals will be relatively stable for an idling engine.
- For an intermittent condition, refer to **Intermittent Conditions** .
- The following table illustrates the typical voltages for the HO2S circuits:

HO2S Voltages

• **Ignition On, Engine Off** • **HO2S Disconnected**	
HO2S Circuit	**Voltage**
Heater Control	Less than 0.5 V
Heater Supply Voltage	B+
Reference Voltage	3.3-3.8 V
Low Reference	5.9-6.4 V
Pump Current	4.8-5.3 V
Input Pump Current	3.3-3.8 V

Test Description

2: This step verifies that there is no other condition with the HO2S circuits.

4: This step verifies that a condition exists. If the HO2S is secure in the exhaust system and the DTC fails this ignition, replace the HO2S.

DTC P2415 Circuit

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	1. Turn ON the ignition, with the engine OFF.		

2	2. Observe the DTC information with a scan tool. Is DTC P2241, P2242, P2247, P2249, P2255, P2256, P2630, or P2631 set?	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	Inspect the condition of the appropriate HO2S. Is the HO2S loose in the exhaust pipe?	Go to **Step 5**	Go to **Step 4**
4	1. Observe the Freeze Frame/Failure records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition cycle?	Go to **Step 6**	Go to Diagnostic Aids
5	Reinstall the appropriate HO2S. Did you complete the repair?	Go to **Step 7**	-
6	Replace the HO2S sensor. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1** . Did you complete the replacement?	Go to **Step 7**	-
7	1. Use the scan tool in order to clear the DTCs. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. Does the DTC run and pass?	Go to **Step 8**	Go to **Step 2**
8	With a scan tool, select Capture Info in order to observe the stored information. Does the scan tool display any DTCs that you have not diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2553

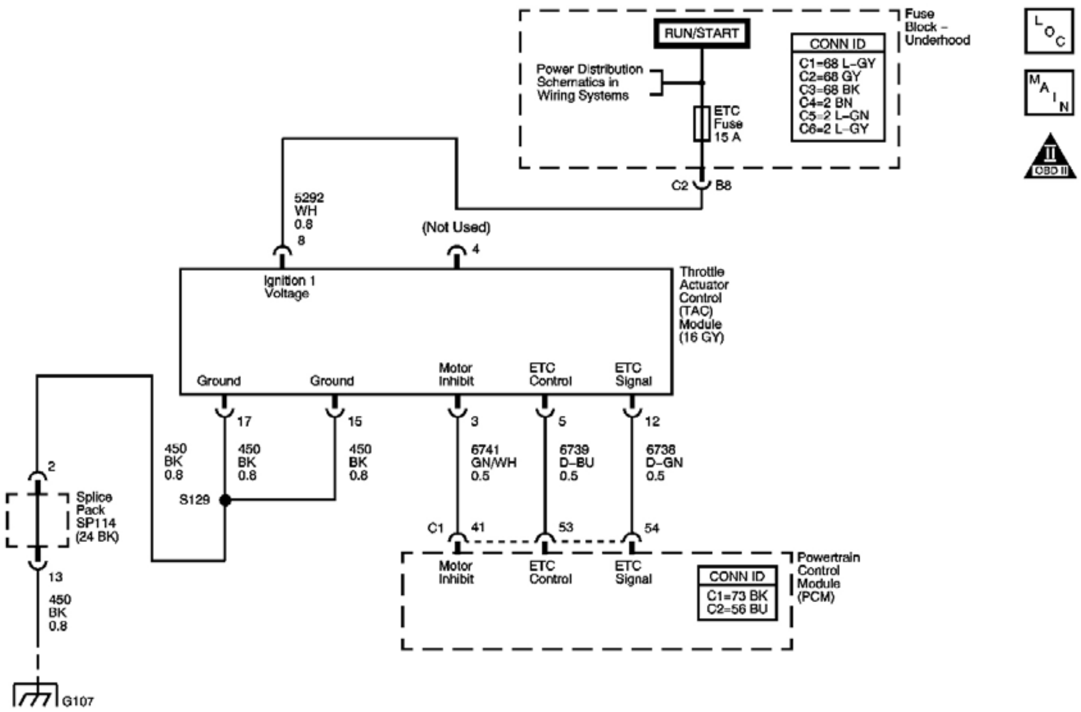


Fig. 2: DTC P2553 Circuit
Courtesy of GENERAL MOTORS CORP.

Description

The DTC P2553 Throttle Actuator Control (TAC) Inhibit Control Performance diagnostic detects a fault in the TAC motor control circuit. The powertrain control module (PCM) receives accelerator pedal position (APP) sensor information and calculates the desired throttle position. The PCM sends this desired throttle position or target value to the TAC module. The TAC module achieves the desired throttle position by commanding the throttle control motor to position the throttle valve at the target value. The TAC module then compares the TP sensor 1 value to the target value. If necessary, the throttle control motor is moved slightly in order to obtain the exact target value position. If activity is detected in the TAC motor control circuitry when there should be no activity, DTC P2553 sets. The TAC motor and circuitry are integral parts of the TAC module and are not serviced separately. The TAC module is not serviceable and must be replaced with the throttle body assembly. For additional information on the operation of the TAC system refer to **Throttle Actuator Control (TAC) System Description** .

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P2553 Throttle Actuator Control (TAC) Inhibit Control Performance

Conditions for Running the DTC

- DTC P2108 is not set.
- The ignition is ON.
- Battery voltage is at least 8.0 volts.
- DTC P2553 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The control circuit of the TAC motor appears to be active, even when no motor commands have been given.
- The above conditions is present for at least 300 milliseconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame buffer.

Conditions for Clearing the MIL/DTC

- The MIL turns OFF after 3 consecutively passing trips without a fault present.
- A history DTC clears after 40 consecutive warm-up cycles without a fault.
- Perform the scan tool Clear DTC Information function.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

3: The normal voltage reading is approximately 0.67 volts. If the conditions for a DTC P2553 are present, the circuit voltage would default to 0.0 volts.

5: After replacing the TAC module, a new minimum throttle position and idle speed must also be established.

DTC P2553 Circuit

Step	Action	Value (s)	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	1. Turn ON the ignition, leaving the engine			

2	OFF. 2. Use the scan tool in order to clear the DTCs. 3. Start and run the engine for 1 minute. Is a DTC P2553 set?	-	Go to **Step 4**	Go to **Step 3**
3	1. Turn ON the ignition, with the engine OFF. 2. Observe the voltage on the TAC Module Power Inhibit Feedback parameter of the scan tool. Is the voltage within the specified range?	0.63-0.70 V	Go to **Intermittent Conditions**	Go to **Step 4**
4	1. Inspect for a short to voltage in the ETC Signal circuit. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 6**	Go to **Step 5**
5	1. Replace the TAC module. Refer to **Throttle Body Assembly Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 6**	-
6	1. Use the scan tool in order to clear the DTCs. 2. Start the engine. 3. Operate the vehicle within the Freeze Frame conditions as specified or until the DTC P2553 diagnostic test has run. Refer to the Test Description. Does the DTC run and pass?	-	Go to **Step 7**	Go to **Step 2**
7	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2554

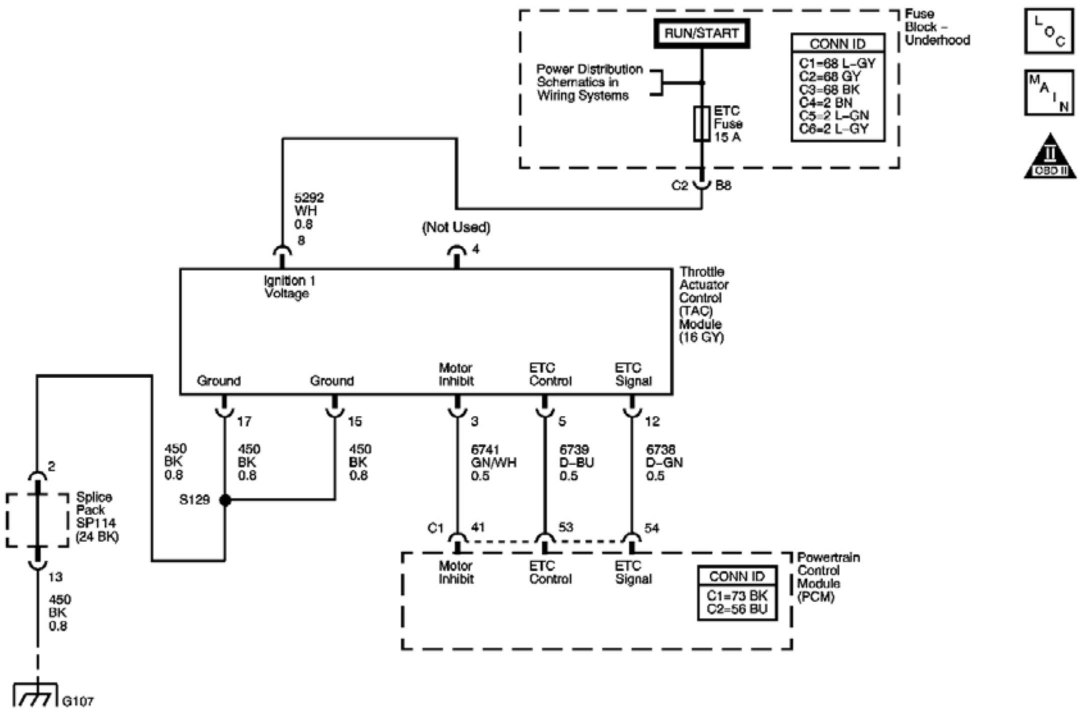


Fig. 3: DTC P2554 Circuit
Courtesy of GENERAL MOTORS CORP.

Description

The DTC P2554 Throttle Actuator Control (TAC) Inhibit Circuit Low Voltage diagnostic detects a fault in the TAC motor control circuit. The powertrain control module (PCM) receives accelerator pedal position (APP) sensor information and calculates the desired throttle position. The PCM sends this desired throttle position or target value to the TAC module. The TAC module achieves the desired throttle position by commanding the throttle control motor to position the throttle valve at the target value. The TAC module then compares the TP sensor 1 value to the target value. If necessary, the throttle control motor is moved slightly in order to obtain the exact target value position. If the TAC motor control circuit voltage is too low, DTC P2554 sets. The TAC motor and circuitry are integral parts of the TAC module and are not serviced separately. The TAC module is not serviceable and must be replaced with the throttle body assembly. For additional information on the operation of the TAC system refer to **Throttle Actuator Control (TAC) System Description** .

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P2554 Throttle Actuator Control (TAC) Inhibit Circuit Low Voltage

Conditions for Running the DTC

- DTC P0122, P0123, P0222, P0223, P)641, P0651, P2100, P2101, P2108, P2122, P2123, P2127, P2128, P2138, P2176, and U0107 are not set.
- The ignition is ON.
- DTC P2554 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The control circuit of the TAC motor is less than 0.48 volts when the motor is active.
- The above conditions is present for at least 160 milliseconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame buffer.

Conditions for Clearing the MIL/DTC

- The MIL turns OFF after 3 consecutively passing trips without a fault present.
- A history DTC clears after 40 consecutive warm-up cycles without a fault.
- Perform the scan tool Clear DTC Information function.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

3: The normal voltage reading is approximately 0.67 volts. If the conditions for a DTC P2554 are present, the circuit voltage would default to 0.0 volts.

5: This step checks for an open in the TAC module electrical grounds. The TAC module can not operate correctly if there are faulty electrical grounds.

6: After replacing the TAC module, a new minimum throttle position and idle speed must also be established.

DTC P2554 Circuit

Step	Action	Value (s)	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**

2	1. Turn ON the ignition, leaving the engine OFF. 2. Use the scan tool in order to clear the DTCs. 3. Start and run the engine for 1 minute. Is a DTC P2554 set?	-	Go to **Step 4**	Go to **Step 3**
3	1. Turn ON the ignition, with the engine OFF. 2. Observe the voltage on the TAC Module Power Inhibit Feedback parameter of the scan tool. Is the voltage within the specified range?	0.63-0.70 V	Go to **Intermittent Conditions**	Go to **Step 4**
4	1. Inspect for a short to ground or an open in the ETC Motor Inhibit circuit. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 7**	Go to **Step 5**
5	1. Inspect for an intermittent or poor electrical connection at TAC module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 7**	Go to **Step 6**
6	1. Replace the TAC module. Refer to **Throttle Body Assembly Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 7**	-
7	1. Use the scan tool in order to clear the DTCs. 2. Start the engine. 3. Operate the vehicle within the Freeze Frame conditions as specified or until the DTC P2554 diagnostic test has run. Refer to the Test Description. Does the DTC run and pass?	-	Go to **Step 8**	Go to **Step 2**
	With a scan tool, observe the stored information,			

8	Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2555

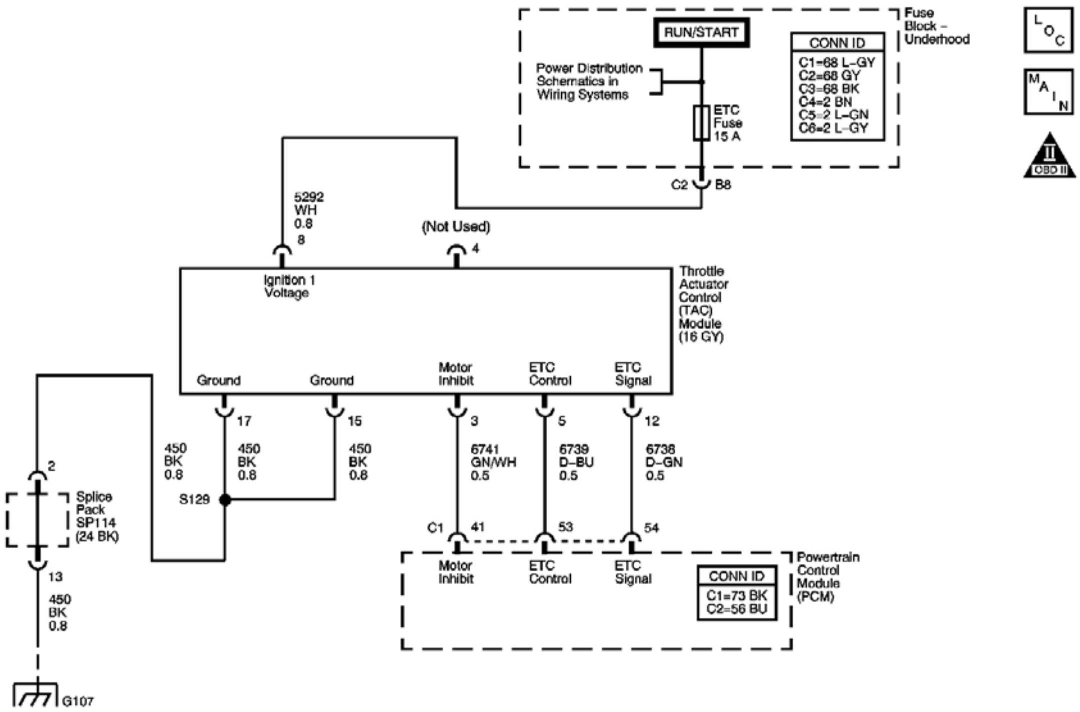


Fig. 4: DTC P2555 Circuit
Courtesy of GENERAL MOTORS CORP.

Description

The DTC P2555 Throttle Actuator Control (TAC) Inhibit Circuit High Voltage diagnostic detects a fault in the TAC motor control circuit. The powertrain control module (PCM) receives accelerator pedal position (APP) sensor information and calculates the desired throttle position. The PCM sends this desired throttle position or target value to the TAC module. The TAC module achieves the desired throttle position by commanding the throttle control motor to position the throttle valve at the target value. The TAC module then compares the TP sensor 1 value to the target value. If necessary, the throttle control motor is moved slightly in order to obtain the exact target value position. If the TAC motor control circuit voltage is too high, DTC P2555 sets. The TAC motor and circuitry are integral parts of the TAC module and are not serviced separately. The TAC module is not serviceable and must be replaced with the throttle body assembly. For additional information on the operation of the TAC system refer to **Throttle Actuator Control (TAC) System Description** .

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC P2555 Throttle Actuator Control (TAC) Inhibit Circuit High Voltage

Conditions for Running the DTC

- Before the PCM can report DTC P2555 failed, DTC P2554 must run and pass.
- The ignition is ON.
- DTC P2555 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The PCM has detected a lower than expected voltage on the TAC motor control circuit, when the motor is inactive, or a higher than expected voltage when the motor is active.
- The above conditions is present for at least 160 milliseconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame buffer.

Conditions for Clearing the MIL/DTC

- The MIL turns OFF after 3 consecutively passing trips without a fault present.
- A history DTC clears after 40 consecutive warm-up cycles without a fault.
- Perform the scan tool Clear DTC Information function.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

3: The normal voltage reading is approximately 0.67 volts. If the conditions for a DTC P2555 are present, the circuit voltage would default to 0.0 volts.

5: This step checks for an open in the TAC module electrical grounds. The TAC module can not operate correctly if there are faulty electrical grounds.

8: After replacing the TAC module, a new minimum throttle position and idle speed must also be established.

DTC P2555 Circuit

Step	Action	Value	Yes	No

		(s)		
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, leaving the engine OFF. 2. Use the scan tool in order to clear the DTCs. 3. Start and run the engine for 1 minute. Is a DTC P2555 set?	-	Go to **Step 4**	Go to **Step 3**
3	1. Turn ON the ignition, with the engine OFF. 2. Observe the voltage on the TAC Module Power Inhibit Feedback parameter of the scan tool. Is the voltage within the specified range?	0.63-0.70 V	Go to **Intermittent Conditions**	Go to **Step 4**
4	1. Inspect for a short to voltage in the ETC Motor Inhibit circuit. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 5**
5	Probe each TAC module ground circuit with a test lamp connected to B+. Did the test lamp illuminate on both ground circuits?	-	Go to **Step 7**	Go to **Step 6**
6	Repair the open in the ground circuits of the TAC module. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 9**	-
7	1. Inspect for an intermittent or poor electrical connection at TAC module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 8**
	1. Replace the TAC module. Refer to **Throttle Body Assembly Replacement** .			

8	2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 9**	-
9	1. Use the scan tool in order to clear the DTCs. 2. Start the engine. 3. Operate the vehicle within the Freeze Frame conditions as specified or until the DTC P2555 diagnostic test has run. Refer to the Test Description. Does the DTC run and pass?	-	Go to **Step 10**	Go to **Step 2**
10	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2627 OR P2630

Circuit Description

The wide band heated oxygen sensor (HO2S) measures the amount of oxygen in the exhaust system and provides more information than the switching style HO2S. The wide band sensor consists of an oxygen sensing cell, an oxygen pumping cell, and a heater. The exhaust gas sample passes through a diffusion gap between the sensing cell and the pumping cell. The powertrain control module (PCM) supplies a voltage to the HO2S and uses this voltage as a reference to the amount of oxygen in the exhaust system. An electronic circuit within the PCM controls the pump current through the oxygen pumping cell in order to maintain a constant voltage in the oxygen sensing cell. The PCM monitors the voltage variation in the sensing cell and attempts to keep the voltage constant by increasing or decreasing the amount of current flow, or oxygen ion flow, to the pumping cell. By measuring the amount of current required to maintain the voltage in the sensing cell, the PCM can determine the concentration of oxygen in the exhaust. The HO2S voltage is displayed as a lambda value. A lambda value of 1 is equal to a stoichiometric air fuel ratio of 14.7:1. Under normal operating conditions, the lambda value will remain around 1. When the fuel system is lean, the oxygen level will be high and the lambda signal will be high or more than 1. When the fuel system is rich, the oxygen level will be low, and the lambda signal will be low or less than 1. The PCM uses this information to maintain the correct air/fuel ratio. If the PCM detects that the pumping current circuit voltage is less than a predetermined value, this DTC sets.

DTC Descriptors

This diagnostic procedure supports the following DTCs.

- DTC P2627 HO2S Pumping Current Trim Circuit Low Voltage Bank 1 Sensor 1
- DTC P2630 HO2S Pumping Current Trim Circuit Low Voltage Bank 2 Sensor 1

Conditions for Running the DTC

- DTCs P0443, P2414, and P2415 are not set.
- The ignition is ON.
- The HO2S heater is commanded ON.
- DTC P2627, and DTC P2630, run continuously once the above conditions are met.

Conditions for Setting the DTC

- The HO2S pumping current circuit voltage is less than 0.4 volts.
- The above condition is met for at least 5 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

- Use the **J-35616** Connector Test Adapter Kit for any test that requires probing the PCM harness connector or a component harness connector.
- The Loop Status for the respective bank will default to Open when the DTC is current.
- The wide band sensors do not toggle or switch like a switching HO2S. The HO2S signals will be relatively stable for an idling engine.
- For an intermittent condition, refer to **Intermittent Conditions** .
- The following table illustrates the typical voltages for the HO2S circuits:

HO2S Voltages

• **Ignition On, Engine Off** • **HO2S Disconnected**	
HO2S Circuit	**Voltage**
Heater Control	Less than 0.5 V
Heater Supply Voltage	B+
Reference Voltage	3.3-3.8 V

Low Reference	5.9-6.4 V
Pump Current	4.8-5.3 V
Input Pump Current	3.3-3.8 V

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step determines whether a condition currently exists. If the Lambda value fluctuates near 1.00 and Loop Status is Closed, the HO2S is operating correctly.

4: This step tests for a condition in the pump current circuit. Test for a short to ground, or a wire to wire short to the low reference circuit C1-40, if the voltage measures less than 4.8 volts.

6: Inspect the HO2S connector for water intrusion, corrosion, and bent or damaged terminals.

7: Inspect the PCM connectors for water intrusion, corrosion, and bent or damaged terminals.

9: After replacing the PCM, a new minimum throttle position and idle speed must be established.

DTC P2627 or P2630 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **DTC P2627 is for bank 1 sensor 1 - Rear and DTC P2630 is for bank 2 sensor 1 - Front.** 1. Allow the engine to reach operating temperature. 2. Observe the Loop Status Bank 1 or Loop Status Bank 2 with a scan tool. Does the scan tool display Closed Loop?	-	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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.	-		

	Did the DTC fail this ignition?		Go to **Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the appropriate HO2S sensor connector. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage between the HO2S pump current circuit and a good ground with a DMM. Is the voltage less than the specified value?	4.8 V	Go to **Step 5**	Go to **Step 6**
5	Test the pump current circuit of the HO2S for a short to ground or a short to the low reference circuit. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 7**
6	Test for shorted terminals and for poor connections at the HO2S sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 8**
7	Test for shorted terminals and for poor connections at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 9**
8	Replace the HO2S sensor. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** or **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1** . Did you complete the replacement?	-	Go to **Step 10**	-
9	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 10**	-
10	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?		Go to **Step 2**	Go to **Step 11**
11	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2628 OR P2631

Circuit Description

The wide band heated oxygen sensor (HO2S) measures the amount of oxygen in the exhaust system and provides more information than the switching style HO2S. The wide band sensor consists of an oxygen sensing cell, an oxygen pumping cell, and a heater. The exhaust gas sample passes through a diffusion gap between the sensing cell and the pumping cell. The powertrain control module (PCM) supplies a voltage to the HO2S and uses this voltage as a reference to the amount of oxygen in the exhaust system. An electronic circuit within the PCM controls the pump current through the oxygen pumping cell in order to maintain a constant voltage in the oxygen sensing cell. The PCM monitors the voltage variation in the sensing cell and attempts to keep the voltage constant by increasing or decreasing the amount of current flow, or oxygen ion flow, to the pumping cell. By measuring the amount of current required to maintain the voltage in the sensing cell, the PCM can determine the concentration of oxygen in the exhaust. The HO2S voltage is displayed as a lambda value. A lambda value of 1 is equal to a stoichiometric air fuel ratio of 14.7:1. Under normal operating conditions, the lambda value will remain around 1. When the fuel system is lean, the oxygen level will be high and the lambda signal will be high or more than 1. When the fuel system is rich, the oxygen level will be low, and the lambda signal will be low or less than 1. The PCM uses this information to maintain the correct air/fuel ratio. If the PCM detects that the pumping current circuit voltage is more than a predetermined value, this DTC sets.

DTC Descriptors

This diagnostic procedure supports the following DTCs.

- DTC P2628 HO2S Pumping Current Trim Circuit High Voltage Bank 1 Sensor 1
- DTC P2631 HO2S Pumping Current Trim Circuit High Voltage Bank 2 Sensor 1

Conditions for Running the DTC

- DTCs P0443, P2414, and P2415 are not set.
- The ignition is ON.
- The HO2S heater is commanded ON.
- DTC P2628 and DTC P2631, run continuously once the above conditions are met.

Conditions for Setting the DTC

- The HO2S pumping current circuit voltage is more than 4.68 volts.

- The above condition is met for at least 5 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The PCM stores this information in the Freeze Frame and/or Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A last test failed, or current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use a scan tool in order to clear the MIL and the DTC.

Diagnostic Aids

- Use the **J-35616** Connector Test Adapter Kit for any test that requires probing the PCM harness connector or a component harness connector.
- The Loop Status for the respective bank will default to Open when the DTC is current.
- The wide band sensors do not toggle or switch like a switching HO2S. The HO2S signals will be relatively stable for an idling engine.
- For an intermittent condition, refer to **Intermittent Conditions** .
- The following table illustrates the typical voltages for the HO2S circuits:

HO2S Voltages

• Ignition On, Engine Off • HO2S Disconnected	
HO2S Circuit	**Voltage**
Heater Control	Less than 0.5 V
Heater Supply Voltage	B+
Reference Voltage	3.3-3.8 V
Low Reference	5.9-6.4 V
Pump Current	4.8-5.3 V
Input Pump Current	3.3-3.8 V

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step determines whether a condition currently exists. If the Lambda value fluctuates near 1.00 and

Loop Status is Closed, the HO2S is operating correctly.

4: This step tests for a condition in the pump current circuit. Test for an open, a high resistance, or a short to voltage, if the voltage measured is not within the specified range.

6: Inspect the HO2S connector for water intrusion, corrosion, and bent or damaged terminals.

7: Inspect the PCM connectors for water intrusion, corrosion, and bent or damaged terminals.

9: After replacing the PCM, a new minimum throttle position and idle speed must be established.

DTC P2628 or P2631 Circuit

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **DTC P2628 is for bank 1 sensor 1 - Rear and DTC P2631 is for bank 2 sensor 1 - Front.** 1. Allow the engine to reach operating temperature. 2. Observe the Loop Status Bank 1 or Loop Status Bank 2 with a scan tool. Does the scan tool display Closed Loop?	-	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the appropriate HO2S sensor connector. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage between the HO2S pump current circuit and a good ground with a	4.8-5.3 V		

	DMM. Is the voltage within the specified range?		Go to **Step 6**	Go to **Step 5**
5	Test the pump current circuit of the HO2S for an open, a high resistance, or a short to voltage. Refer to **Circuit Testing** and**Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 7**
6	Test for shorted terminals and for poor connections at the HO2S sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 8**
7	Test for shorted terminals and for poor connections at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 9**
8	Replace the HO2S sensor. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** or **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1** . Did you complete the replacement?	-	Go to **Step 10**	-
9	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 10**	-
10	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 90 seconds. 3. Start the engine. 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. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 11**
11	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2646

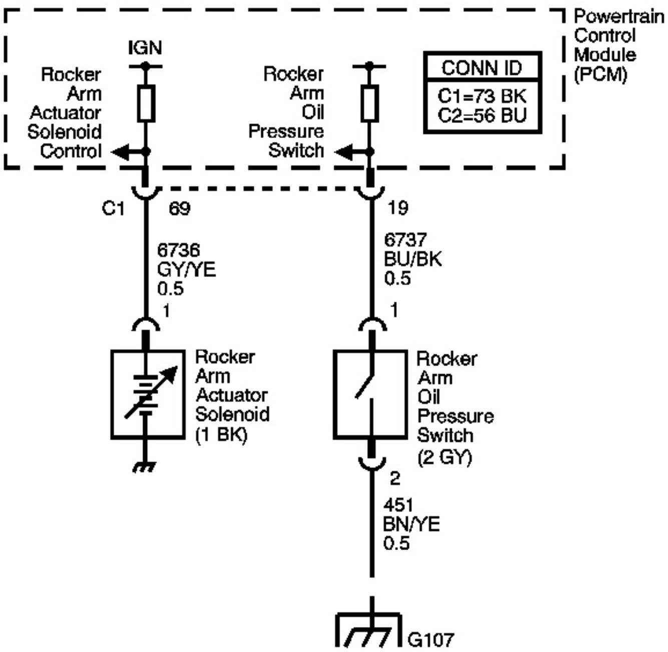


Fig. 5: DTC P2646 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P2646 Intake Rocker Arm Actuator System Stuck Off diagnostic monitors the operation of the rocker arm oil control solenoid. The rocker arm oil control solenoid enables the powertrain control module (PCM) to operate the high speed cam system. The high speed cam system significantly increases valve lift at engine speeds above 4,400 RPM. A second camshaft lobe with a high lift profile is cast into each camshaft, alongside the low/medium speed lobes. Unique rocker arms follow both the high speed and low/medium speed cam lobes. At engine speeds below 4,400 RPM, the low/medium speed cam lobes operate the rocker arms. When the rocker arm oil control solenoid is turned ON between 4,400-6,500 RPM, the rocker arms are operated by the high speed cam lobes. The rocker arm oil control solenoid is energized by a 12-volt signal from the PCM.

The rocker arm oil pressure switch detects oil pressure when oil is flowing thru the rocker arm oil supply system. When the rocker arm oil control solenoid is ON, the oil pressure switch opens and the signal circuit to the PCM remains high. A DTC P2646 sets when the signal circuit of the rocker arm oil pressure switch remains low even when engine speed is more than 4,400 RPM. For additional information on the operation of the rocker arm oil control system refer to **Rocker Arm Oil Control System Description** .

Rocker Arm Actuator System Operation

Rocker Arm Oil Control Solenoid	Oil Pressure/Flow	Rocker Arm Oil Pressure Switch
On	High	Open

Off	Low	Closed

DTC Descriptors

This diagnostic procedure supports the following DTC.

DTC P2646 Intake Rocker Arm Actuator System Stuck Off

Conditions for Running the DTC

- Battery voltage is at least 10.5 volts.
- The engine coolant temperature (ECT) is at least 10°C (50°F).
- Engine speed is more than 4,900 RPM.
- The transmission is not in Park or Neutral.
- DTC P2646 runs every time the enable criteria is met and the rocker arm oil control system is active.

Conditions for Setting the DTC

- The signal circuit of the rocker arm oil pressure switch stays low.
- The above condition is present for at least 5 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL).
- The PCM stores the conditions that were present when the DTC set as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL on the third consecutive trip cycle during which the diagnostic has been run and the fault condition is no longer present.
- A DTC clears after 40 consecutive warm-up cycles have occurred without a fault.
- A DTC can be cleared by using the scan tool Clear DTC Information function.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

3: This step checks for a short to ground in the oil pressure switch signal circuit. A DTC P2647 will set if the signal circuit is not shorted to ground.

4: This step checks the operation of the rocker arm oil control solenoid. When commanded ON, oil pressure should increase to at least 392 kPa (56 psi).

6: This step tests the operation of the rocker arm oil pressure switch. The oil pressure switch is normally closed to ground with less than 48 kPa (7 psi) of oil pressure. With the oil control solenoid energized oil pressure will open the switch and the scan tool should indicate ON.

11: After replacing the PCM the relationship between the CKP sensor and the crankshaft must be re-established. A new minimum throttle position and idle speed must also be established.

DTC P2646 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn OFF the ignition. 2. Disconnect the rocker arm oil control solenoid. 3. Measure the resistance of the solenoid with a DMM. Is the resistance within the specified range?	14-30 ohm at 20°C (68°F)	Go to **Step 3**	Go to **Step 10**
3	1. Turn ON the ignition with the engine OFF. 2. Leave the rocker arm oil control solenoid disconnected. 3. Clear any DTCs with the scan tool. 4. Wait 10 seconds and check for DTCs. Did a DTC P2647 set?	-	Go to **Step 4**	Go to **Step 8**
4	1. Remove the oil pressure switch. 2. Install the **EN 46332** oil pressure gage adapter to the engine. 3. Install the oil pressure gage from the **SA9127E** bar gage set to the adapter. 4. Install the oil pressure switch to the adapter. 5. Start and run the engine until the coolant temperature is 85°C (185°F). 6. Increase the engine speed to 2,800 RPM. 7. Command the intake rocker arm actuator solenoid ON with the scan tool. Refer to **Scan Tool Output**	392 kPa (56 psi)		

	Controls . Is the oil pressure more than the specified value?		Go to **Step 6**	Go to **Step 5**
5	1. Turn OFF the ignition. 2. Remove the rocker arm oil control solenoid. Refer to **Rocker Arm Oil Control Solenoid Valve Replacement** . 3. Inspect for any of the following conditions: • A stuck or binding spool valve • A restriction or blockage in the oil passages. 4. Repair any condition as necessary. Did you find and correct a condition?	-	Go to **Step 12**	Go to **Step 9**
6	1. Observe the intake rocker arm actuator oil pressure switch parameter on the scan tool. 2. Increase the engine speed to 2,800 RPM. 3. Command the rocker actuator solenoid ON with the scan tool. Did the oil pressure switch indicate ON when the solenoid was commanded ON?	-	Go to **Intermittent Conditions**	Go to **Step 6**
7	1. Disconnect the electrical connector of the rocker arm oil pressure switch. 2. Connect a DMM to the signal circuit of the oil pressure switch and ground. 3. Turn ON the ignition, with the engine OFF. 4. Measure the DC voltage. Is the voltage more than the specified value?	6.9 V	Go to **Step 10**	Go to **Step 8**
8	1. Inspect for a short to ground in the signal circuit of the rocker arm oil pressure switch. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems.	-		

	Did you find and correct a condition?		Go to **Step 12**	Go to **Step 11**
9	Replace the rocker arm oil control solenoid valve. Refer to **Rocker Arm Oil Control Solenoid Valve Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
10	Replace the rocker arm oil pressure switch. Refer to **Rocker Arm Oil Pressure Switch Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
11	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Use the scan tool in order to clear the DTCs. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC run and pass?	-	Go to **Step 13**	Go to **Step 2**
13	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2647

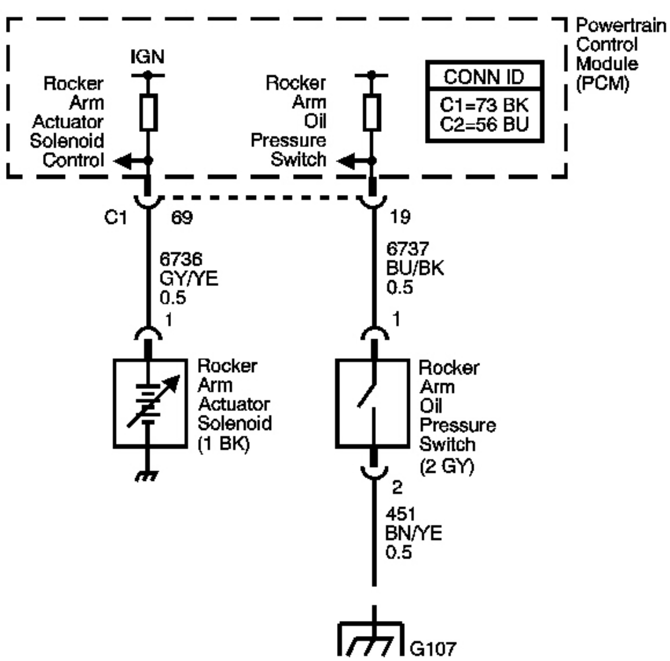


Fig. 6: DTC P2647 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P2647 Intake Rocker Arm Actuator System Stuck On diagnostic monitors the operation of the rocker arm oil control solenoid. The rocker arm oil control solenoid enables the powertrain control module (PCM) to operate the high speed cam system. The high speed cam system significantly increases valve lift at engine speeds above 4,400 RPM. A second camshaft lobe with a high lift profile is cast into each camshaft, alongside the low/medium speed lobes. Unique rocker arms follow both the high speed and low/medium speed cam lobes. At engine speeds below 4,400 RPM, the low/medium speed cam lobes operate the rocker arms. When the rocker arm oil control solenoid is turned ON between 4,400-6,500 RPM, the rocker arms are operated by the high speed cam lobes. The rocker arm oil control solenoid is energized by a 12-volt signal from the PCM.

The rocker arm oil pressure switch detects oil pressure when oil is flowing thru the rocker arm oil supply system. When the rocker arm oil control solenoid is ON, the oil pressure switch opens and the signal circuit to the PCM remains high. A DTC P2647 sets when the signal circuit of the rocker arm oil pressure switch is high when engine speed is less than 4,200 RPM. For additional information on the operation of the rocker arm oil control system refer to **Rocker Arm Oil Control System Description** .

Rocker Arm Actuator System Operation

Rocker Arm Oil Control Solenoid	Oil Pressure/Flow	Rocker Arm Oil Pressure Switch
On	High	Open

Off	Low	Closed

DTC Descriptors

This diagnostic procedure supports the following DTC.

DTC P2647 Intake Rocker Arm Actuator System Stuck On

Conditions for Running the DTC

- Battery voltage is at least 10.5 volts
- The engine coolant temperature (ECT) is at least 10°C (50°F).
- Engine speed is less than 4,200 RPM
- The transmission is not in Park or Neutral
- DTC P2647 runs every time the enable criteria is met and the rocker arm oil control system is active.

Conditions for Setting the DTC

- The signal circuit of the rocker arm oil pressure switch stays high.
- The above condition is present for at least 5 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL).
- The PCM stores the conditions that were present when the DTC set as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL on the third consecutive trip cycle during which the diagnostic has been run and the fault condition is no longer present.
- A DTC clears after 40 consecutive warm-up cycles have occurred without a fault.
- A DTC can be cleared by using the scan tool Clear DTC Information function.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

2: This step checks whether the condition that caused the DTC to set still exists.

4: The rocker arm oil pressure switch is closed when oil pressure is less than 49 kPa (7 psi).

8: This step tests for a stuck on rocker arm oil control solenoid.

14: After replacing the PCM, a new minimum throttle position and idle speed must also be established.

DTC P2647 Circuit

Step	Action	Values	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Install a scan tool. 2. Start the engine. 3. Observe the Intake Rocker Arm Actuator Oil Pressure Switch parameter on the scan tool. Is the oil pressure switch indicating ON?	-	Go to **Step 4**	Go to **Step 3**
3	1. Use the scan tool in order to clear the DTCs. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Freeze Frame conditions as specified or within the Conditions for Running the DTC. Did a DTC P2647 set?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the electrical connector of the rocker arm oil pressure switch. 3. Measure the resistance of the rocker arm oil pressure switch. Is the resistance less than the specified value?	3ohm	Go to **Step 5**	Go to **Step 12**
5	1. Connect a DMM to the signal circuit of the oil pressure switch and a good ground. 2. Turn ON the ignition, with the engine OFF. Is the signal circuit voltage more than the specified value?	6.9 V	Go to **Step 6**	Go to **Step 7**
6	1. Test for an open or high resistance in the ground circuit of the rocker arm oil pressure switch. 2. Inspect for poor electrical connections at the rocker arm oil pressure switch and G107. Refer to **Testing for Intermittent Conditions and Poor Connections** in	-		

	Wiring Systems. 3. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct a condition?		Go to **Step 15**	Go to **Step 8**
7	1. Test for an open in the input circuit of the rocker arm oil pressure switch. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 15**	Go to **Step 13**
8	1. Remove the oil pressure switch. 2. Install the **EN 46332** oil pressure gage adapter to the engine. 3. Install the oil pressure gage from the **SA9127E** bar gage set to the adapter. 4. Install the oil pressure switch to the adapter. 5. Start the engine. Is the oil pressure indicated on the oil pressure gage more than the specified value?	49 kPa (7 psi)	Go to **Step 9**	Go to **Step 11**
9	1. Inspect for any of the following conditions: • A stuck or binding spool valve • A damaged and leaking spool valve • A broken spool valve spring 2. Repair any condition as necessary. Did you find and correct a condition?	-	Go to **Step 15**	Go to **Step 10**
10	Replace the rocker arm oil control solenoid valve. Refer to **Rocker Arm Oil Control Solenoid Valve Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
11	Inspect for poor electrical connections at the rocker arm oil pressure switch. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 15**	Go to **Step 13**
12	Replace the rocker arm oil pressure switch. Refer to **Rocker Arm Oil Pressure Switch Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
	Inspect for poor electrical connections at the PCM.			

13	Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 15**	Go to **Step 14**
14	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 15**	-
15	1. Use the scan tool in order to clear the DTCs. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC run and pass?	-	Go to **Step 16**	Go to **Step 2**
16	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2648

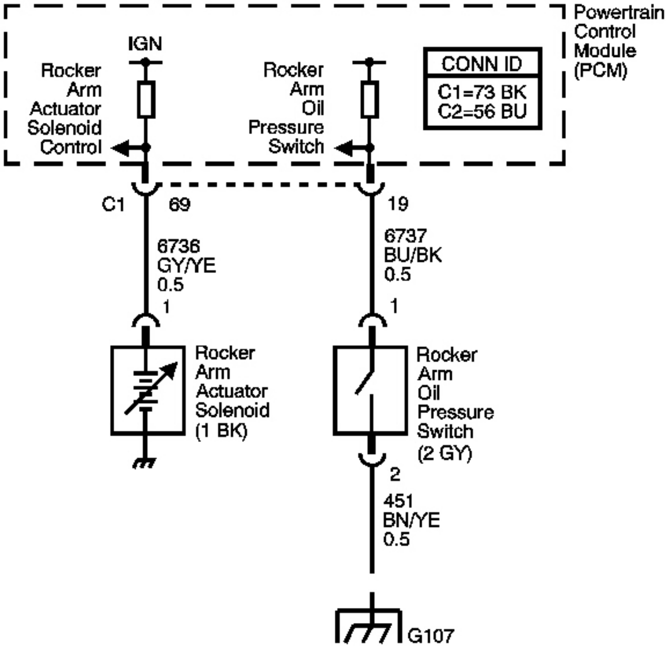


Fig. 7: DTC P2648 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P2648 Intake Rocker Arm Actuator Solenoid Control Circuit Low Voltage diagnostic monitors the electrical circuit of the rocker arm oil control solenoid. The rocker arm oil control solenoid enables the powertrain control module (PCM) to operate the high speed cam system. The high speed cam system significantly increases valve lift at engine speeds above 4,400 RPM. A second camshaft lobe with a high lift profile is cast into each camshaft, alongside the low/medium speed lobes. Unique rocker arms follow both the high speed and low/medium speed cam lobes. At engine speeds below 4,400 RPM, the low/medium speed cam lobes operate the rocker arms. When the rocker arm oil control solenoid is turned ON between 4,400-6,500 RPM, the rocker arms are operated by the high speed cam lobes. The rocker arm oil control solenoid is energized by a 12-volt signal from the PCM. A short to ground in the solenoid control circuit will set a DTC P2648. For additional information on the operation of the rocker arm oil control system refer to **Rocker Arm Oil Control System Description** .

DTC Descriptors

This diagnostic procedure supports the following DTC.

DTC P2648 Intake Rocker Arm Actuator Solenoid Control Circuit Low Voltage

Conditions for Running the DTC

- Before the PCM can report DTC P2648 failed, DTC P0325 must run and pass.
- Battery voltage is at least 10.1 volts.
- The ignition is ON.
- DTC P2648 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The control circuit of the rocker arm oil control solenoid is low when the solenoid is ON.
- The above condition is present for at least 2.5 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL).
- The PCM stores the conditions that were present when the DTC set as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL on the third consecutive trip cycle during which the diagnostic has been run and the fault condition is no longer present.
- A DTC clears after 40 consecutive warm-up cycles have occurred without a fault.
- A DTC can be cleared by using the scan tool Clear DTC Information function.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

3: This step checks the operation of the rocker arm oil control solenoid. With the oil control solenoid energized oil pressure will open the switch and the scan tool should indicate ON.

5: This step checks for a short to ground in the rocker arm oil control solenoid circuit. The PCM provides a 12 volt bias signal on the solenoid control circuit that can be measured with the DMM.

8: After replacing the PCM, a new minimum throttle position and idle speed must also be established.

DTC P2648 Circuit

Step	Action	Values	Yes	No
Connector End View Reference:Powertrain Control Module (PCM) Connector End Views or **Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	1. Perform the scan tool Clear DTC			

2	Information function. 2. Start the engine. 3. Operate the engine for 1 minute. 4. Review the scan tool data and check for DTC P2648. Is DTC P2648 set?	-	Go to **Step 4**	Go to **Step 3**
3	1. Start the engine. 2. Start and run the engine until the coolant temperature is 85°C (185°F). 3. Increase the engine speed to 2,800 RPM. 4. Observe the rocker arm actuator oil pressure switch parameter on the scan tool. 5. Command the rocker arm oil control solenoid ON and OFF with the scan tool. Refer to **Scan Tool Output Controls** . Did the oil pressure switch indicate ON when the solenoid was commanded ON and OFF when the solenoid was commanded OFF?	-	Go to **Intermittent Conditions**	Go to **Step 4**
4	1. Disconnect the rocker arm oil control solenoid. 2. Measure the resistance of the solenoid from the electrical terminal to the solenoid housing, with a DMM. Is the resistance within the specified range?	14-30 ohm at 20°C (68°F)	Go to **Step 5**	Go to **Step 7**
5	1. Turn OFF the engine. 2. Disconnect the electrical connector of the rocker arm oil control solenoid. 3. Connect a DMM to the control circuit of the rocker arm solenoid and ground. 4. Turn ON the ignition with the engine OFF. Is the voltage near the specified value?	12 V	Go to **Step 7**	Go to **Step 6**
	1. Inspect the solenoid control circuit of the Rocker Arm Oil Control Solenoid for a short to ground.			

6	2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Was a repair necessary?	-	Go to **Step 9**	Go to **Step 8**
7	Replace the rocker arm oil control solenoid. Refer to **Rocker Arm Oil Control Solenoid Valve Replacement** . Is the action complete?	-	Go to **Step 9**	-
8	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 9**	-
9	1. Use the scan tool in order to clear the DTCs. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC run and pass?	-	Go to **Step 10**	Go to **Step 2**
10	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2649

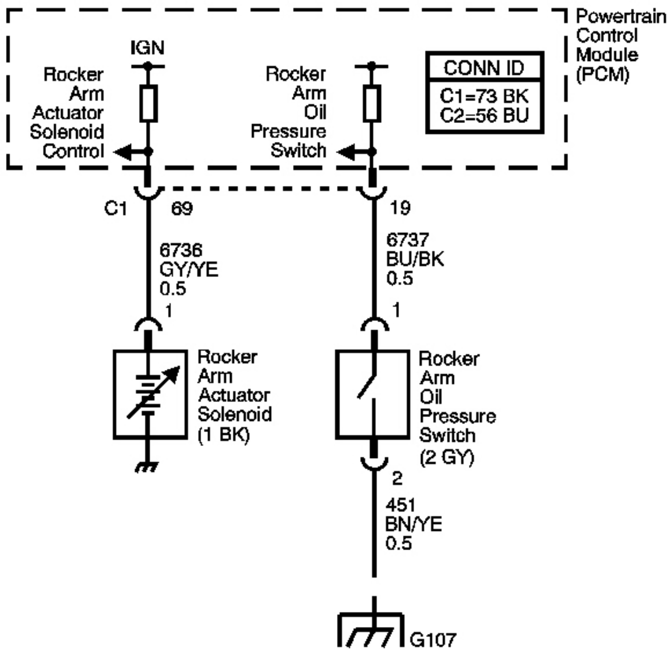


Fig. 8: DTC P2649 Circuit
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The DTC P2649 Intake Rocker Arm Actuator Solenoid Control Circuit High Voltage diagnostic monitors the electrical circuit of the rocker arm oil control solenoid. The rocker arm oil control solenoid enables the powertrain control module (PCM) to operate the high speed cam system. The high speed cam system significantly increases valve lift at engine speeds above 4,400 RPM. A second camshaft lobe with a high lift profile is cast into each camshaft, alongside the low/medium speed lobes. Unique rocker arms follow both the high speed and low/medium speed cam lobes. At engine speeds below 4,400 RPM, the low/medium speed cam lobes operate the rocker arms. When the rocker arm oil control solenoid is turned ON between 4,400-6,500 RPM, the rocker arms are operated by the high speed cam lobes. The rocker arm oil control solenoid is energized by a 12-volt signal from the PCM. An open or a short to voltage in the solenoid control circuit will set a DTC P2649. For additional information on the operation of the rocker arm oil control system refer to **Rocker Arm Oil Control System Description** .

DTC Descriptors

This diagnostic procedure supports the following DTC.

DTC P2649 Intake Rocker Arm Actuator Solenoid Control Circuit High Voltage

Conditions for Running the DTC

- Before the PCM can report DTC P2649 failed, DTC P0325 must run and pass.
- Battery voltage is at least 10.1 volts
- The ignition is ON.
- DTC P2649 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The control circuit of the rocker arm oil control solenoid is high when the solenoid is OFF.
- The above condition is present for at least 1.2 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL).
- The PCM stores the conditions that were present when the DTC set as Freeze Frame data.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL on the third consecutive trip cycle during which the diagnostic has been run and the fault condition is no longer present.
- A DTC clears after 40 consecutive warm-up cycles have occurred without a fault.
- A DTC can be cleared by using the scan tool Clear DTC Information function.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

3: This step checks the operation of the rocker arm oil control solenoid. With the oil control solenoid energized oil pressure will open the switch and the scan tool should indicate ON.

5: This step checks for an open in the rocker arm oil control solenoid circuit. The PCM provides a 12 volt bias signal on the solenoid control circuit that is pulled low when the solenoid is OK and has a good ground.

6: This step determines whether the PCM can send the command to operate the rocker arm oil control solenoid. All rocker arm oil control system DTCs must be cleared in order to command the solenoid ON with the scan tool. The PCM provides a 12 volt bias signal on the solenoid control circuit that is pulled low when the solenoid is OK and has a good ground.

11: After replacing the PCM, a new minimum throttle position and idle speed must also be established.

DTC P2649 Circuit

Step	Action	Values	Yes	No
Connector End View Reference:Powertrain Control Module (PCM) Connector End Views or **Engine Controls Connector End Views**				

1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Perform the scan tool Clear DTC Information function. 2. Start the engine. 3. Operate the engine for 1 minute. 4. Review the scan tool data and check for DTC P2649. Is DTC P2649 set?	-	Go to **Step 4**	Go to **Step 3**
3	1. Start the engine. 2. Start and run the engine until the coolant temperature is 85°C (185°F). 3. Increase the engine speed to 2,800 RPM. 4. Observe the rocker arm actuator oil pressure switch parameter on the scan tool. 5. Command the rocker arm oil control solenoid ON and OFF with the scan tool. Refer to **Scan Tool Output Controls** . Did the oil pressure switch indicate ON when the solenoid was commanded ON and OFF when the solenoid was commanded OFF?	-	Go to **Intermittent Conditions**	Go to **Step 4**
4	1. Disconnect the rocker arm oil control solenoid. 2. Measure the resistance of the solenoid from the electrical terminal to the solenoid housing, with a DMM. Is the resistance within the specified range?	14-30 ohm at 20°C (68°F)	Go to **Step 5**	Go to **Step 9**
5	1. Turn OFF the engine. 2. Disconnect the electrical connector of the rocker arm oil control solenoid valve. 3. Connect a DMM to the control circuit of the rocker arm solenoid and ground. 4. Turn ON the ignition with the engine OFF.	12 V		

	Is the voltage near the specified value?		Go to **Step 6**	Go to **Step 7**
6	1. Turn OFF the engine. 2. Connect a test lamp to the control circuit of the rocker arm solenoid and ground. 3. Turn ON the ignition with the engine OFF. 4. Clear any DTCs with the scan tool. 5. Start the engine. 6. Ensure that the engine coolant temperature is at least 85°C (185°F). 7. Increase the engine speed to 2,800 RPM. 8. Command the rocker arm oil control solenoid ON and OFF with the scan tool while observing the test lamp. Did the test lamp illuminate when the solenoid was commanded ON with the scan tool?	-	Go to **Step 8**	Go to **Step 11**
7	1. Inspect the control circuit of the Rocker Arm Oil Control Solenoid for an open. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Was a repair necessary?	-	Go to **Step 12**	Go to **Step 10**
8	Locate and repair the poor electrical connection or poor ground to the rocker arm solenoid. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 12**	-
9	Replace the rocker arm oil control solenoid. Refer to **Rocker Arm Oil Control Solenoid Valve Replacement** . Is the action complete?	-	Go to **Step 12**	-
10	1. Inspect for poor electrical connections at the PCM. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Was a repair necessary?	-	Go to **Step 12**	Go to **Step 11**

11	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Use the scan tool in order to clear the DTCs. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Does the DTC run and pass?	-	Go to **Step 13**	Go to **Step 2**
13	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC U0107

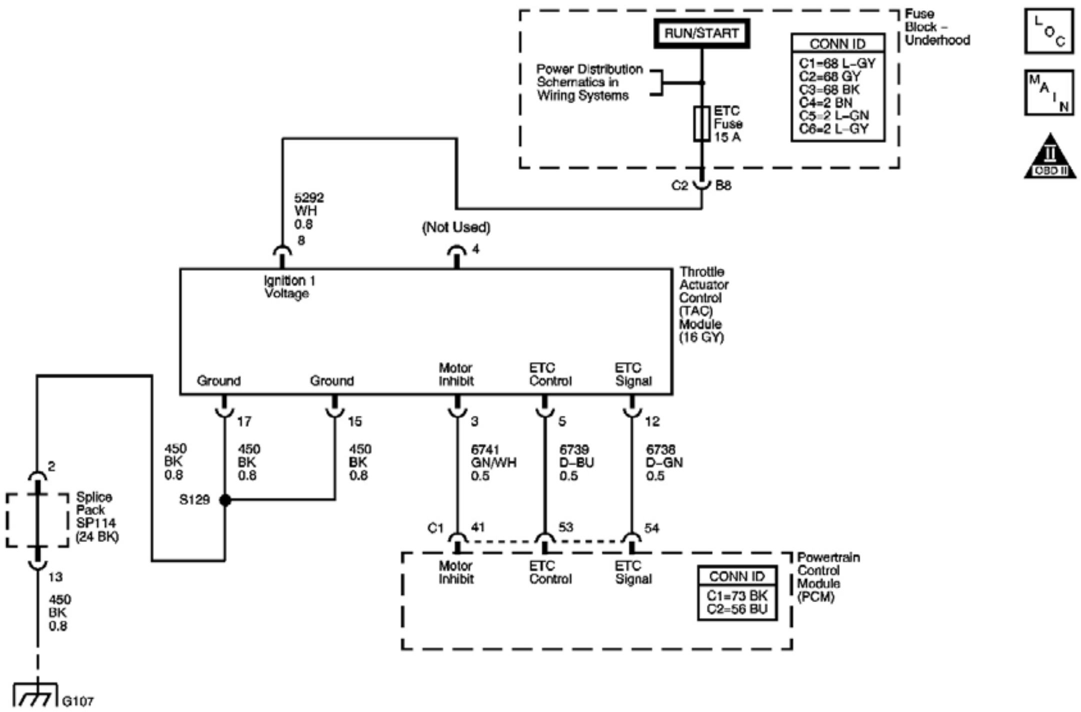


Fig. 9: DTC U0107 Circuit
Courtesy of GENERAL MOTORS CORP.

Description

The DTC U0107 Lost Communication With the Throttle Actuator Control (TAC) Module diagnostic monitors the communication between the TAC module and the powertrain control module (PCM). The TAC module and the PCM communicate on a serial data line. If the PCM can not communicate with the TAC module, DTC U0107 sets.

DTC Descriptor

This diagnostic procedure supports the following DTC.

DTC U0107 Lost Communication With the Throttle Actuator Control (TAC) Module

Conditions for Running the DTC

- DTC P0122, P0123, P0222, P0223, P0641, P0651, P2100, P2101, P2108, P2122, P2123, P2127, P2128, P2135, P2138, and P2176 are not set.
- The ignition is ON.
- Battery voltage is at least 8.0 volts.
- DTC U0107 runs continuously once the above conditions are met.

Conditions for Setting the DTC

Either of the conditions below is present for at least 250 milliseconds:

- The PCM did not detect any signal on the serial data line.
- The serial data signal is unreadable.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information will be stored in the Freeze Frame buffer.

Conditions for Clearing the MIL/DTC

- The MIL turns OFF after 3 consecutively passing trips without a fault present.
- A history DTC clears after 40 consecutive warm-up cycles without a fault.
- Perform the scan tool Clear DTC Information function.

Test Description

The numbers below refer to the step numbers in the diagnostic table.

1: The Diagnostic System Check-Engine Controls prompts the technician to complete some basic checks and store the Freeze Frame data on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. The information is then stored in the scan tool for later reference.

7: This step checks for an open in the ignition positive voltage supply to the TAC module.

8: This step checks for an open in the TAC module electrical grounds. The TAC module can not operate correctly if there are faulty electrical grounds.

17: After replacing the PCM a new minimum throttle position and idle speed must also be established.

DTC U0107 Circuit

Step	Action	Value (s)	Yes	No
Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, leaving the engine OFF. 2. Use the scan tool in order to clear the DTCs. 3. Start and run the engine for 1 minute. Is a DTC U0107 set?	-	Go to **Step 4**	Go to **Step 3**

3	1. Use the scan tool in order to clear the DTCs. 2. Start the engine. 3. Operate the vehicle within the Freeze Frame conditions as specified or until the DTC U0107 diagnostic test has run. Refer to the Test Description. Does the DTC run and pass?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	Is a DTC P2554 or P2555 also set?	-	Go to **DTC P2554** or **DTC P2555**	Go to **Step 5**
5	1. Turn OFF the ignition. 2. Disconnect the TAC module electrical connector. 3. Connect a DMM to the ETC Control circuit and a good ground. 4. Turn ON the ignition, leaving the engine OFF. Is the voltage at the specified value?	B+	Go to **Step 6**	Go to **Step 10**
6	Connect the DMM to the ETC Signal circuit and a good ground. Is the voltage at the specified value?	B+	Go to **Step 7**	Go to **Step 11**
7	Connect the DMM to the ignition positive voltage circuit and ground. Is the voltage at the specified value?	B+	Go to **Step 8**	Go to **Step 13**
8	Probe each TAC module ground circuit with a test lamp connected to B+. Did the test lamp illuminate on both ground circuits?	-	Go to **Step 9**	Go to **Step 12**
9	1. Inspect for an open in the TAC Motor Inhibit circuit. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 14**
10	1. Inspect for an open or a short in the ETC Control circuit. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 16**
	1. Inspect for an open or a short in the ETC Signal circuit.			

11	2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 16**
12	Repair the open in the ground circuits of the TAC module. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 18**	-
13	1. Repair the open or the short to ground in the ETC ignition positive voltage circuit. Refer to **Wiring Repairs** in Wiring Systems. 2. Replace the ETC fuse as necessary. Did you complete the repair?	-	Go to **Step 18**	-
14	1. Inspect for an intermittent or poor electrical connection at TAC module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 15**
15	1. Replace the TAC module. Refer to **Throttle Body Assembly Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** . Did you complete the replacement?	-	Go to **Step 18**	-
16	1. Inspect for an intermittent or poor electrical connection at PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. 2. Repair as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 17**
17	1. Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . 2. Perform the idle learn procedure. Refer to **Idle Learn Procedure** .	-		-

	Did you complete the replacement?		Go to **Step 18**	
18	1. Use the scan tool in order to clear the DTCs. 2. Start the engine. 3. Operate the vehicle within the Freeze Frame conditions as specified or until the DTC U0107 diagnostic test has run. Refer to the Test Description. Does the DTC run and pass?	-	Go to **Step 19**	Go to **Step 2**
19	With a scan tool, observe the stored information, Capture Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK