

## 08 GRP09 All Engines

SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
Exhaust Camshaft Position Actuator Solenoid Control Circuit Bank 1	P0013	This DTC checks the circuit for electrical integrity during operation.	The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match.	Output driver commanded on Ignition switch is in crank or run 11 volts < Ignition Voltage < 18 volts	19 failures out of 30 samples 250ms loop continuous	DTC Type B
Exhaust Camshaft Position System Performance Bank 1	P0014	Detects a VVT system error by comparing the desired and actual cam positions when VVT is activated	Camshaft position error [absolute value of (desired position - actual position)]: 3.75 degrees at all oil temps  Table is a function of Engine RPM and Oil Temperature	Engine is running VVT is enabled Desired camshaft position > 0 Δ Desired Camshaft position > 1 degree for 3 seconds 9 volts ≤ System voltage ≤ 18 volts Power Take Off (PTO) not active DTCs not active for the following sub-systems: Cam sensors Crank sensors Cam to crank rationality	135 fail counts out of 150 sample counts  100ms loop Continuous	DTC Type B
Camshaft Position Sensor-B Bank-1 Correlation  (Encoded Cam Sensor)	P0017	Detects cam to crank misalignment by monitoring if cam sensor pulse occurs during the incorrect crank position  (Cam to crank Correlation Diagnostic)	If any cam sensor pulse is more than 16.31 degrees out of sequence with the corresponding crank sensor pulse.	IF CAM_TYPE = ENCODED_CAM AND CAM_TYPE ≠ CSI_CAM AND Engine_Running = TRUE AND Crank_Sync_Flag = Crank_In_Sync AND Cam_Phaser_Position = PARKED AND Fault_Pending[CMP_CKT_Perf] = FALSE  AND Fault_Active [CMP_CKT] = FALSE AND Fault_Active [CKP_SnsrA_Ckt] = FALSE  AND Fault_Active [CKP_SnsrA_Perf] = FALSE  AND Fault_Active [CKP_SnsrB_Ckt] = FALSE  AND Fault_Active [CKP_SnsrB_Perf] = FALSE  AND Fault_Active [CKP_SnsrAB_Corr] = FALSE  THEN ENABLE DIAGNOSTIC  ELSE DISABLE DIAGNOSTIC  ENDIF	IF The cam edge is outside of the min/max boundary OR IF The number of failed teeth exceeds 4  THEN Increment the failed tooth counter  IF The failed tooth counter exceeds 24  Report fail.	DTC Type B
O2S Heater Control Circuit Bank 1 Sensor 1	P0030	This DTC checks the Heater Output Driver circuit for electrical integrity	Voltage low during driver open state (indicates short-to-ground or open circuit) or voltage high during driver closed state (indicates short to voltage).	<ul style="list-style-type: none"> <li>• Ignition switch is in crank or run</li> <li>• 11 volts &lt; Ignition Voltage &lt; 18 volts</li> <li>• RPM &gt; 400</li> </ul>	20 failures out of 25 samples  Frequency: 250ms loop Continuous	DTC Type B
O2S Heater Control Circuit Bank 1 Sensor 2	P0036	This DTC checks the Heater Output Driver circuit for electrical integrity	Voltage low during driver open state (indicates short-to-ground or open circuit) or voltage high during driver closed state (indicates short to voltage).	<ul style="list-style-type: none"> <li>• Ignition switch is in crank or run</li> <li>• 11 volts &lt; Ignition Voltage &lt; 18 volts</li> <li>• RPM &gt; 400</li> </ul>	20 failures out of 25 samples  Frequency: 250ms loop Continuous	DTC Type B

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HO2S Heater Resistance Bank 1 Sensor 1	P0053	Detects an oxygen sensor heater having an incorrect or out of range resistance value.	3.7 < Calculated Heater resistance < 8.9	<ul style="list-style-type: none"> <li>• Coolant – IAT &lt; 140°C</li> <li>• Engine Soak Time &gt; 36000 Seconds</li> <li>• -30 °C &lt; Coolant Temp &lt; 45°C</li> <li>• Coolant Fault = Not Active</li> <li>• Ignition Off Timer Fault = Not Active</li> <li>• Intake Air Temp Fault = Not Active</li> <li>• Ignition Voltage &lt; 18</li> </ul>	Once per valid cold start.	DTC Type B																																								
HO2S Heater Resistance Bank 1 Sensor 2	P0054	Detects an oxygen sensor heater having an incorrect or out of range resistance value.	3.6 < Calculated Heater resistance < 10.3	<ul style="list-style-type: none"> <li>• Coolant – IAT &lt; 140°C</li> <li>• Engine Soak Time &gt; 36000 Seconds</li> <li>• -30 °C &lt; Coolant Temp &lt; 45°C</li> <li>• Coolant Fault = Not Active</li> <li>• Ignition Off Timer Fault = Not Active</li> <li>• Intake Air Temp Fault = Not Active</li> <li>• Ignition Voltage &lt; 18</li> </ul>	Once per valid cold start.	DTC Type B																																								
MAP/MAF/Throttle Position Correlation	P0068	Detect when manifold absolute pressure and measured airflow do not match estimated engine airflow as established by the TPS	<p>Difference between measured MAP and estimated MAP &gt; MAP_Lim kPa OR V5B OOR OR After Throt Blade MAP sensor TFTKO, then MAP leg failed</p> <p>Difference between measured MAF and estimated MAF &gt; MAF_Lim grams/sec OR MAF sensor TFTKO OR Vbatt &lt; 10 volts, then MAF leg failed.</p> <table style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr> <th></th> <th>TPS</th> <th>MAP_Lim</th> <th>MAF_Lim</th> </tr> </thead> <tbody> <tr><td>1</td><td>5%</td><td>19.8</td><td>7.7</td></tr> <tr><td>2</td><td>10%</td><td>16</td><td>10.3</td></tr> <tr><td>3</td><td>15%</td><td>16.8</td><td>13</td></tr> <tr><td>4</td><td>20%</td><td>15.1</td><td>16.8</td></tr> <tr><td>5</td><td>25%</td><td>19.2</td><td>23.3</td></tr> <tr><td>6</td><td>30%</td><td>17.4</td><td>35.1</td></tr> <tr><td>7</td><td>35%</td><td>100</td><td>255</td></tr> <tr><td>8</td><td>40%</td><td>100</td><td>255</td></tr> <tr><td>9</td><td>100%</td><td>100</td><td>255</td></tr> </tbody> </table>		TPS	MAP_Lim	MAF_Lim	1	5%	19.8	7.7	2	10%	16	10.3	3	15%	16.8	13	4	20%	15.1	16.8	5	25%	19.2	23.3	6	30%	17.4	35.1	7	35%	100	255	8	40%	100	255	9	100%	100	255	Engine running, engine speed > 800 rpm	<p>Continuously fail MAP AND MAF legs for longer than 187.5 msec</p> <p>Continuous in the main processor</p>	DTC Type A
	TPS	MAP_Lim	MAF_Lim																																											
1	5%	19.8	7.7																																											
2	10%	16	10.3																																											
3	15%	16.8	13																																											
4	20%	15.1	16.8																																											
5	25%	19.2	23.3																																											
6	30%	17.4	35.1																																											
7	35%	100	255																																											
8	40%	100	255																																											
9	100%	100	255																																											
Mass Air Flow System Performance (Rationality)	P0101	This DTC determines if the MAF sensor is stuck within the normal operating range	(Measured Flow – Modeled air Flow) Filtered > 15 AND (Measured Manifold Air Pressure – Manifold Model 2 pressure) Filtered > 20	<p>Engine rpm =&gt;400 and &lt;= 6000</p> <p>MAP sensor high/low DTCs not active</p> <p>MAF sensor high/low DTCs not active</p> <p>Crank sensor DTCs not active</p> <p>Engine Coolant DTCs not active</p> <p>Intake Air Temp. DTCs not active</p> <p>Engine Coolant &gt; 70 deg C and &lt; 125 deg C</p> <p>Intake Air Temp &gt; -7 deg C and &lt; 100 deg C</p>	<p>Continuous</p> <p>The Mass Air Flow reading and Mass Air Flow calculation are performed during the same 12.5 ms loop</p>	DTC Type B																																								

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Mass Air Flow Sensor Circuit Low Frequency	P0102	Detects a continuous short to low or a open in either the signal circuit or the MAF sensor	MAF $\leq$ 900 Hz	Engine Running > 1 second Engine Speed $\geq$ 300 RPM System Voltage $\geq$ 11 volts The above must be present for a period of time greater than 1.0 second	250 test failures in 313 test samples  1 sample every Lo Res event	DTC Type B
Mass Air Flow Sensor Circuit High Frequency	P0103	Detects a continuous short to high in either the signal circuit or the MAF sensor	MAF $\geq$ 14500 Hz	Engine Running > 1 second Engine Speed $\geq$ 300 RPM System Voltage $\geq$ 11 volts The above must be present for a period of time greater than 1.0 second	250 test failures in 313 test samples  1 sample every Lo Res event	DTC Type B
Map Sensor Range/ Performance (Rationality)	P0106	This DTC determines if the MAP sensor is stuck within the normal operation range	(Measured MAP - Manifold Model 1 pressure) filtered > 20 AND (Measured MAP - Manifold Model 2 pressure) filtered > 20	Engine rpm $\Rightarrow$ 400 and $\leq$ 6000 MAP sensor high/low DTCs not active MAF sensor high/low DTCs not active Crank sensor DTCs not active Engine Coolant DTCs not active Intake Air Temp. DTCs not active Engine Coolant > 70 deg C and < 125 deg C Intake Air Temp > -7 deg C and < 100 deg C	Continuous  The MAP reading and the Manifold Model calculations are performed in the same LoRes loop	DTC Type B
Manifold Absolute Pressure Sensor Circuit Low	P0107	Detects a MAP sensor output that is out of the operating range low or continuous short to low or open in either the signal circuit or the MAP sensor.	MAP voltage < 3% of Vref (0.15 volts)	Map Sensor has Deadbands	320 test failures in 400 test samples  1 sample/12.5 ms	DTC Type B
Manifold Absolute Pressure Sensor Circuit High	P0108	Detects a MAP sensor output that is out of the operating range high or continuous short to high in either the signal circuit or the MAP sensor.	MAP voltage > 97% of Vref (4.85 volts)	Map Sensor has Deadbands	320 test failures in 400 test samples  1 sample/12.5 ms	DTC Type B
Intake Air Temp Sensor Circuit Low (High Temp)	P0112	This DTC detects a continuous short to ground in the IAT signal circuit or the IAT sensor	Raw IAT < 45 ohms	VS sensor DTCs not active ECT sensor DTCs not active Engine run time > 10 seconds ECT Temperature < 150°C VSS $\geq$ 0 KPH	50 test failures in 63 test samples  1 sample/100 msec	DTC Type B
Intake Air Temp Sensor Circuit High (Low Temp)	P0113	This DTC detects a continuous open or short to high in the IAT signal circuit or the IAT sensor	Raw IAT > 163,000 Ohms	MAF sensor DTCs not active ECT sensor DTCs not active VS sensor DTCs not active Engine run time > 10 seconds ECT > -40 MAF > 511 gm/s 511 KPH $\geq$ VSS	50 test failures in 63 test samples  1 sample/100 msec	DTC Type B

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ECT Sensor Performance	P0116	This DTC detects if the engine coolant sensor is biased high while in range	<p>A failure will be reported if any of the following occur:</p> <p>ECT at power up &gt; IAT at power up by KtECTD_T_HSC_FastFailTempDiff after a minimum 8 hour soak (fast fail).</p> <p>ECT at power up &gt; IAT at power up by 15.75°C after a minimum 8 hour soak and a block heater has not been detected.</p> <p>ECT at power up &gt; IAT at power up by 15.75°C after a minimum 8 hour soak and the time spent cranking the engine without starting is greater than 10 seconds with the fuel level being above a minimum level of 2.5%.</p>	<ul style="list-style-type: none"> <li>• No VSS DTCs</li> <li>• No IAT DTCs</li> <li>• No ECT sensor shorted DTCs</li> <li>• ECM/PCM Internal Engine Off Timer Performance DTC not active</li> <li>• Non-volatile memory failure has not been detected on power-up.</li> <li>• Engine off time &gt; 8 hours</li> <li>• Test run this trip = false</li> <li>• Test aborted this trip = false</li> </ul> <p>Block heater detection:</p> <ul style="list-style-type: none"> <li>- ECT at power up &gt; IAT at power up by 15.75°C</li> <li>- Power up IAT &gt; 15.75°C</li> </ul> <p>Vehicle driven a minimum of 400 seconds above 24 KPH and IAT drops more than 5.25° C from power up IAT.</p>	<p><b>Frequency:</b> 100 ms loop Continuous</p>	DTC Type B
ECT Sensor Circuit Low Voltage	P0117	Determines if the ECT sensor is shorted low by checking for an ECT sensor resistance below a threshold	ECT resistance < 47 Ω (150 degree C)	<p>No IAT DTCs IAT ≤ 70 °C Or Engine run time ≥ 10 sec</p>	<p>50/100 counts 1 count/sec  Continuous check</p>	DTC Type B
ECT Sensor Circuit High Voltage	P0118	Determines if the ECT sensor is shorted high by checking for an ECT sensor resistance above a threshold	ECT resistance > 420,000 Ω (-60 degree C)	<p>No IAT DTCs IAT ≥ -7 °C Or Engine run time ≥ 60 sec</p>	<p>50/100 counts 1 count/sec  Continuous check</p>	DTC Type B
Throttle Position (TP) Sensor 1 Circuit	P0120	Detects a continuous or intermittent short or open in TP sensor #1 circuit	.325 Volts > TPS > 4.75 Volts	<p>Ignition in unlock/accessory, run or crank System voltage &gt; 5.23 V No 5 V reference DTCs</p>	<p>79/159 counts; 52 counts continuous; 3.125 msec /count in the ECM main processor</p> <p>19/39 counts or 13 counts continuous; 12.5 msec/count in the MHC processor</p>	DTC Type A
Throttle Position Sensor Circuit Performance (Rationality)	P0121	The DTC determines if a TPS sensor is stuck within the normal operating range	Filtered throttle error > 350 kPa*grams per second	<p>Engine rpm =&gt;400 and &lt;= 6000 MAP sensor high/low DTCs not active MAF sensor high/low DTCs not active Crank sensor DTCs not active Engine Coolant DTCs not active Intake Air Temp. DTCs not active Engine Coolant &gt; 70 deg C and &lt; 125 deg C Intake Air Temp &gt; -7 deg C and &lt; 100 deg C</p>	<p>Continuous</p> <p>Calculations are performed every 12.5 ms</p>	DTC Type B

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Throttle Position (TP) Sensor 1 Circuit Lo	P0122	Detects a continuous or intermittent OOR lo TPS	TPS < .325 Volts	Ignition in unlock/accessory, run or crank System voltage>5.23 V No 5 V reference DTCs	79/159 counts; 52 counts continuous; 3.125 msec /count in the ECM main processor  19/39 counts or 13 counts continuous; 12.5 msec/count in the MHC processor	DTC Type A
Throttle Position (TP) Sensor 1 Circuit Hi	P0123	Detects a continuous or intermittent OOR lo TPS	TPS > 4.75 Volts	Ignition in unlock/accessory, run or crank System voltage>5.23 V No 5 V reference DTCs	79/159 counts; 52counts continuous; 3.125 msec /count in the ecm main processor  19/39 counts or 13 counts continuous; 12.5 msec/count in the MHC processor	DTC Type A
Engine Coolant Temperature (ECT) Below Thermostat Regulating Temperature	P0128	Detects if the engine coolant temperature rises too slowly due to an ECT sensor or cooling system fault	Actual accumulated airflow > predicted accumulated airflow and engine coolant temperature <77°C  Airflow is accumulated every sec if 10 grams/sec < MAF < 55 grams/sec	No MAF, IAT, VSS, ECT circuit DTCs Start up ECT < 72 °C Minimum average airflow > 5 grams/sec VSS > 8 KPH for .5 kilometer 30 secs < Engine run time < 1800 secs IAT ≥ -7 °C Engine RPM < 3300	30 sec 1 sec loop  Frequency: Once per ignition cycle	DTC Type B

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O2S Circuit Low Voltage Bank 1 Sensor 1	P0131	This DTC determines if the O2 sensor circuit is shorted to low.	O2 sensor voltage < 50 millivolts	<p><u>Common Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's</li> <li>• Catalyst monitor diagnostic Intrusive Test = Not Active</li> <li>• Post Oxygen Sensor Diagnostic Intrusive Test = Not Active</li> <li>• Traction Control, AIR, Fuel, Idle, EGR, and Engine Not Overspeed Intrusive Tests = Not Active</li> <li>• 10 volts &lt; system voltage &lt; 18 volts</li> <li>• EGR, Idle, Fuel Inj, and AIR Device controls = Not Active</li> <li>• Fuel Level &gt; 10 % or fuel level data fault active</li> </ul> <p><u>Specific Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• <math>0.99 \leq</math> Equivalence ratio <math>\leq 1.01</math></li> <li>• 5 % <math>\leq</math> throttle position <math>\leq 50</math> %</li> <li>• Fuel state = closed loop with no fault pending</li> <li>• All fuel injectors = ON</li> <li>• Traction Control = not active</li> </ul> <p>All of the above met for at least 2 seconds</p>	<p>425 test failures out of 500 samples</p> <p><u>Frequency:</u> Continuous 100 ms loop</p>	DTC Type B
O2S Circuit High Voltage Bank 1 Sensor 1	P0132	This DTC determines if the O2 sensor or circuit is shorted to high.	O2 sensor voltage > 1050 millivolts	<p><u>Common Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's</li> <li>• Catalyst monitor diagnostic Intrusive Test = Not Active</li> <li>• Post Oxygen Sensor Diagnostic Intrusive Test = Not Active</li> <li>• Traction Control, AIR, Fuel, Idle, EGR, and Engine Not Overspeed Intrusive Tests = Not Active</li> <li>• 10 volts &lt; system voltage &lt; 18 volts</li> <li>• EGR, Idle, Fuel Inj, and AIR Device controls = Not Active</li> <li>• Fuel Level &gt; 10 % or fuel level data fault active</li> </ul> <p><u>Specific Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• <math>0.99 \leq</math> Equivalence Ratio <math>\leq 1.01</math></li> <li>• 0 % <math>\leq</math> throttle position <math>\leq 50</math> %</li> <li>• Fuel State = Closed loop</li> </ul> <p>All of the above met for at least 2 seconds</p>	<p>130 test failures out of 150 sample test</p> <p><u>Frequency:</u> Continuous 100 ms loop</p>	DTC Type B

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O2S Slow Response Bank 1 Sensor 1	P0133	This DTC determines if the O2 sensor response time is degraded	Refer to “ <b>O2S Slow Response Bank 1 Sensor 1 (P0133), O2S Slow Response Bank 2 Sensor 1 (P0153) Pass/Fail Thresholds.</b> ” In Lookup Tables section.	<p><u>Common Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC’s</li> <li>• Catalyst monitor diagnostic Intrusive Test = Not Active</li> <li>• Post Oxygen Sensor Diagnostic Intrusive Test = Not Active</li> <li>• Traction Control, AIR, Fuel, Idle, EGR, and Engine Not Overspeed Intrusive Tests = Not Active</li> <li>• 10 volts &lt; system voltage &lt; 18 volts</li> <li>• EGR, Idle, Fuel Inj, and AIR Device controls = Not Active</li> <li>• Fuel Level &gt; 10 % or fuel level data fault active</li> </ul> <p><u>Specific Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• O2 Heater on for ≥ 40 seconds</li> <li>• B1S1 DTCs = Not Active</li> <li>• Learned heater resistance is valid</li> <li>• Misfire DTC = Not Active</li> <li>• ECT &gt; 70 °C</li> <li>• IAT &gt; -40 °C</li> <li>• Engine run time &gt; 200 seconds</li> <li>• EVAP Canister purge duty cycle ≥ 0 %</li> <li>• 15 gps ≤ MAF ≤ 50 gps</li> <li>• 1000 ≤ RPM ≤ 3500</li> <li>• Ethanol percentage &lt; 87 %</li> <li>• Baro &gt; 69.8 kPa</li> <li>• Throttle position ≥ 5 % Fuel state = closed loop Transmission (automatic) not in Park, Reverse or Neutral</li> <li>• Transmission gear selection is not defaulted</li> <li>• Baro is not defaulted</li> </ul> <p>All of the above met for at least 2 second.</p>	<p>100 seconds</p> <p><u>Frequency:</u> Once per trip</p> <p><u>Green Sensor Delay Criteria</u></p> <ul style="list-style-type: none"> <li>• The diagnostic will not be enabled until the next ignition cycle after the following has been met: Airflow greater than 20 g/sec for 120000 grams of accumulated flow non-continuously. (Note that all other enable criteria must be met on the next ignition cycle for the test to run on that ignition cycle)</li> </ul> <p>Note: this feature is only enabled when the vehicle is new and cannot be enabled in service</p>	DTC Type B

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O2S Circuit Insufficient Activity Bank 1 Sensor 1	P0134	This DTC determines if the O2 sensor circuit is open.	400 millivolts < O2 sensor < 500 millivolts	<p><u>Common Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's</li> <li>• Catalyst monitor diagnostic Intrusive Test = Not Active</li> <li>• Post Oxygen Sensor Diagnostic Intrusive Test = Not Active</li> <li>• Traction Control, AIR, Fuel, Idle, EGR, and Engine Not Overspeed Intrusive Tests = Not Active</li> <li>• 10 volts &lt; system voltage &lt; 18 volts</li> <li>• EGR, Idle, Fuel Inj, and AIR Device controls = Not Active</li> </ul> <p><u>Specific Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• Engine run time &gt; 200 seconds</li> <li>• Ethanol percentage &gt; 87 %</li> <li>• No B1S1 heater related DTCs</li> </ul>	<p>450 test failures in a 500 test samples</p> <p>Minimum of 0 occurrences of a delta TP sensor <math>\geq 5\%</math> during diagnostic test</p> <p><u>Frequency:</u> Continuous for pre catalyst sensors 100 ms loop rate</p>	DTC Type B
O2S Heater Performance Bank 1 Sensor 1	P0135	This DTC determines if the O2 sensor heater is functioning properly by monitoring the current through the heater circuit.	O2 sensor heater current is < 0.25 amps or > 2.7 amps	<p><u>Common Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's</li> <li>• Catalyst monitor diagnostic Intrusive Test = Not Active</li> <li>• Post Oxygen Sensor Diagnostic Intrusive Test = Not Active</li> <li>• Traction Control, AIR, Fuel, Idle, EGR, and Engine Not Overspeed Intrusive Tests = Not Active</li> <li>• 10 volts &lt; system voltage &lt; 18 volts</li> <li>• EGR, Idle, Fuel Inj, and AIR Device controls = Not Active</li> </ul> <p><u>Specific Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• Heater On time <math>\geq 120</math> seconds</li> <li>• O2 heater not in Device control</li> <li>• B1S1 O2 heater resistance DTC not active</li> </ul>	<p>8 test failures in 10 test samples</p> <p>Frequency: 1 tests per trip 30 seconds delay between tests 1 second execution rate</p>	DTC Type B



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O2S Circuit Low Voltage Bank 1 Sensor 2	P0137	This DTC determines if the O2 sensor circuit is shorted to low by checking for a lean condition during steady throttle.	O2 sensor voltage < 50 millivolts	<p><u>Common Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's</li> <li>• Catalyst monitor diagnostic Intrusive Test = Not Active</li> <li>• Post Oxygen Sensor Diagnostic Intrusive Test = Not Active</li> <li>• Traction Control, AIR, Fuel, Idle, EGR, and Engine Not Overspeed Intrusive Tests = Not Active</li> <li>• 10 volts &lt; system voltage &lt; 18 volts</li> <li>• EGR, Idle, Fuel Inj, and AIR Device controls = Not Active</li> <li>• Fuel Level &gt; 10 % or fuel level data fault active</li> </ul> <p><u>Specific Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• 0.99 ≤ Equivalence ratio ≤ 1.01</li> <li>• 5 % ≤ throttle position ≤ 50 %</li> <li>• Fuel state = closed loop</li> <li>• All fuel injectors = ON</li> <li>• Traction Control = not active</li> </ul> <p>All of the above met for at least 2 seconds</p>	<p>510 test failures in a 600 test sample</p> <p><u>Frequency:</u> Continuous 100 ms loop</p>	DTC Type B
O2S Circuit High Voltage Bank 1 Sensor 2	P0138	This DTC determines if the O2 sensor or circuit is shorted to high	O2 sensor voltage > 1050 millivolts	<p><u>Common Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's</li> <li>• Catalyst monitor diagnostic Intrusive Test = Not Active</li> <li>• Post Oxygen Sensor Diagnostic Intrusive Test = Not Active</li> <li>• Traction Control, AIR, Fuel, Idle, EGR, and Engine Not Overspeed Intrusive Tests = Not Active</li> <li>• 10 volts &lt; system voltage &lt; 18 volts</li> <li>• EGR, Idle, Fuel Inj, and AIR Device controls = Not Active</li> <li>• Fuel Level &gt; 10 % or fuel level data fault active</li> </ul> <p><u>Specific Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• 0.99 ≤ Equivalence Ratio ≤ 1.01</li> <li>• 5 % ≤ throttle position ≤ 50 %</li> <li>• Fuel State = Closed loop</li> </ul> <p>All of the above met for at least 2 seconds</p>	<p>510 test failures in a 600 test sample</p> <p><u>Frequency:</u> Continuous 100 ms loop</p>	DTC Type B

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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
O2 Sensor Slow Response – Rich to Lean Bank 1 Sensor 2	P013A	This DTC determines if the post catalyst O2 sensor has Slow Response in a predefined Rich to Lean voltages range during Rich to Lean transition. The diagnostic is an intrusive test which runs in a DFCO mode to achieve the required response.	The EWMA of the Post O2 (B1S2) normalized integral value is NaOXYD_i_POPD_R2L_EWMA > 5.14 integral units (this value is proportional to mVxsec).	<p><u>Common Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• No O2 circuit, response, heater current, or heater resistance DTC's active</li> <li>• No TP Sensor, ETC, MAF, MAP, EVAP, Secondary Air, Fuel Injector DTC's, Fuel Trim System DTCs, Misfire DTCs, E85 FFS DTCs</li> <li>• 10 volts &lt; system voltage &lt; 18 volts</li> <li>• Learned heater resistance is valid</li> <li>• ICAT MAT Burnoff delay is not active</li> <li>• Green O2 Sensor Condition is not present</li> <li>• Fuel Level &gt; 10 % or fuel level data fault active</li> </ul> <p><u>Specific Enable Criteria:</u></p> <ul style="list-style-type: none"> <li>• The DFCO mode and no driver initiated throttle input.</li> <li>• Complete and PASS the following POPD tests:               <ol style="list-style-type: none"> <li>1. P2270 and P2272, if applicable.</li> <li>2. P013E and P014A, if applicable</li> </ol> </li> </ul>	<p>From 450 millivolts Post O2 Voltage to 150 millivolts Post O2 voltage OR up to 9.7 grams of accumulated air flow for the R2L Slow Response Test.</p> <p><u>Frequency:</u> Once per trip Note: if NaPOPD_b_InitialResponseIs Active = TRUE for the given Fuel Bank OR NePOPD_b_RapidResponseIs Active = TRUE, multiple tests per trip are allowed.</p> <p><u>Green Sensor Delay Criteria</u></p> <ul style="list-style-type: none"> <li>• The diagnostic will not be enabled until the next ignition cycle after the following has been met: Airflow greater than 20 g/sec for 120,000 grams of accumulated flow non-continuously. (Note that all other enable criteria must be met on the next ignition cycle for the test to run on that ignition cycle) Note: this feature is only enabled when the vehicle is new and cannot be enabled in service</li> </ul>	DTC Type A

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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
O2 Sensor Slow Response – Lean to Rich Bank 1 Sensor 2	P013B	This DTC determines if the post catalyst O2 sensor has Slow Response in a predefined Lean to Rich voltages range during Lean to Rich transition. The diagnostic is an intrusive test which increases the delivered A/F ratio to achieve the required rich threshold..	The EWMA of the Post O2 (B1S2) normalized integral value is NaOXYD_i_POPD_L2R_EWMA > 5.21 integral units (this value is proportional to mVxsec).	<p><u>Common Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• No O2 circuit, response, heater current, or heater resistance DTC's active</li> <li>• No TP Sensor, ETC, MAF, MAP, EVAP, Secondary Air, Fuel Injector DTC's, Fuel Trim System DTCs, Misfire DTCs, E85 FFS DTCs</li> <li>• 10 volts &lt; system voltage &lt; 18 volts</li> <li>• Learned heater resistance is valid</li> <li>• ICAT MAT Burnoff delay is not active</li> <li>• Green O2 Sensor Condition is not present</li> <li>• Fuel Level &gt; 10 % or fuel level data fault active</li> </ul> <p><u>Specific Enable Criteria:</u></p> <ul style="list-style-type: none"> <li>• Complete and PASS the following POPD tests:               <ol style="list-style-type: none"> <li>1. P2270 and P2272, if applicable.</li> <li>2. P013E and P014A, if applicable.</li> <li>3. P013A and P013C, if applicable.</li> <li>4. P2271 and P2273, if applicable.</li> <li>5. P013F and P014B, if applicable.</li> </ol> </li> </ul>	<p>From 350 millivolts Post O2 Voltage to 650 millivolts Post O2 Voltage OR up to 62.3 grams of accumulated air flow for the L2R Slow Response Test.</p> <p><u>Frequency:</u> Once per trip Note: if NaPOPD_b_InitialResponseIs Active = TRUE for the given Fuel Bank OR NePOPD_b_RapidResponseIs Active = TRUE, multiple tests per trip are allowed.</p> <p><u>Green Sensor Delay Criteria</u></p> <ul style="list-style-type: none"> <li>• The diagnostic will not be enabled until the next ignition cycle after the following has been met: Airflow greater than 20 g/sec for 120,000 grams of accumulated flow non-continuously. (Note that all other enable criteria must be met on the next ignition cycle for the test to run on that ignition cycle) Note: this feature is only enabled when the vehicle is new and cannot be enabled in service</li> </ul>	DTC Type A

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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
O2 Sensor Delayed Response Rich to Lean Bank 1 Sensor 2	P013E	This DTC determines if the post catalyst O2 sensor has an initial delayed response to an A/F change from Rich to Lean. The diagnostic is an intrusive test which runs in a DFCO mode to achieve the required response..	Post catalyst (B1S2) O2 sensor voltage cannot drop below 450 millivolts within 21.4 grams of accumulated air flow.	<p><u>Common Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• No O2 circuit, response, heater current, or heater resistance DTC's active</li> <li>• No TP Sensor, ETC, MAF, MAP, EVAP, Secondary Air, Fuel Injector DTC's, Fuel Trim System DTCs, Misfire DTCs, E85 FFS DTCs</li> <li>• 10 volts &lt; system voltage &lt; 18 volts</li> <li>• Learned heater resistance is valid</li> <li>• ICAT MAT Burnoff delay is not active</li> <li>• Green O2 Sensor Condition is not present</li> <li>• Fuel Level &gt; 10 % or fuel level data fault active</li> </ul> <p><u>Specific Enable Criteria:</u></p> <ul style="list-style-type: none"> <li>• The DFCO mode and no driver initiated throttle input.</li> <li>• Complete and PASS the following POPD tests: P2270 and P2272, if applicable</li> </ul>	<p>Up to 21.4 grams of accumulated air flow for the Rich to Lean Delayed Response Test.</p> <p>Frequency: Once per trip Note: if NaPOPD_b_InitialResponseIs Active = TRUE for the given Fuel Bank OR NePOPD_b_RapidResponseIs Active = TRUE, multiple tests per trip are allowed. Green Sensor Delay Criteria</p> <ul style="list-style-type: none"> <li>• The diagnostic will not be enabled until the next ignition cycle after the following has been met: Airflow greater than 20 g/sec 120,000 grams of accumulated flow non-continuously. (Note that all other enable criteria must be met on the next ignition cycle for the test to run on that ignition cycle)</li> </ul> <p>Note: this feature is only enabled when the vehicle is new and cannot be enabled in service</p>	<p style="text-align: center;">DTC Type</p> <p style="text-align: center;">B</p>

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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
O2 Sensor Delayed Response Lean to Rich Bank 1 Sensor 2	P013F	This DTC determines if the post catalyst O2 sensor has an initial delayed response to an A/F change from Lean to Rich. The diagnostic is an intrusive test which increases the delivered A/F ratio to achieve the required rich threshold.	Post catalyst (B1S2) O2 sensor voltage cannot achieve 350 millivolts within 82.3 grams of accumulated air flow.	<p><u>Common Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• No O2 circuit, response, heater current, or heater resistance DTC's active</li> <li>• No TP Sensor, ETC, MAF, MAP, EVAP, Secondary Air, Fuel Injector DTC's, Fuel Trim System DTCs, Misfire DTCs, E85 FFS DTCs</li> <li>• 10 volts &lt; system voltage &lt; 18 volts</li> <li>• Learned heater resistance is valid</li> <li>• ICAT MAT Burnoff delay is not active</li> <li>• Green O2 Sensor Condition is not present</li> <li>• Fuel Level &gt; 10 % or fuel level data fault active</li> </ul> <p><u>Specific Enable Criteria:</u></p> <ul style="list-style-type: none"> <li>• Complete and PASS the following POPD tests:               <ol style="list-style-type: none"> <li>1. P2270 and P2272, if applicable.</li> <li>2. P013E and P014A, if applicable.</li> <li>3. P013A and P013C, if applicable.</li> <li>4. P2271 and P2273, if applicable.</li> </ol> </li> </ul>	<p>Up to 82.3 grams of accumulated air flow for the Lean to Rich Delayed Response Test.</p> <p><u>Frequency:</u> Once per trip Note: if NaPOPD_b_InitialResponseIs Active = TRUE for the given Fuel Bank OR NePOPD_b_RapidResponseIs Active = TRUE, multiple tests per trip are allowed.</p> <p><u>Green Sensor Delay Criteria</u></p> <ul style="list-style-type: none"> <li>• The diagnostic will not be enabled until the next ignition cycle after the following has been met: Airflow greater than 20 g/sec for 120,000 grams of accumulated flow non-continuously. (Note that all other enable criteria must be met on the next ignition cycle for the test to run on that ignition cycle)</li> </ul> <p>Note: this feature is only enabled when the vehicle is new and cannot be enabled in service</p>	DTC Type B

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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
O2S Circuit Insufficient Activity Bank 1 Sensor 2	P0140	This DTC determines if the O2 sensor circuit is open.	<p>400 millivolts &lt; O2 sensor &lt; 500 millivolts for regular open test</p> <p>300 millivolts &lt; O2 sensor &lt; 600 millivolts to fail the fast pass open test (must fail the regular open test in order to fail the DTC; regular open test is run if fast pass is not run or if fast pass fails)</p>	<p><u>Common Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's</li> <li>• Catalyst monitor diagnostic Intrusive Test = Not Active</li> <li>• Post Oxygen Sensor Diagnostic Intrusive Test = Not Active</li> <li>• Traction Control, AIR, Fuel, Idle, EGR, and Engine Not Overspeed Intrusive Tests = Not Active</li> <li>• 10 volts &lt; system voltage &lt; 18 volts</li> <li>• EGR, Idle, Fuel Inj, and AIR Device controls = Not Active</li> <li>• Fuel Level &gt; 10 % or fuel level data fault active</li> </ul> <p><u>Specific Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• Ethanol percentage &gt; 87 %</li> <li>• No B1S2 heater related DTCs</li> <li>• PCM State = run</li> </ul> <p><u>Fast Pass:</u></p> <ul style="list-style-type: none"> <li>• Engine run time ≤ 100 seconds</li> </ul> <p>(Fast pass cannot report a fail; if Fastpass fails, the regular open test is run)</p> <p><u>Regular Open Test</u></p> <ul style="list-style-type: none"> <li>• Engine run time &gt; 200 seconds</li> <li>• Fuel state = closed loop</li> </ul>	<p>1000 test failures in a 1100 test samples</p> <p>Minimum of 3 occurrences of a delta TP sensor ≥ 5 % during diagnostic test</p> <p>(sample counts – failure counts) &lt; 60 within 100 seconds of engine run time to fail the fast pass test (regular open test is run when fast pass fails; to fail DTC the regular open test must fail)</p> <p><u>Frequency:</u> Once/trip for post catalyst sensors 100 ms loop</p>	DTC Type B
O2S Heater Performance Bank 1 Sensor 2	P0141	This DTC determines if the O2 sensor heater is functioning properly by monitoring the current through the heater circuit.	O2 sensor heater current is < 0.25 amps or > 2.3 amps	<p><u>Common Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's</li> <li>• Catalyst monitor diagnostic Intrusive Test = Not Active</li> <li>• Post Oxygen Sensor Diagnostic Intrusive Test = Not Active</li> <li>• Traction Control, AIR, Fuel, Idle, EGR, and Engine Not Overspeed Intrusive Tests = Not Active</li> <li>• 10 volts &lt; system voltage &lt; 18 volts</li> <li>• EGR, Idle, Fuel Inj, and AIR Device controls = Not Active</li> </ul> <p><u>Specific Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• Heater ON time ≥ 120 seconds</li> <li>• O2 heater not in Device control</li> <li>• B1S1 O2 heater resistance DTC not active</li> </ul>	<p>8 test failures in 10 test samples</p> <p>Frequency: 1 tests per trip 30 seconds delay between tests 1 second execution rate</p>	DTC Type B

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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
Fuel System Too Lean Bank 1	P0171	<p>Determines if the fuel control system is in a lean condition, based on the EWMA of long-term fuel trim (LONG FT).</p> <p>(Note: EWMA stands for “Exponentially Weighted Moving Average”)</p>	The EWMA of LONG FT samples $\geq$ 1.29	<ul style="list-style-type: none"> <li>• No Misfire, pre-cat O2S, or EVAP DTC’s</li> <li>• No Fuel Injector DTC’s</li> <li>• No IAC, MAF, MAP, ECT, EGR, or A.I.R. DTC’s</li> <li>• No TP Sensor or TAC System DTC’s</li> <li>• Engine speed &gt; 400 RPM but &lt; 7000 RPM</li> <li>• BARO &gt; 70 kPa</li> <li>• ECT &gt; -20°C but &lt; 150°C</li> <li>• MAP &gt; 11 kPa but &lt; 254 kPa</li> <li>• IAT &gt; -20°C but &lt; 150°C</li> <li>• MAF &gt; 1 g/s but &lt; 511 g/s</li> <li>• VSS &lt; 300 km/h</li> <li>• Closed Loop and LONG FT enabled</li> <li>• Not in Device Control</li> <li>• EGR Flow Diagnostic Intrusive Test = Not Active</li> <li>• Catalyst Monitor Diagnostic Intrusive Test = Not Active</li> <li>• Post O2 Diagnostic Intrusive Test = Not Active</li> <li>• EVAP diagnostic is at any stage except the “tank pull down” portion of the test.</li> <li>• Fuel Level &gt; 10 % (must be &lt; 10% for at least 30 seconds to disable; default is to enable if fuel sender is faulty)</li> </ul> <p>General Notes:</p> <ol style="list-style-type: none"> <li>1. At least 32 seconds of LTM data must accumulate on each trip, with at least 22 seconds of data in the current fuel trim cell before a pass or fail decision can be made.</li> <li>2. In consideration of the above enable criterion, development data indicates that the Fuel Adjustment System Diagnostic (FASD) is typically enabled during (84%) of the EPAIII drive cycle. This is also typical of real-world driving, however values will vary slightly (higher or lower) based on the specific enable conditions present during the drive cycle.</li> </ol>	<p>The EWMA of LONG FT samples <math>\geq</math> 1.29 for <math>\geq</math> 100 ms</p> <p><u>Frequency:</u> Continuous 100 ms loop</p>	DTC Type B

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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
Fuel System Too Rich Bank 1	P0172	<p>Determines if the fuel control system is in a rich condition, based on the EWMA of long-term fuel trim (LONG FT).</p> <p>(Note: EWMA stands for “Exponentially Weighted Moving Average”)</p>	<p>There exists both a Passive and, if needed, Intrusive rich test.</p> <p>Passive: The EWMA of purge-off LONG FT samples <math>\leq 0.79</math></p> <p>Intrusive: If a passive decision cannot be made, and the EWMA of purge-on LONG FT samples <math>\leq 0.80</math>, purge is ramped off to determine if excess purge is the cause. Therefore, the following must also occur to report a failure:</p> <p>The EWMA of LONG FT samples with purge off <math>\leq 0.79</math> for at least 7 seconds during each of 2 intrusive segments.</p> <p>Intrusive Notes:</p> <ol style="list-style-type: none"> <li>1. Segments can last up to 60 seconds, and are separated by the smaller of a 30 second purge-on time or enough time to purge 18 grams of vapor.</li> <li>2. A maximum of 3 completed segments or 30 intrusive attempts are allowed for each intrusive test.</li> </ol>	<ul style="list-style-type: none"> <li>• No Misfire, pre-cat O2S, or EVAP DTC's</li> <li>• No Fuel Injector DTC's</li> <li>• No IAC, MAF, MAP, ECT, EGR, or A.I.R. DTC's</li> <li>• No TP Sensor or TAC System DTC's</li> <li>• Engine speed &gt; 400 RPM but &lt; 7000 RPM</li> <li>• BARO &gt; 70 kPa</li> <li>• ECT &gt; -20°C but &lt; 150°C</li> <li>• MAP &gt; 11 kPa but &lt; 254 kPa</li> <li>• IAT &gt; -20°C but &lt; 150°C</li> <li>• MAF &gt; 1 g/s but &lt; 511 g/s</li> <li>• VSS &lt; 300 km/h</li> <li>• Closed Loop and LONG FT enabled</li> <li>• Not in Device Control</li> <li>• EGR Flow Diagnostic Intrusive Test = Not Active</li> <li>• Catalyst Monitor Diagnostic Intrusive Test = Not Active</li> <li>• Post O2 Diagnostic Intrusive Test = Not Active</li> <li>• EVAP diagnostic is at any stage except the “tank pull down” portion of the test.</li> </ul> <p>General Notes:</p> <ol style="list-style-type: none"> <li>1. At least 32 seconds of LTM data must accumulate on each trip, with at least 22 seconds of data in the current fuel trim cell before a pass or fail decision can be made.</li> <li>2. In consideration of the above enable criterion, development data indicates that the Fuel Adjustment System Diagnostic (FASD) is typically enabled during (84%) of the EPAIII drive cycle. This is also typical of real-world driving, however values will vary slightly (higher or lower) based on the specific enable conditions present during the drive cycle.</li> </ol>	<p>Passive: The EWMA of purge-off LONG FT samples <math>\leq 0.79</math> for <math>\geq 100</math>ms</p> <p>Intrusive: If rich fail counter is <math>\geq 2</math> before pass counter <math>\geq 2</math>, diagnostic fails.</p> <p><u>Frequency:</u> Continuous 100 ms loop</p>	DTC Type B
Fuel Injector 1 Control Circuit	P0201	Detects fuel injector circuit continuity	Injector driver feedback indication = fault	Engine Running 18 volts > System Voltage > 9 volts Condition Stable > 5sec	10/20 counts 4 counts/sec  Continuous check	DTC Type B
Fuel Injector 2 Control Circuit	P0202	Detects fuel injector circuit continuity	Injector driver feedback indication = fault	Engine Running 18 volts > System Voltage > 9 volts Condition Stable > 5sec	10/20 counts 4 counts/sec  Continuous check	DTC Type B
Fuel Injector 3 Control Circuit	P0203	Detects fuel injector circuit continuity	Injector driver feedback indication = fault	Engine Running 18 volts > System Voltage > 9 volts Condition Stable > 5sec	10/20 counts 4 counts/sec  Continuous check	DTC Type B
Fuel Injector 4 Control Circuit	P0204	Detects fuel injector circuit continuity	Injector driver feedback indication = fault	Engine Running 18 volts > System Voltage > 9 volts Condition Stable > 5sec	10/20 counts 4 counts/sec  Continuous check	DTC Type B



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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
Fuel Injector 5 Control Circuit	P0205	Detects fuel injector circuit continuity	Injector driver feedback indication = fault	Engine Running 18 volts > System Voltage > 9 volts Condition Stable > 5sec	10/20 counts 4 counts/sec  Continuous check	DTC Type B
Throttle Position (TP) Sensor 2 Circuit	P0220	Detects a continuous or intermittent short or open in TP sensor #2 circuit	.25 Volts > TPS > 4.59 Volts	Ignition in Unlock/accessory, run, crank System voltage > 5.23 V No 5 V reference DTCs	79/159 counts; 52 counts continuous; 3.125 msec /count in the motor processor  19/39 counts or 13 counts continuous; 12.5 msec/count in the MHC processor	DTC Type A
Throttle Position (TP) Sensor 2 Lo	P0222	Detects a continuous or intermittent short or open in TP sensor #2 circuit	TPS < .25 Volts	Ignition in Unlock/accessory, run, crank System voltage > 5.23 V No 5 V reference DTCs	79/159 counts ; 52 counts continuous; 3.125 msec /count in the ecm main processor  19/39 counts or 13 counts continuous; 12.5 msec/count in the MHC processor	DTC Type A
Throttle Position (TP) Sensor 2 Circuit Hi	P0223	Detects a continuous or intermittent short or open in TP sensor #2 circuit	TPS > 4.59 Volts	Ignition in Unlock/accessory, run, crank System voltage > 5.23 V No 5 V reference DTCs	79/159 counts ; 52 counts continuous; 3.125 msec /count in the ecm main processor  19/39 counts or 13 counts continuous; 12.5 msec/count in the MHC processor	DTC Type A
Fuel Pump Primary Circuit (ODM)	P0230	This DTC checks the circuit for electrical integrity during operation.	The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match.	RunCrankIgnInRange (11 volts ≤ Ignition ≤ 18 volts) Engine speed ≥ 0 RPM	8 failures out of 10 samples 250 msec / sample  continuous	DTC Type B

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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
Random Misfire Detected  Cylinder 1 Misfire Cylinder 2 Misfire Cylinder 3 Misfire Cylinder 4 Misfire Cylinder 5 Misfire	P0300  P0301 P0302 P0303 P0304 P0305	Determine if a random misfire or a cylinder specific misfire is occurring by monitoring crankshaft velocity	Deceleration index Vs Engine speed Vs Load and Camshaft Position  Emission Failure Threshold = 1% misfire  Catalyst Damage Threshold = 5% to 18% misfire depending on engine speed and engine load.	Engine run time > 1 engine cycle No VSS, crank, TPS, MAP, ECT, MAF, ETC, PCM, cam, fuel sensing, throttle actuator, IAT DTCs Crankshaft position system variation must be learned or engine speed < 1000 RPM. Fuel cutoff not active Power management is not active Brake torque management not active Drag Control not active: N/A Fuel level > 10%. Disablement ends 500 engine cycles after a low fuel level condition ceases, and fuel disable does not occur with a fuel sensor DTC -7 °C < ECT < 125°C If ECT at startup < -7°C disable until ECT > 21°C 450 RPM < Engine speed < 5800 RPM 9 V < System voltage < 18 V + TP delta < 95% per 100 msec - TP delta < 95% per 100 msec Abnormal engine speed is not present Excess engine acceleration is not present No rough road TCS is not active Positive and zero torque. Detectable engine speed and engine load region EGR intrusive test not active: N/A AIR intrusive test not active: N/A Cam sensor is in sync with crank sensor. Misfire diagnostic is not requesting to disable TCC when transmission is in hot mode Crankshaft ring filter inactive (after a low level misfire, another misfire may not be detectable until crankshaft ringing ceases)	<u>Emission Exceedence</u> = 5 failed 200 revolution blocks of 16. Failure reported with 1 exceedence in first 16*200 revolution block, or 4 exceedences thereafter  <u>1st Catalyst Exceedence</u> = Number of 200 revolution blocks as data supports for catalyst damage.  <u>2nd and subsequent Catalyst Exceedences</u> = 1 200 revolution block with catalyst damage. Failure reported with 3 exceedences in FTP, or 1 exceedence outside FTP.  <u>Frequency:</u> Continuous	DTC Type B
Crankshaft Position System Variation Not Learned	P0315	Determine if the crankshaft position system variation has not been learned	Sum of Compensation Factors are $\leq$ KfCASE_FactorSumMin or $\geq$ KfCASE_FactorSumMax	PCM state = Run Manufacturers enable counter must be 0	0.5 sec  100msec loop  Continuous check	DTC Type A
Knock Sensor (KS) Module Performance	P0324	This diagnostic will detect a failed internal ECM component associated with knock control	Any Cylinder's Avg Gain Signal > 4.5V if RPM > 2000 RPM OR All Cylinder's Actual Signals < 0.2V if RPM > 1500 RPM	APC > 65.  Temporarily disabled ('Indeterminate' state reported) for samples in which P0325, P0327, P0328, P0330, P0332, or P0333 report 'Failed' state.	50 Counts out of 63 Counts  100ms sample rate Continuous	DTC Type A

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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
Knock Sensor (KS) Circuit Bank 1	P0325	This diagnostic checks for an open to the knock sensor	Gated Low Pass Filter Voltage > 4V or < 1.24 V	Coolant > -40 C and Engine Run Time > 2 Minutes PTO not active  Temporarily disabled ('Indeterminate' state reported) for samples in which P0327 or P0328 report 'Failed' state.	50 Counts out of 63 Counts  100ms sample rate Continuous	DTC Type B
Knock Sensor (KS) Performance Bank 1	P0326	This diagnostic checks for an overactive knock sensor caused by noisy engine components (e.g. lifters)	Fast Retard $\geq 10$	Engine Speed $\geq 1800$ RPM MAP $\geq 55$ KPA No throttle fault No PTO active Fast spark retard active	50 Counts out of 63 Counts  100ms sample rate Continuous	DTC Type B
Knock Sensor (KS) Circuit Low Bank 1	P0327	This diagnostic checks for an out of range low knock sensor signal	Sensor Input Signal Line > 2.86 V or Sensor Return Signal Line < 1.48 V	Coolant > -40 C and Engine Run Time > 2 Minutes PTO not active	50 Counts out of 63 Counts  100ms sample rate Continuous	DTC Type B
Knock Sensor (KS) Circuit High Bank 1	P0328	This diagnostic checks for an out of range high knock sensor signal	Sensor Input Signal Line < 2.02 V or Sensor Return Signal Line > 3.76 V	Coolant > -40 C and Engine Run Time > 2 Minutes PTO not active	50 Counts out of 63 Counts  100ms sample rate Continuous	DTC Type B

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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
Crankshaft Position Sensor-A Circuit	P0335	<p>Crank Sensor Event Test Incorrect number of crank sensor pulses in a given number of cam sensor pulses</p> <p><u>Crank Time Without Match Test</u> Excessive time without crank sensor match</p>	<p>Crank Sensor Event Test 90 &gt; number of crank pulses &gt; 110</p> <p><u>Crank Time Without Match Test</u> See 'TIME LENGTH AND FREQUENCY' column</p>	<p>Crank Sensor Event Test IF [(Engine Running = TRUE OR Engine Cranking = TRUE) AND (Primary_Cam_Sync_Flag = CAM_SIDE OR Primary_Cam_Sync_Flag = CAM_CYLINDER) AND PRIMARY_CAM_TYPE ≠ CSI_CAM) AND Fault Active [Primary Cam-Ckt] = FALSE</p> <p>AND Fault Active [Primary Cam-Perf] = FALSE]</p> <p>THEN Enable diagnostic</p> <p>ELSE Disable diagnostic</p> <p>ENDIF</p> <p><u>Crank Time Without Match Test</u> IF [(Engine Running = TRUE OR Engine Cranking = TRUE) AND (Engine Speed Defaulted &lt; 2000 RPM) AND {(Cranking Motor Is Engaged = TRUE AND</p> <p>THEN Enable diagnostic</p> <p>ELSE Disable diagnostic</p> <p>ENDIF</p>	<p>Crank Sensor Event Test</p> <ul style="list-style-type: none"> <li>• One test = 10 cam sensor pulses</li> <li>• Fail report = 8/10 tests exceed malfunction criteria</li> </ul> <p><u>Monitor Time in NoActivity</u></p> <p>If time exceeds 0.125 seconds</p> <p>Set P0335</p> <p>Diagnostic executes every 12.5 milliseconds</p>	DTC Type B
Crankshaft Position Sensor-A Performance	P0336	Detects an excessive number of crank sensor resyncs.	See 'TIME LENGTH AND FREQUENCY' column	<p>IF [Engine Running = TRUE AND Engine Speed &gt; 450 RPM] Crank decoding enabled No V ref B fault active</p> <p>THEN Enable diagnostic</p> <p>ELSE Disable diagnostic</p> <p>ENDIF</p>	<p>20 crank resyncs occur within 25 secs</p> <p>Set P0336</p> <p>Or</p> <p>Crank pulses without gaining sync during a time period.</p> <p>If time exceeds 0.4 seconds</p> <p>Set P0336</p> <p>Diagnostic executes every 250 milliseconds</p>	DTC Type B



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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
Camshaft Position Sensor-B Bank-1 Performance	P0366	Detects cam sensor performance malfunctions by monitoring for the incorrect number of cam sensor pulses in a given number of crank sensor pulses	<p>After Engine Start (slow event based)</p> <p><u>Near Engine Start (fast event based)</u> 5 &gt; cam pulses &gt; 15</p>	<p>After Engine Start (slow event based)</p> <p>IF[ {   (CAM_TYPE ≠ CSI AND ) } AND   CKP_MedRes_Active = TRUE AND   Crank_Sync_Flag = Crank_In_Sync AND   Fault_Active[CMP_Ckt] = FALSE AND   Fault_Active[CKP_SnsrA_Ckt] = FALSE</p> <p>AND   Fault_Active[CKP_SnsrA_Perf] = FALSE</p> <p>AND   Fault_Active[CKP_SnsrB_Ckt] = FALSE</p> <p>AND   Fault_Active[CKP_SnsrB_Perf] = FALSE</p> <p>AND   Fault_Active[CKP_SnsrAB_Corr] = FALSE</p> <p>THEN   Enable diagnostic</p> <p>ELSE   Disable diagnostic</p> <p>ENDIF</p> <p><u>Near Engine Start (fast event based)</u></p> <p>IF[   MedRes_CKP_Counter ≤ 10 AND   CKP_MedRes_Active = TRUE AND   Crank_Sync_Flag = Crank_In_Sync AND   CAM_TYPE ≠ CSI_CAM AND   Fault_Active[CMP-Ckt] = FALSE ]</p> <p>THEN   ENABLE DIAGNOSTIC</p> <p>ELSE   DISABLE DIAGNOSTIC</p> <p>ENDIF</p> <p>Footnote: the crank MedRes counter increments when the diagnostic is enabled and counts the number of crank MedRes software interrupts. ECM throughput prohibits interrupting on every crank sensor pulse. Typical crank MedRes software interrupts occur twice per cylinder, but varies in each engine.</p>	<p>After Engine Start One Test = 1200 MedRes software interrupts</p> <p>8 failed tests out of the last 10tests</p> <p>Near Engine Start One Test = 12 MedRes software interrupts</p> <p>Fail Report = 1 failed test</p>	DTC Type B

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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
Secondary AIR Incorrect Airflow	P0411	<p>Detects an insufficient flow condition</p> <p>This test is run during Phase 1 (AIR pump commanded On, Valve commanded Open)</p> <p>Leaks downstream of the valve are detected via an evaluation of both pressure error and average pressure "String Length" – a term that represents the absolute pressure delta accumulated every 6.25ms, then averaged over the duration of the test. Low "String Length" values are indicative of downstream leaks or blockages.</p>	<p>Predicted System Pressure versus Actual System Pressure Error &gt; 5.0kPa OR System Pressure Error &lt; -3.4kPa</p> <p>OR</p> <p>[System Pressure Error &gt; 0 kPa OR System Pressure Error &lt; 0 kPa] while the Average String Length &lt; 35</p> <p><u>Notes:</u> The "String Length" failure threshold may be a function of average MAF on applications where this was deemed necessary (i.e. "String Length" vs. MAF look-up table).</p>	<p>No active MAF DTCs No active MAP DTCs No active AIR Pressure Sensor Performance DTCs No active AIR Pressure Sensor Circuit DTCs No active AIR pump relay DTCs No active AIR valve relay DTCs No active IAT DTCs No active ECT DTCs No active Misfire DTCs No active Catalyst Monitor DTCs No active P0606 DTC No active 5 Volt DTCs No active EST DTCs No active Fuel Injector DTCs BARO &gt; 70 kPa Engine Airflow &lt; 42 g/s 9V &lt; System Voltage &lt; 18V Stability Time &gt; 5 seconds AIR System commanded On Additional "String Length" accumulation criterion: AIR commanded On for &gt; 3 sec. 5600 RPM &gt; Engine RPM &gt; 6400 RPM</p>	<p>Phase 1 Conditional test weight &gt; 7 seconds</p> <p>Conditional test weight is based on BARO, MAF, &amp; System Voltage.</p> <p>Total "String Length" accumulation time &gt; 10 sec.</p> <p>Frequency: Once per trip when AIR pump commanded On</p>	DTC Type B
Secondary AIR Solenoid Control Circuit Bank 1	P0412	This DTC checks the AIR solenoid circuit for electrical integrity	The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match.	11V < System Voltage < 18V	<p>50/63 counts</p> <p>Frequency: 4 counts/second</p> <p>Continuous check</p>	DTC Type B
Secondary AIR Pump Control Circuit	P0418	This DTC checks the AIR pump relay circuit for electrical integrity	The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match.	11V < System Voltage < 18V	<p>50/63 counts</p> <p>Frequency: 4 counts/second</p> <p>Continuous check</p>	DTC Type B

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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
Catalyst System Low Efficiency Bank 1	P0420	Oxygen Storage	<p>Normalized Ratio OSC Value &lt; 0.30 (EWMA filtered)</p> <p>Normalized Ratio OSC Value Calculation Information and Definitions =</p> <p>1. Raw OSC Calculation = (post cat O2 Resp time - pre cat O2 Resp time)</p> <p>2. BestFailing OSC value from a calibration table (based on temp and exhaust gas flow)</p> <p>3. WorstPassing OSC value (based on temp and exhaust gas flow)</p> <p>Normalized Ratio Calculation = (1-2) / (3-2)</p> <p>A Normalized Ratio of 1 essentially represents a good part and a ratio of 0 essentially represents a very bad part.</p>	<p><u>General Enable</u></p> <ul style="list-style-type: none"> <li>No EVAP, PTO not active, TAC system, MAF, CAM, ECT, CKP, EGR, BARO, AIR, EST, Fuel Injector, Fuel Trim, Idle Air, MAP, IAT, Misfire, O2 Sensor, TP Sensor, VSS or Engine Overtemp Protection Mode DTCs</li> </ul> <p><u>Valid Idle Period Criteria</u></p> <ul style="list-style-type: none"> <li>Throttle Position &lt; 2%</li> <li>Vehicle Speed &lt;= 1.6 kph</li> <li>Engine speed &gt;= 1250 RPM for a minimum of 16 seconds since end of last idle period.</li> <li>Engine run time &gt;= 100 seconds</li> <li>Tests attempted this trip &lt; 255.00</li> <li>The catalyst diagnostic has not yet completed for the current trip.</li> </ul> <p><u>Catalyst Idle Conditions Met Criteria</u></p> <p>General Enable met and the Valid Idle Period Criteria met</p> <ul style="list-style-type: none"> <li>Green Converter Delay = Not Active</li> <li>Induction Air &gt; -20° C</li> <li>Induction Air &lt; 85° C</li> <li>FASD and/ or POS Diagnostic Intrusive Test and/or AIR Diagnostic Intrusive Test not Active</li> <li>RunCrank Voltage &gt; 10.8 volts</li> <li>Ethanol Estimation Is NOT in Progress</li> <li>ECT &gt;= 50° C</li> <li>ECT &lt;= 125 ° C</li> <li>Barometric Pressure &gt; 70 KPA</li> <li>Idle Time is &lt;= 50 seconds ⇒ Idle time is incremented if the vehicle speed &lt;= 1.6 kph and the throttle position &lt;= 2.0% as identified in the Valid Idle Period Criteria section.</li> <li>Short Term Fuel Trim &lt; 1.12</li> <li>Short Term Fuel Trim &gt; 0.90</li> <li>Predicted catalyst temp ≥ 500°C AND engine airflow &gt; 14 grams per second for at least 30 seconds with a closed throttle time ≤ 60 seconds consecutively (closed throttle consideration involves having the TPS &lt; the value as stated in the Valid Idle Period Criteria Section)</li> </ul> <p><b>Continued next page</b></p>	<p>1 test attempted per valid idle period</p> <p>Minimum of 1 test per trip</p> <p>Maximum of 8 tests per trip</p> <p><u>Frequency:</u></p> <ul style="list-style-type: none"> <li>Fueling Related : 12.5 ms</li> <li>OSC Measurements: 100 ms</li> <li>Temp Prediction: 1000ms</li> </ul> <p>Rapid Step Response (RSR) feature will initiate multiple tests:</p> <ul style="list-style-type: none"> <li>If the difference between current EWMA value and the current OSC Normalized Ratio value is &gt;= 0.75</li> <li>The current OSC Normalized Ratio value is &lt;= 0.25</li> </ul> <p>Maximum of 8 tests per trip. Maximum of 24 tests to detect failure when RSR is enabled.</p> <p><u>Green Converter Delay Criteria</u></p> <p>This is part of the check for the Catalyst Idle Conditions Met Criteria section</p> <ul style="list-style-type: none"> <li>The diagnostic will not be enabled until the following has been met: Predicted catalyst temperature &gt;= 600° C for 3600 seconds non-continuously.</li> <li>Note: this feature is only enabled when the vehicle is new and cannot be enabled in service</li> </ul>	DTC Type A



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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
Catalyst System Low Efficiency Bank 1 <b>(Continued from prior page)</b>	P0420			<ul style="list-style-type: none"> <li>• Closed loop fueling</li> <li>• PRNDL is in Drive Range</li> </ul> <p><b><u>Idle Stable Criteria :: Must hold true from after Catalyst Idle Conditions Met to the end of test</u></b></p> <ul style="list-style-type: none"> <li>• MAF &gt;= 2 grams per second</li> <li>• MAF &lt;=15 grams per second</li> <li>• Predicted catalyst temperature &lt;= 800 degC</li> </ul> <p><b><u>Engine Fueling Criteria at Beginning of Idle Period</u></b>                      The following fueling related must also be met from between 4 and 7 seconds after the Catalyst Idle Conditions Met Criteria has been met for at least 4 seconds prior to allowing intrusive control</p> <ul style="list-style-type: none"> <li>• Number of pre-O2 switches &gt;= 2</li> <li>• Short Term Fuel Trim Avg &gt;= 0.96</li> <li>• Short Term Fuel Trim Avg &lt;= 1.04</li> </ul>		

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Evaporative Emission (EVAP) System Small Leak Detected	P0442	This DTC will detect a small leak ( $\geq 0.020''$ ) in the EVAP system between the fuel fill cap and the purge solenoid. The engine off natural vacuum method (EONV) is used.	<p><b><u>SMALL LEAK TEST FAIL:</u></b>            Engine Off Natural Vacuum (EONV) while the engine is off.            The total pressure change achieved during the test is normalized against a target value that is based upon fuel level and ambient temperature. (values range from 622.7 to 622.7 Pa). The normalized value is entered into EWMA (with 0= perfect pass and 1=perfect fail). Once EWMA exceeds the fail threshold, the DTC light is illuminated. The DTC light can be turned off if the EWMA falls below the re-pass threshold for 3 consecutive trips.</p> <p>Fail threshold = 0.55            Re-Pass threshold = 0.35</p>	<p><b><u>TEST ENABLE :</u></b>            No MAP Sensor DTC's            No MAF Sensor DTC's            No Thermostat Rationality DTC's            VSS DTC's not active            No Fuel Tank Pressure Sensor circuit DTC's            No Fuel Tank Pressure Sensor Performance DTC's            No EVAP Canister Purge Valve Solenoid circuit DTC's            No EVAP Canister Vent Solenoid circuit DTC's            No Fuel Level Sensor DTC's            ECT Sensor DTC's not active            IAT Sensor DTC's not active            EVAP Canister Purge Valve stuck open DTC not active.            EVAP large leak DTC not active.            Ignition off timer DTC not active.            EVAP Canister Vent restriction DTC is not active            10% <math>\leq</math> Fuel Level <math>\leq</math> 90%            Drive time <math>\geq</math> 600 seconds.            Drive length <math>\geq</math> 5 kilometers.            ECT <math>\geq</math> 70°C.            No fuel filling (fuel level increment <math>\geq</math> 20%) During EONV test.            BARO <math>\geq</math> 74.0kPa            Estimated ambient temperature at end of drive <math>\geq</math> 0°C but <math>\leq</math> 34°C.            Odometer <math>\geq</math> 16.1 kilometers</p> <p>Estimate of Ambient Air Temperature Valid Conditions to be valid</p> <ol style="list-style-type: none"> <li>1. Cold Start                  Startup <math>\Delta^{\circ}\text{C}(\text{ECT}-\text{IAT}) \leq 8^{\circ}\text{C}</math> if ECT &gt; IAT</li> </ol> <p style="text-align: center;">OR</p> <ol style="list-style-type: none"> <li>2. Hot Restart                  Sufficient drive length to get accurate estimate of ambient air temperature (at least a minimum of 4 minutes and 3 kilometers)</li> </ol>	Once per trip, during hot soak (up to 2400 sec.). Time since last complete test $\geq$ 17 hours if EWMA is passing, or $\geq$ 10 hours if EWMA is failing. No more than 2 attempts per day.	DTC Type A EWMA  Average run length is 5 under normal conditions  Run length is 2 to 6 trips after code clear or non-volatile reset
Evaporative Emission (EVAP) Canister Purge Solenoid Valve Circuit (ODM)	P0443	This DTC checks the circuit for electrical integrity during operation.	The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match.	RunCrankIgnInRange (11 volts $\leq$ Ignition $\leq$ 18 volts	20 failures out of 25 samples 250 msec /sample  Continuous with solenoid operation	DTC Type B

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Evaporative Emission (EVAP) Vent System Performance	P0446	This DTC will determine if a restriction is present in the vent solenoid, vent filler, vent hose or EVAP canister	Tank Vacuum > 2989 Pa for 5 seconds BEFORE Purge Volume $\geq$ 10 liters  OR  Vented Vacuum < 623 Pa or Vented Vacuum > 1245 Pa for 60 seconds  2 liters of fuel must be consumed after setting the DTC active the first time to set the DTC active the second time.	<u>General Test Enable:</u> No MAP Sensor DTC's No TP Sensor DTC's No VSS DTC's No IAT DTC's No ECT DTC's No Fuel Tank Pressure Sensor circuit DTC's No EVAP Canister Purge Valve solenoid circuit DTC's No EVAP Canister Vent Solenoid circuit DTC's No Thermostat Rationality DTC's 10 % $\leq$ Fuel Level $\leq$ 90. % 11 V $\leq$ System Voltage $\leq$ 18 V 4 °C $\leq$ Startup IAT $\leq$ 30°C Startup ECT $\leq$ 35 °C BARO $\geq$ 74.00 kPa (8000 ft)	Once per Cold Start  Time is dependent on driving conditions  Max. before test abort is 1000 seconds	DTC Type B
Evaporative Emission (EVAP) Vent Solenoid Control Circuit (ODM)	P0449	This DTC checks the circuit for electrical integrity during operation.	The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match.	RunCrankIgnInRange (11 volts $\leq$ Ignition $\leq$ 18 volts)	20 failures out of 25 samples 250 msec / sample  Continuous with solenoid operation	DTC Type B
Fuel Tank Pressure (FTP) Sensor Circuit Performance	P0451	The DTC will be set if the fuel tank vacuum sensor is out of range when it tries to re-zero prior to the phase-1 or phase-2 portions of the engine-off natural vacuum small leak test.	The tank vacuum sensor voltage is compared to a window about the nominal sensor voltage offset (~1.5 volts)  Upper voltage threshold (voltage addition above the nominal voltage): 0.2 volts  Lower voltage threshold (voltage subtraction below the nominal voltage): 0.2 volts  The difference between tank vacuum sensor voltage and the nominal offset voltage is then normalized against the appropriate threshold listed above to produce a ratio between 0.0 and 1.0. This normalized re-zero ratio is then filtered with a EWMA (with 0= perfect pass and 1=perfect fail). Once EWMA exceeds the fail threshold, the DTC light is illuminated. The DTC light can be turned off if the EWMA falls below the re-pass threshold for 3 consecutive trips.  Fail threshold = 0.73 Re-Pass threshold = 0.40	This test will execute whenever the engine-off natural vacuum small leak test (P0442) executes	This test is executed during an engine-off natural vacuum small leak test. The number of times that it executes can range from zero to two per engine-off period.  The length of the test is determined by the refueling rationality test, which can take up to 600 seconds to complete.	DTC Type A EWMA average run length: 6
Fuel Tank Pressure (FTP) Sensor Circuit Low Voltage	P0452	This DTC will detect a fuel tank pressure sensor signal that is too low out of range.	Fuel tank pressure sensor signal < 3% of Vref (0.15 volts) produces a failing sample. Otherwise, the sample is considered passing.	<ul style="list-style-type: none"> <li>0.10 second delay after sensor power up for sensor warm-up</li> <li>ECM State <math>\diamond</math> crank</li> </ul>	80 failures out of 100 samples 100ms / sample  Continuous	DTC Type B

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Fuel Tank Pressure (FTP) Sensor Circuit High Voltage	P0453	This DTC will detect a fuel tank pressure sensor signal that is too high out of range.	Fuel tank pressure sensor signal > 97% of Vref (4.85 volts) produces a failing sample. Otherwise, the sample is considered passing.	<ul style="list-style-type: none"> <li>0.10 second delay after sensor power up for sensor warm-up</li> <li>ECM state &lt;&gt; crank</li> </ul>	80 failures out of 100 samples 100ms / sample  Continuous	DTC Type B
Fuel Tank Pressure (FTP) Sensor Circuit Intermittent	P0454	This DTC will detect intermittent tank vacuum sensor signals that would have caused the engine-off natural vacuum small leak test to abort due to an apparent re-fueling event.	<p>If an abrupt change in tank vacuum is detected the engine-off natural vacuum test is aborted due to an apparent refueling event. Subsequent to the abort, a refueling rationality test is executed to confirm that a refueling event occurred. If a refueling is confirmed, then the test sample is considered passing. Otherwise, the sample is considered failing indicating an intermittent signal problem.</p> <p>The abrupt change is defined as a change &gt; 112 Pa and &lt; 249 Pa vacuum in the span of 1.0 seconds.</p> <p>A refueling event is confirmed if the fuel level has a persistent change of 10.0 % for 30 seconds.</p>	This test will execute whenever the engine-off natural vacuum small leak test (P0442) executes	<p>This test is executed during an engine-off natural vacuum small leak test. The test can only execute up to once per engine-off period.</p> <p>The length of the test is determined by the refueling rationality test, which can take up to 600 seconds to complete.</p> <p>The test will report a failure if 2 out of 3 samples are failures.</p>	DTC Type A
Evaporative Emission (EVAP) System Large Leak Detected	P0455	This DTC will detect a weak vacuum condition (large leak or purge blockage) in the Evap system.	<p>Purge volume &gt; 15 liters BEFORE Tank vacuum ≤ 2740 Pa</p> <p>2 liters of fuel must be consumed after setting the DTC active the first time to set the DTC active the second time.</p> <p><u>Weak Vacuum Follow-up Test</u> (fuel cap replacement test) Weak Vacuum Test failed. Passes if tank vacuum ≥ 2740 Pa.</p> <p>Note: Weak Vacuum Follow-up Test can only report a pass.</p>	<p><u>General Test Enable</u> No MAP Sensor DTC's No TP Sensor DTC's No VSS DTC's No IAT DTC's No ECT DTC's No Fuel Tank Pressure circuit Sensor DTC's No Fuel Tank Pressure Intermittant DTC's No Evap Canister Purge Valve solenoid circuit DTC's No EVAP Canister Vent Solenoid circuit DTC's No Thermostat Rationality DTC's 10 % ≤ Fuel Level ≤ 90. % 11 V ≤ System Voltage ≤ 18 V BARO ≥ 74.00 kPa (8000 ft)</p> <p><u>Cold Start Test</u></p> <ul style="list-style-type: none"> <li>Startup temperature Δ(ECT-IAT): ≤ 8 °C if ECT &gt; IAT</li> <li>Cold Test Timer ≤ 1000 seconds</li> <li>4 °C ≤ Startup IAT ≤ 30°C</li> <li>Startup ECT ≤ 35 °C</li> </ul> <p><u>Weak Vacuum Follow-up Test</u> This test can run following a weak vacuum failure or on a hot restart.</p>	<p>Once per cold start</p> <p>Time is dependent on driving conditions</p> <p>Max. before test abort is 1000 seconds</p> <p><u>Weak Vacuum Follow-up Test</u> With large leak detected, the follow-up test is limited to 1300 seconds. Once the MIL is on, the follow-up test runs indefinitely.</p>	DTC Type B
Fuel Level Sensor 1 Performance	P0461	This DTC will detect a fuel sender stuck in range in the primary fuel tank.	IF Delta Fuel Volume change less than 10 liters over an accumulated 241 Kilometers.	No VSS DTC's set Engine Running	250 ms / sample Continuous	DTC Type B

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Fuel Level Sensor 1 Circuit Low Voltage	P0462	This DTC will detect a fuel sender stuck out of range low in the primary fuel tank.	Fuel level Sender % of 5V range < 10 %	RunCrankIgnInRange (11 volts ≤ Ignition ≤ 18 volts)	240 failures out of 300 samples 100ms / sample  Continuous	DTC Type B
Fuel Level Sensor 1 Circuit High Voltage	P0463	This DTC will detect a fuel sender stuck out of range high in the primary fuel tank.	Fuel level Sender % of 5V range > 60%	RunCrankIgnInRange (11 volts ≤ Ignition Voltage ≤ 18 volts)	240 failures out of 300 samples 100ms / sample  Continuous	DTC Type B
Fuel Level Sensor 1 Circuit Intermittent	P0464	This DTC will detect intermittent fuel level sensor signals that would have caused the engine-off natural vacuum small leak test to abort due to an apparent refueling event.	If a change in fuel level is detected the engine-off natural vacuum test is aborted due to an apparent refueling event. Subsequent to the abort, a refueling rationality test is executed to confirm that a refueling event occurred. If a refueling is confirmed, then the test sample is considered passing. Otherwise, the sample is considered failing indicating an intermittent signal problem.  The refuel event is defined as a change of 20% fuel level during the engine-off test.  A refueling event is confirmed if the fuel level has a persistent change of 20 % for 30 seconds.	This test will execute whenever the engine-off natural vacuum small leak test (P0442) executes	This test is executed during an engine-off natural vacuum small leak test. The test can only execute up to once per engine-off period.  The length of the test is determined by the refueling rationality test, which can take up to 600 seconds to complete.  The test will report a failure if 2 out of 3 samples are failures.	DTC Type A
Evaporative Emission (EVAP) System Flow During Non-Purge	P0496	This DTC will determine if the purge solenoid is leaking to engine manifold vacuum.	Tank Vacuum > 2491 Pa for 5.00 sec BEFORE Test time > 60 seconds (cold start)	<u>General Test Enable:</u> No MAP Sensor DTC's No TP Sensor DTC's No VSS DTC's No IAT DTC's No ECT DTC's No Fuel Tank Pressure Sensor circuit DTC's No EVAP Canister Purge Valve solenoid circuit DTC's No EVAP Canister Vent Solenoid circuit DTC's No Thermostat Rationality DTC's 10 % ≤ Fuel Level ≤ 90 % 11 V ≤ System Voltage ≤ 18 V 4 °C ≤ Startup IAT ≤ 30°C Startup ECT ≤ 35 °C BARO ≥ 74.00 kPa (8000 ft)	Once per cold start.  Cold start: max time is 1000 seconds	DTC Type B

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Idle System - Low Engine Speed	P0506	This DTC will determine if a low idle exists.	<p>Filtered Engine Speed Error &gt; Fault threshold where the fault threshold = 95 rpm</p> <p>Filter coefficient for engine speed error = 0.00375</p>	<p>No MAF, MAP, Baro, IAT, ECT, TP, Injector, Fuel System, Misfire, EST (spark), ETC, VSS, EGR or Purge DTC's</p> <p>TCM Communication Fault not active</p> <p>Engine Run &gt; 60 sec.</p> <p>ECT &gt; 60 C</p> <p>BARO &gt; 70 kPa</p> <p>IGN. voltage &gt; 11 volts but &lt; 18 volts</p> <p>IAT &gt; -20 C</p> <p>Time since a gear state change &gt; 3 seconds</p> <p>Time since a TCC mode change is &gt; 3 seconds</p> <p>Idle control logic indicates that the engine is in an idle condition</p> <p>Idle conditions present for &gt; 5 seconds to enable diagnostic test</p> <p>Vehicle Speed &lt; 2 Kph</p> <p>Engine overtemperature light not on</p> <p>Clutch pedal must be at the top or the bottom of travel to enable the diagnostic test.</p> <p>PTO (power take-off) must not be active.</p> <p>Off-vehicle device control (service bay control) must not be active.</p>	<p>Time for each test:</p> <p>Filtered engine speed error must be within pass criteria continuously for 10 seconds to consider a pass.</p> <p>Filtered engine speed must reach the fault threshold to set a fault.</p> <p>Frequency:</p> <p>Continuous after enable; 100ms loop</p>	DTC Type B

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Idle System - High Engine Speed	P0507	This DTC will determine if a high idle exists	<p>Filtered Engine Speed Error &lt; Fault threshold where the fault threshold = 190 rpm</p> <p>Filter coefficient for engine speed error = 0.00375</p>	<p>No MAF, MAP, Baro, IAT, ECT, TP, Injector, Fuel System, Misfire, EST (spark), ETC, VSS, EGR or Purge DTC's</p> <p>TCM Communication Fault not active</p> <p>Engine Run &gt; 60 sec.</p> <p>ECT &gt; 60 C</p> <p>BARO &gt; 70 kPa</p> <p>IGN. voltage &gt; 11 volts but &lt; 18 volts</p> <p>IAT &gt; -20 C</p> <p>Time since a gear state change &gt; 3 seconds</p> <p>Time since a TCC mode change is &gt; 3 seconds</p> <p>Idle control logic indicates that the engine is in an idle condition</p> <p>Idle conditions present for &gt; 5 seconds to enable diagnostic test</p> <p>Vehicle Speed &lt; 2 kph</p> <p>Engine overtemperature light not on</p> <p>Clutch pedal must be at the top or the bottom of travel to enable the diagnostic test.</p> <p>PTO (power take-off) must not be active.</p> <p>Off-vehicle device control (service bay control) must not be active.</p>	<p>Time for each test:</p> <p>Filtered engine speed error must be within pass criteria continuously for 10 seconds to consider a pass.</p> <p>Filtered engine speed must reach the fault threshold to set a fault.</p> <p>Frequency:</p> <p>Continuous after enable; 100ms loop</p>	DTC Type B
Cruise control multi-function switch circuit	P0564	This DTC will determine if the signal from the cruise multi-func switch is invalid.	Voltage on cruise switch circuit is in an invalid range determined by HWIO software.	Diagnostic is disabled during the execution of a code clear or OFVC diagnostic re-enable event and may remain disabled for about 1 second afterward.	<p>Time for each test:</p> <p>Voltage on cruise switch circuit must be in an invalid range for more than 2.5 seconds to fail.</p> <p>Diagnostic passes as long as a failure has not occurred during current key cycle. If a failure has occurred, cruise control will be unavailable for the duration of the current key cycle.</p> <p>Frequency:</p> <p>Continuous after enable; 12.5ms loop</p>	DTC Type B

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Cruise control resume switch circuit	P0567	This DTC will determine if the signal from the cruise resume switch is invalid.	Cruise control resume switch has been in the "applied" state for more than a calibratable period of time.	Diagnostic is disabled during the execution of a code clear or OFVC diagnostic re-enable event and may remain disabled for about 1 second afterward.	Time for each test: Cruise control resume switch has been in the "applied" state for more than 120 seconds.  Diagnostic passes as long as a failure has not occurred during current key cycle. If a failure has occurred, cruise control will be unavailable for the duration of the current key cycle.  Frequency: Continuous after enable; 12.5ms loop	DTC Type B
Cruise control set switch circuit	P0568	This DTC will determine if the signal from the cruise set switch is invalid.	Cruise control set switch has been in the "applied" state for more than a calibratable period of time.	Diagnostic is disabled during the execution of a code clear or OFVC diagnostic re-enable event and may remain disabled for about 1 second afterward.	Time for each test: Cruise control set switch has been in the "applied" state for more than 120 seconds.  Diagnostic passes as long as a failure has not occurred during current key cycle. If a failure has occurred, cruise control will be unavailable for the duration of the current key cycle.  Frequency: Continuous after enable; 12.5ms loop	DTC Type B
Control Module Read Only Memory (ROM)	P0601	This DTC will be stored if the calibration check sum is incorrect	Calculated checksum does not match stored checksum	<ul style="list-style-type: none"> <li>PCM state = crank or run</li> <li>Ignition voltage <math>\geq</math> 5 volts</li> </ul>	1 failure if it occurs during the first ROM test of the ignition cycle, otherwise 5 failures  <u>Frequency:</u> Runs continuously in the background	DTC Type A
Control Module Not Programmed	P0602	This DTC will be stored if the PCM is a service PCM that has not been programmed.	Service calibration installed	<ul style="list-style-type: none"> <li>Ignition on</li> <li>PCM is identified through calibration as a Service PCM</li> </ul>	1 test failure  Tested once on controller power-up	DTC Type A
Control Module Long Term Memory Reset	P0603	Non-volatile memory checksum error at controller power-up	Checksum at power-up does not match checksum at power-down	Ignition on	1 test failure  Tested once on controller power-up	DTC Type A



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ECM RAM FAILURE	P0604	Indicates that ECM is unable to correctly write and read data to and from RAM	Data read does not match data written	Ignition in Run or Crank	Should finish within 30 seconds at all engine conditions.	DTC Type A
PCM Processor Processor Performance Check - Throttle limiting Fault Processor Performance Check - ETC software is not executed in proper order Processor Performance Check Processor Performance Check - SPI failed Processor Performance Check - motor processor state of health (Main) Processor Performance Check - Learn Corruption Fault (Main&motor processor) Processor Performance Check - Learn Corruption Fault MAIN & motor processor Processor Performance Check - motor processor state of health (Main) Processor Performance Check - MAIN state of health (motor processor)	P0606	Indicates that the ECM has detected an ETC internal processor integrity fault	MHC processor detects throttle limiting fault  Software tasks loops > schedule tasks loop  Loss of SPI communication from the motor processor  1.5 msec < Average motor processor state of health toggle > 2.5 msec  TPS or APPS minimum learned values fail compliment check  TPS or APPS minimum learned values fail range check  Motor processor integrity check error occurs  Motor processor integrity check error of main processor occurs	Ignition in unlock/accessory, run or crank System voltage>5.23 V	187.5 ms in the MHC processor  Error > 5 times of loop time; loop time are 12.5, 25,50,100 and 250 ms in the main processor  In the main processor, 159/400 counts intermittent or 15 counts continuous; 39 counts continuous @ initialization  In the MHC processor 475 ms at initialization, 175 msec continuous or 20/200 intermittent.  187.5ms continuous/100 ms intermittent in the main processor  187.5ms continuous/100 msec intermittent in the main processor	DTC Type A
Control Module Accelerator Pedal Position (APP) System Performance	P060D	Verify that the indicated accelerator pedal position calculation is correct	PPS sensor switch fault  Difference between Main processor indicated accelerator pedal position and MHC processor indicated accelerator pedal position > 2.5%  If your program does not have equal slope pedal sensors, delete number one above as it does not apply.	Ignitions in unlock/ accessory and run, System voltage > 5.23 V No PCM processor DTC  Ignition in unlock, accessory, run or crank System voltage > 5.23 V No PCM processor DTC, No Comm Fault w/ Main	39 counts continuous; 12.5 msec/count in the MHC processor	DTC Type A
Control Module EEPROM Error	P062F	Indicates that there is an EEPROM error	EEPROM write will not complete	Ignition on.	1 test failure  Tested once on controller power-up	DTC Type A

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5 Volt Reference 1 Circuit	P0641	Detects a continuous or intermittent short on the #1 5 V sensor reference circuit	Vref1 < 4.43 or > 4.66 volts	Ignition in unlock/accessory, run or crank System voltage > 5.23 V No ECM processor DTCs	19/39 counts or 187.5 msec continuous; 12.5 msec/count in main /MHC processor	DTC Type A
Malfunction Indicator Lamp (MIL) Control Circuit	P0650	This DTC checks the circuit for electrical integrity during operation.	The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match.	Ignition voltage $\geq$ 11 volts, and $\leq$ 18 volts Remote start is not active	20 failures out of 25 samples  250ms loop continuous	DTC Type B  No MIL
5 Volt Reference 2 Circuit	P0651	Detects a continuous or intermittent short on the #2 5 V sensor reference circuit	Vref1 < 4.43 or > 4.66 volts	Ignition in unlock/accessory, run or crank System voltage > 5.23 V No ECM processor DTCs	19/39counts or 187.5 msec continuous; 12.5 msec/count in main/MHC processor	DTC Type A
Control Module Power Relay Control Circuit	P0685	This DTC checks the circuit for electrical integrity during operation.	The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match.	Ignition voltage $\geq$ 11 volts, and $\leq$ 18 volts	8 failures out of 10 samples  250ms loop continuous	DTC Type B
Powertrain Relay Feedback Circuit High	P0690	This DTC is a check to determine if the Powertrain relay is functioning properly	PT Relay feedback voltage is $\geq$ 16 volts  Stuck Test: PT Relay feedback voltage is > 2 volts when commanded 'OFF'	Powertrain relay commanded "ON" No Powertrain Relay Control output driver fault	5 failures out of 6 samples 1 second / sample Stuck Test: 100ms / sample Continuous failures $\geq$ 2 seconds	DTC Type B
Transmission Control Module (TCM) Requested MIL Illumination	P0700	Monitors the TCM MIL request line to determine when the TCM has detected a MIL illuminating fault.	Transmission Emissions-Related DTC set	Ignition in run or crank Time since power-up > 3 seconds	Continuous	DTC Type A  No MIL
Inlet Airflow System Performance	P1101	This DTC determines if there are multiple air induction problems affecting airflow and/or manifold pressure.	Filtered Throttle Error > 350 kPa*grams per second And Filtered Manifold2 Error > 20 kPa And Filtered Pressure1 Error > 20 kPa  OR Filtered Airflow Error > 15 grams per second	Engine rpm $\Rightarrow$ 400 and $\leq$ 6000 MAP sensor high/low DTCs not active EGR circuit/performance DTCs not active MAF sensor high/low DTCs not active Crank sensor DTCs not active Engine Coolant DTCs not active Intake Air Temp. DTCs not active Engine Coolant > 70 deg C and < 125 deg C Intake Air Temp > -7 deg C and < 100 deg C	Continuous  Evaluated every 12.5 ms	DTC Type B

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O2S Insufficient Switching Bank 1 Sensor 1	P1133	This DTC determines if the O2 sensor is no longer sufficiently switching.	Half cycle L/R switches < 58 OR Half cycle R/L switches < 58  OR  Slope Time L/R switches < 4 OR Slope Time R/L switches < 4	<u>Common Enable Criteria</u> <ul style="list-style-type: none"> <li>• No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's</li> <li>• Catalyst monitor diagnostic Intrusive Test = Not Active</li> <li>• Post Oxygen Sensor Diagnostic Intrusive Test = Not Active</li> <li>• Traction Control, AIR, Fuel, Idle, EGR, and Engine Not Overspeed Intrusive Tests = Not Active</li> <li>• 10 volts &lt; system voltage &lt; 18 volts</li> <li>• EGR, Idle, Fuel Inj, and AIR Device controls = Not Active</li> </ul> <u>Specific Enable Criteria</u> <ul style="list-style-type: none"> <li>• O2 Heater on for <math>\geq 40</math> seconds</li> <li>• B1S1 DTCs = Not Active</li> <li>• Learned heater resistance is valid</li> <li>• Misfire DTC = Not Active</li> <li>• ECT &gt; 70 °C</li> <li>• IAT &gt; -40 °C</li> <li>• Engine run time &gt; 200 seconds</li> <li>• EVAP Canister purge duty cycle <math>\geq 0</math> %</li> <li>• 15 gps <math>\leq</math> MAF <math>\leq</math> 50 gps</li> <li>• 1000 <math>\leq</math> RPM <math>\leq</math> 3500</li> <li>• Ethanol percentage &lt; 87 %</li> <li>• Baro &gt; 69.8 kPa</li> <li>• Throttle position <math>\geq 5</math> %</li> <li>• Fuel Level &gt; 10 %</li> <li>• Fuel state = closed loop</li> <li>• No fuel level data faults</li> <li>• Transmission (automatic) not in Park, Reverse or Neutral</li> <li>• Transmission gear selection is not defaulted</li> <li>• Baro is not defaulted</li> </ul> All of the above met for at least 2 second.	100 seconds  <u>Frequency:</u> Once per trip  <u>Green Sensor Delay Criteria</u> <ul style="list-style-type: none"> <li>• The diagnostic will not be enabled until the next ignition cycle after the following has been met: Airflow greater than 20 g/sec for 120000 grams of accumulated flow non-continuously. (Note that all other enable criteria must be met on the next ignition cycle for the test to run on that ignition cycle)</li> </ul> Note: this feature is only enabled when the vehicle is new and cannot be enabled in service	DTC Type B

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Air Fuel Imbalance Bank 1	P1174	Determines if the air-fuel delivery system is imbalanced by monitoring the pre-catalyst O2 sensor voltage characteristics	<p>The Bank 1 AFIM Filtered Length Ratio (EWMA) variable exceeds a value of 0.10.</p> <p>Notes:</p> <ol style="list-style-type: none"> <li>The AFIM Filtered Length Ratio is determined by calculating the difference between the measured O2 voltage length (accumulated O2 voltage over a 2.5 second period) and an emissions-correlated threshold value, divided by the threshold value, and finally multiplied by a Quality Factor (the latter ranges between 0 and 1, based on robustness to false diagnosis in the current operating region). The resulting ratio is then filtered utilizing an Exponentially Weighted Moving Average (EWMA).</li> <li>The AFIM Filtered Length Ratio is initialized to 0.0 at the beginning of every trip.</li> <li>The first report is delayed for 30 seconds to allow time for the AFIM Filtered Length Ratio variable to saturate. This minimizes the possibility of reporting a pass before a potential failure could be detected.</li> </ol>	<ul style="list-style-type: none"> <li>No Misfire, Fuel Injector, A.I.R., or EVAP DTC's</li> <li>No ECT, MAF, MAP, or pre-cat O2 Sensor DTC's</li> <li>Device Control = Not Active</li> <li>Intrusive Diagnostics = Not Active</li> <li>Engine OverSpeed Protection = Not Active</li> <li>Reduced Power Mode (ETC DTC) = Not Active</li> <li>PTO = Not Active</li> <li>Traction Control = Not Active</li> <li>Fuel Control in A/F Closed Loop or Learn-Enabled</li> <li>System Voltage &gt; 10 V but &lt; 18 V, must be out of this range for &gt; 4 seconds to disable</li> <li>Engine Run Time ≥ 60 seconds</li> <li>ECT &gt; -20 °C</li> <li>Engine speed ≥ 1000 RPM but ≤ 6000 RPM</li> <li>MAF ≥ 20 g/s but ≤ 510 g/s</li> <li>Delta O2 voltage during previous 12.5ms ≥ 5</li> <li>O2 sensor voltages switches &gt; 1 time during current 2.5 second sample period</li> <li>Quality Factor ≠ 0 in the current operating region</li> </ul>	<p>EWMA variable is updated after every 2.5 seconds of valid data.</p> <p><u>Frequency:</u> Continuous Monitoring of O2 voltage signal in 12.5ms loop</p>	DTC Type B
Cold Start Emission Reduction Control	P1400	Model based test computes exhaust thermal energy from elevated idle speed and retarded spark advance. Detects if the cold start emission reduction system has failed resulting in the delivered thermal energy being out of range.	<p>(Average desired accumulated exhaust energy - Average estimated accumulated exhaust energy) &lt; -6.5 kJ/s OR (Average desired accumulated exhaust energy - Average estimated accumulated exhaust energy) &gt; 0.2 kJ/s</p>	<ul style="list-style-type: none"> <li>Cold start emission reduction strategy is active.</li> <li>Vehicle speed &lt; 2 KPH.</li> <li>Throttle position &lt; 2%.</li> <li>No DTC's set for the following systems: MAP, MAF, IAT, ECT, Misfire, Electronic Spark Timing, Crank sensor, Idle, Fuel Injection, ETC, VS sensor, 5 volt reference, Intake Flow Rationality, ECM Memory</li> <li>Manufacturers Enable Counter must be 0</li> </ul>	<p>100 ms loop</p> <p>Runs once per trip when the cold start emission reduction strategy is active.</p> <p>Test completes after 15 seconds of accumulated qualified data.</p>	DTC Type A

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Throttle Actuator Control (TAC) Module - Throttle Actuator Position Performance	P1516	Detect a throttle positioning error. Determine if the actuator has been miswired.	$ \text{throttle error}  \geq 2\%$ after $> .4875$ sec stability with no change in error sign, OR $ \text{throttle error}  > 6.2\%$ TPS1 $< 2.18$ Volts	Ignition in run or crank [(RPM $>0$ and system voltage $> 5.4$ Volts) OR (RPM=0 and not in battery saver mode and System voltage $> 11$ Volts)] No comm. Fault w/ Main TPS min learn not active No ignition correlation DTC active.	187.5ms in the MHC processor	DTC Type A
Ignition Correlation	P1682	Detect a continuous or intermittent OOC between the Run/Crank Ignition Voltage & ETC Run/Crank Ignition Voltage	$ \text{Run/Crank} - \text{ETC Run/Crank}  > 3$ V	Ignition in unlock/accessory, run or crank System voltage $> 5.23$ V & Powertrain Relay Commanded on. Run/Crank Ignition $\geq$ voltage required to engage relay at the current IAT temperature, or ETC Run/Crank $>$ voltage required to hold relay in once engaged. Pull-In Voltage                      Hold-In Voltage 23° C = 7.00 volts                      5.50 volts 85° C = 8.70 volts 95° C = 9.00 volts 105° C = 9.20 volts 125° C = 10.00 volts	14 / 14 counts , 12.5msec loop time, in main processor	DTC Type A
Control Module Throttle Actuator Position Performance	P2101	Detect a throttle positioning error Detect excessive motor driver current (PWM)	Difference between measured throttle position and modeled throttle position $> 6.2\%$ Motor driver PWM output $>$ Thresh. Thresh based on system voltage.	Ignition in run or crank [(RPM $>0$ and system voltage $> 5.5$ Volts) OR (RPM=0 and not in battery saver mode and System voltage $> 11$ Volts)] Throttle not at default position NA No ignition correlation DTC active.	15/15 counts continuous Check runs every 12.5 msec in the main processor	DTC Type A
Accelerator Pedal Position (APP) Sensor 1	P2120	Detect a continuous or intermittent short or open in the APP sensor #1 on Main processor Detect a continuous or intermittent short or open in the APP sensor #1 on MHC processor	APP1 $< .325$ OR APP1 $> 4.75$ Volts APP1 $< .325$ OR APP1 $> 4.75$ Volts	Ignition in unlock/accessory, run or crank System voltage $> 5.23$ V No 5 Volt reference DTCs	19/39counts or 13counts continuous; 12.5 msec/count in the main processor  19/39counts or 13counts continuous; 12.5 msec/count in the MHC processor	DTC Type A
Accelerator Pedal Position (APP) Sensor 1 Lo	P2122	Detect a continuous or intermittent short or open in the APP sensor #1 on Main processor	APP 1 $< .325$ Volts	Ignition in unlock/accessory, run or crank System voltage $> 5.23$ V No 5 Volt reference DTCs	19/39counts or 13 counts continuous; 12.5 msec/count in the Main processor	DTC Type A

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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
Accelerator Pedal Position (APP) Sensor 1 Hi	P2123	Detect a continuous or intermittent short or open in the APP sensor #1 on Main processor	APP 1 > 4.75 Volts	Ignition in unlock/accessory, run or crank System voltage >5.23 V No 5 Volt reference DTCs	19/39counts or 13 counts continuous; 12.5 msec/count in the Main processor	DTC Type A
Accelerator Pedal Position (APP) Sensor 2	P2125	Detect a continuous or intermittent short or open in the APP sensor #1 on Main processor Detect a continuous or intermittent short or open in the APP sensor #1 on MHC processor	APP2 < .325 OR APP2 > 4.75 Volts APP2< .325 OR APP2 > 4.75 Volts	Ignition in unlock/accessory, run or crank System voltage >5.23 V No 5 Volt reference DTCs	19/39counts or 13counts continuous; 12.5 msec/count in the main processor  19/39counts or 13counts continuous; 12.5 msec/count in the MHC processor	DTC Type A
Accelerator Pedal Position (APP) Sensor 2 Lo	P2127	Detect a continuous or intermittent short or open in the APP sensor #2 on Main processor	APP 2 < .325 Volts	Ignition in unlock/accessory, run or crank System voltage >5.23 V No 5 Volt reference DTCs	19/39counts or 13 counts continuous; 12.5 msec/count in the Main processor	DTC Type A
Accelerator Pedal Position (APP) Sensor 2 Hi	P2128	Detect a continuous or intermittent short or open in the APP sensor #2 on Main processor	APP 2 > 4.75 Volts	Ignition in unlock/accessory, run or crank System voltage >5.23 V No 5 Volt reference DTCs	19/39counts or 13 counts continuous; 12.5 msec/count in the Main processor	DTC Type A
Throttle Position (TP) Sensor 1-2 Correlation	P2135	Detects a continuous or intermittent correlation fault between TP sensors #1 and #2 on Main processor Detects a continuous or intermittent correlation fault between TP sensors #1 and #2 on MHC processor	Difference between TPS1 displaced and TPS2 displaced > 7.27% offset at min. throttle position with an increasing to 10% at max. throttle position Different between (raw min TPS1) and (raw_min TPS2) > 5% of Vref	Ignition in unlock/accessory, run or crank System voltage >5.23 V No 5 Volt reference DTCs	79/159 counts or 63 counts continuous; 3.125 msec/count in the main processor  19/39 counts or 15 counts continuous; 12.5 msec/count in the MHCprocessor	DTC Type A

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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
Accelerator Pedal Position (APP) Sensor 1-2 Correlation	P2138	Detect an invalid minimum mechanical position correlation between APP sensor #1 and #2	Difference between (raw min. learned PPS#1 voltage-raw min. PPS#1 voltage) and (raw PPS#2 voltage - raw min. learned PPS#2 voltage) > 7.5% offset at min. throttle position with an increasing to 10% (0.5v)at max. throttle position for Main processor.  OR  Difference between the learned PPS1 min and PPS2 min > 5% Vref	Ignition in unlock/accessory, run or crank System voltage >5.23 V No 5 Volt reference DTC's  Ignition in unlock/accessory, run or crank System voltage >5.23 V No 5 Volt reference DTC's	19/39 counts intermittent or 15 counts continuous, 12.5 msec/count in the main processor  19/39 counts intermittent or 15 counts continuous, 12.5 msec/count in the MHC processor	DTC Type A
Minimum Throttle Position Not Learned	P2176	TP minimum learning not completed	TPS > KeTPSC_Pct_MaxThrotSensorMin*0.05 .86Volts during TPS min learn on the Main processor  OR  TPS > KfETCS_Pct_MaxThrotSensorMin*0.05 .86 Volts during TPS min learn on the MHC processor	Minimum TPS learn active state Stable throttle position reading for 40 msec Ignition in run or crank  No TPS circuit DTCs  No ignition correlation DTC active.	1.8secs	DTC Type A

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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
O2 Sensor Signal Stuck Lean Bank 1 Sensor 2	P2270	This DTC determines if the post catalyst O2 sensor is stuck in a normal lean voltage range and thereby can no longer be used for post oxygen sensor fuel control or for catalyst monitoring. The diagnostic is an intrusive test which increases the delivered fuel to achieve the required rich threshold.	Post catalyst (B1S2) O2 sensor cannot achieve voltage $\geq 725$ millivolts.	<p><u>Common Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• No O2 circuit, response, heater current, or heater resistance DTC's active</li> <li>• No TP Sensor, ETC, MAF, MAP, EVAP, Secondary Air, Fuel Injector DTC's, Fuel Trim System DTCs, Misfire DTCs, E85 FFS DTCs</li> <li>• 10 volts &lt; system voltage &lt; 18 volts</li> <li>• Learned heater resistance is valid</li> <li>• ICAT MAT Burnoff delay is not active</li> <li>• Green O2 Sensor Condition is not present</li> <li>• Fuel Level &gt; 10 % or fuel level data fault active</li> </ul> <p><u>Specific Enable Criteria:</u></p> <ul style="list-style-type: none"> <li>• No Fuel Trim or Misfire DTC's active</li> <li>• 900 rpm <math>\leq</math> Engine Speed <math>\leq</math> 2500 rpm</li> <li>• 3 gps <math>\leq</math> Airflow <math>\leq</math> 12 gps</li> <li>• 65 kph <math>\leq</math> Vehicle Speed <math>\leq</math> 120 kph</li> <li>• 0.75 <math>\leq</math> Short term fuel trim <math>\leq</math> 1.10</li> <li>• Fuel state = closed loop</li> <li>• EVAP diagnostic not in control of purge</li> <li>• Ethanol Estimate is not in progress</li> <li>• Post Cell Enabled</li> <li>• Power Take Off is not active</li> <li>• EGR diagnostic is not intrusive</li> <li>• VaOXYC_b_O2_HeaterWarmUpDlyCmplt = TRUE for all post O2 sensors</li> <li>• 500°C <math>\leq</math> Catalytic Converter Temperature <math>\leq</math> 900 °C</li> </ul> <p>All of the above met for at least 3 seconds, and then: ForceCatRich intrusive stage is requested.</p>	<p>Up to 37.7 grams of accumulated air flow for the Rich Voltage Test.</p> <p><u>Frequency:</u> Once per trip</p> <p>Note: if NaPOPD_b_InitialResponseIsActive = TRUE for the given Fuel Bank OR NePOPD_b_RapidResponseIsActive = TRUE, multiple tests per trip are allowed.</p> <p><u>Green Sensor Delay Criteria</u></p> <ul style="list-style-type: none"> <li>• The diagnostic will not be enabled until the next ignition cycle after the following has been met: Airflow greater than 20 g/sec for 120,000 grams of accumulated flow non-continuously. (Note that all other enable criteria must be met on the next ignition cycle for the test to run on that ignition cycle)</li> </ul> <p>Note: this feature is only enabled when the vehicle is new and cannot be enabled in service</p>	<p style="text-align: center;">DTC Type</p> <p style="text-align: center;">B</p>



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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
O2 Sensor Signal Stuck Rich Bank 1 Sensor 2	P2271	This DTC determines if the post catalyst O2 sensor is stuck in a normal rich voltage range and thereby can no longer be used for post oxygen sensor fuel control or for catalyst monitoring. The diagnostic is an intrusive test which requests the DFCO mode to achieve the required lean threshold.	Post catalyst (B1S2) O2 sensor cannot achieve voltage $\leq$ 100 millivolts	<p><u>Common Enable Criteria</u></p> <ul style="list-style-type: none"> <li>• No O2 circuit, response, heater current, or heater resistance DTC's active</li> <li>• No TP Sensor, ETC, MAF, MAP, EVAP, Secondary Air, Fuel Injector DTC's, Fuel Trim System DTCs, Misfire DTCs, E85 FFS DTCs</li> <li>• 10 volts &lt; system voltage &lt; 18 volts</li> <li>• Learned heater resistance is valid</li> <li>• ICAT MAT Burnoff delay is not active</li> <li>• Green O2 Sensor Condition is not present</li> <li>• Fuel Level &gt; 10 % or fuel level data fault active</li> </ul> <p><u>Specific Enable Criteria:</u></p> <ul style="list-style-type: none"> <li>• The DFCO mode and no driver initiated throttle input.</li> <li>• Complete and PASS the following POPD tests:               <ol style="list-style-type: none"> <li>1. P2270 and P2272, if applicable.</li> <li>2. P013E and P014A, if applicable.</li> <li>3. P013A and P013C, if applicable.</li> </ol> </li> </ul>	<p>Up to 32.7 grams of accumulated air flow for the Lean Voltage Test.</p> <p><u>Frequency:</u> Once per trip</p> <p><u>Note:</u> if NaPOPD_b_InitialResponseIsActive = TRUE for the given Fuel Bank OR NePOPD_b_RapidResponseIsActive = TRUE, multiple tests per trip are allowed.</p> <p><u>Green Sensor Delay Criteria</u></p> <ul style="list-style-type: none"> <li>• The diagnostic will not be enabled until the next ignition cycle after the following has been met: Airflow greater than 20 g/sec for 120,000 grams of accumulated flow non-continuously. (Note that all other enable criteria must be met on the next ignition cycle for the test to run on that ignition cycle)</li> </ul> <p><u>Note:</u> this feature is only enabled when the vehicle is new and cannot be enabled in service</p>	DTC Type B
Secondary AIR System Pressure Sensor Circuit Bank 1	P2430	This DTC detects a stuck in range pressure sensor signal	Average Error < 0.5 kPa And Signal Variation < 1	No active P0412 DTC No active P0418 DTC No active DTC P0606 No active DTC P2432 No active DTC P2433 No active 5 Volt reference DTCs AIR pump commanded On	Stuck in range cumulative info > 5 seconds	DTC Type B
Secondary AIR System Pressure Sensor Performance Bank 1	P2431	This DTC detects a skewed pressure sensor signal via a comparison of the AIR pressure sensor signal and estimated BARO, as well as an evaluation of the quality of the comparison.	Difference between AIR pressure sensor and BARO < -10kPa or > 14kPa with AIR pump commanded Off  OR  Difference between AIR pressure sensor and BARO > 50kPa with AIR pump commanded On	No active P0412 DTC No active P0418 DTC No active DTC P0606 No active DTC P2432 No active DTC P2433 No active 5 Volt reference DTCs No active MAP DTCs Transfer Case not in 4WD Low range	Skewed sensor cumulative info > 30 seconds	DTC Type B

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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
Secondary AIR System Pressure Sensor Circuit Low Voltage Bank 1	P2432	This DTC detects an out of range low AIR pressure sensor signal	AIR Pressure Sensor signal < 5% of 5V Ref	No active DTC P0606 No active 5 Volt reference DTCs	800 failures out of 1000  Frequency: 6.25ms continuous	DTC Type B
Secondary AIR System Pressure Sensor Circuit High Voltage Bank 1	P2433	This DTC detects an out of range high AIR pressure sensor signal	AIR Pressure Sensor signal < 94% of 5V Ref	No active DTC P0606 No active 5 Volt reference DTCs	800 failures out of 1000  Frequency: 6.25ms continuous	DTC Type B
Secondary AIR System Shut-off Valve Stuck Open	P2440	This DTC detects if the AIR system control valve is stuck open  This test is run during Phase 2 (Pump commanded On, valve commanded closed)	AIR pressure error < (See Table Below) (actual pressure lower than predicted during Phase 2)  Cumul. Wght. Pres. Err. time -6 -6 -5 -4 -3 -3 -3 -3 -3	No active MAF DTCs No active MAP DTCs No active AIR Pressure Sensor Performance DTCs No active AIR Pressure Sensor Circuit DTCs No active AIR pump relay DTCs No active AIR valve relay DTCs No active IAT DTCs No active ECT DTCs No active Misfire DTCs No active Catalyst Monitor DTCs No active P0606 DTC No active 5 Volt reference DTCs No active EST DTCs No active Fuel Injector DTCs BARO > 70 kPa Engine Airflow < 42 g/s 9V < System Voltage < 18V Stability Time > 5 seconds AIR System commanded On	Phase 2 Conditional test weight > 2.5 seconds  Conditional test weight is based on BARO, MAF, & System Voltage.  Frequency: Once per trip when AIR pump commanded On	DTC Type B
Secondary AIR System Pump Stuck On	P2444	This DTC detects if the SAI pump is stuck On  This test is run during Phase 3 (Pump commanded Off, valve commanded closed)	SAI Pressure Error > 2.5kPa (actual pressure higher than predicted during Phase 3 test)	No active MAF DTCs No active MAP DTCs No active AIR Pressure Sensor Performance DTCs No active AIR Pressure Sensor Circuit DTCs No active AIR pump relay DTCs No active AIR valve relay DTCs No active IAT DTCs No active ECT DTCs No active Misfire DTCs No active Catalyst Monitor DTCs No active P0606 DTC No active 5 Volt reference DTCs No active EST DTCs No active Fuel Injector DTCs BARO > 70 kPa Engine Airflow < 42 g/s 9V < System Voltage < 18V Stability Time > 6 seconds AIR System commanded On	Phase 3 Test cumulative info > 3 seconds  Frequency: Once per trip when SAI pump commanded On	DTC Type A

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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
ECM/PCM Internal Engine Off Timer Performance	P2610	<p>This DTC determines if the engine off timer does not initialize or count properly.</p> <p>Clock rate test: Checks the accuracy of the 1 second timer by comparing it with the 12.5 msec timer</p>	<p>Initial value test: Initial ignition off timer value &lt; 0 sec OR Initial ignition off timer value &gt; 10 sec</p> <p>Clock rate test:</p> <ul style="list-style-type: none"> <li>• Time between ignition off timer increments &lt; 0.8 sec</li> <li>• Time between ignition off timer increments &gt; 1.2 sec</li> <li>• Time since last ignition off timer increment ≥ 1.375 sec</li> <li>• Current ignition off time &lt; old ignition off time</li> </ul> <p>Current ignition off timer minus old ignition off timer ≠ 1.0</p>	<p>ECM is powered down DTC sets on next key cycle if failure detected -40°C ≤ IAT ≤ 125°C</p>	<p>Initial value test: 3 failures 1.375 sec / sample</p> <p>Clock rate test: 8 failures out of 10 samples 1 second / sample test runs once each key-off</p>	DTC Type B
Four Wheel Drive (4WD) Low Switch Circuit	P2771	Transfer Case Ratio is not consistent with position of 4-Wheel Drive Low switch	<p><u>For NR4 Transfer case (2.48)</u></p> <p><u>Fail Case 1</u> Range Switch = OPEN 2.23 ≤ Transfer Case Ratio ≤ 2.73</p> <p><u>Fail Case 2</u> Range Switch = CLOSED 0.80 ≤ Transfer Case Ratio ≤ 1.75</p> <p><u>For NR6 Transfer Case (4.03)</u></p> <p><u>Fail Case 1</u> Range Switch = OPEN 3.63 ≤ Transfer Case Ratio ≤ 4.43</p> <p><u>Fail Case 2</u> Range Switch = CLOSED 0.80 ≤ Transfer Case Ratio ≤ 1.75</p>	<p>8 V ≤ Ignition Voltage ≤ 18 V 1000 ≤ Engine Speed ≤ 5500 RPM 5% ≤ Throttle Position Sensor ≤ 40% -20° C. ≤ Trans Temp ≤ 130° C. Vehicle Speed ≥ 41.0 kmh Engine Run Time ≥ 30 sec 80 ≤ Engine Torque ≤ 8192 N-m Trans Range ≠ Park, Neutral, or Reverse No Engine Position Sensor, Throttle Position Sensor, Vehicle Speed Sensor, or Output Speed Sensor codes</p>	<p><u>Fail Case 1</u> 2 counts @ 2.0 sec</p> <p><u>Fail Case 2</u> 1 count @ 7.0 sec</p> <p>Type B</p>	DTC type B

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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
O2 Sensor Circuit Range/Performance Bank 1 Sensor 1	P2A00	This DTC determines if the O2 sensor voltage is not meeting the voltage criteria to enable closed loop fueling.	Closed loop fuel control O2 sensor Ready flag set to "Not Ready."  O2 sensor voltage must be > 550 millivolts or < 350 millivolts to set closed loop fuel O2 Ready flag. Once set to "Ready," the O2 sensor voltage cannot be > 350 millivolts and < 550 millivolts for > 5 seconds or the O2 Ready flag will be reset to "Not Ready."	<ul style="list-style-type: none"> <li>• No TP Sensor, MAF, MAP, IAT, ECT, EVAP, Secondary Air, Injector DTC's</li> <li>• No B1S1 or B2S1 O2 DTC's</li> <li>• Engine Run Time ≥ 100 seconds</li> <li>• ECT ≥ 70° C</li> <li>• Engine Metal Overtemp = Not Active</li> <li>• Traction Control = Not Active</li> <li>• No default throttle action</li> <li>• Not in Catalyst Protection Mode</li> <li>• 18 volts ≤ Ignition Voltage ≤ 18 volts</li> <li>• 1000 ≤ Engine Speed ≤ 3400</li> <li>• 10 gps ≤ Mass Airflow ≤ 50 gps</li> <li>• Not in Decel Fuel Cutoff Mode</li> <li>• Not in Power Enrichment</li> <li>• Predicted O2 temp ≥ 0°C</li> </ul> <p style="margin-left: 20px;">All of the above met for 5 seconds.</p>	240 test failures in a 300 test sample  <u>Frequency:</u> Continuous 100ms loop	DTC Type B
Control Module Communication Bus Off	U0073	Detects that a CAN serial data bus shorted condition has occurred to force the CAN device driver to enter a bus-off state.	CAN device driver has reported that it has entered a bus-off state.	Ignition in the RUN or ACCESSORY position	5 fails out of 5 samples  <u>Frequency:</u> Continuous 1 second loop	DTC Type B
Lost Communication with TCM	U0101	Detects that CAN serial data communication has been lost with the TCM.	Lost communication with the TCM	Ignition in the RUN or ACCESSORY position	12 fails out of 12 samples  <u>Frequency:</u> Continuous 1 second loop	DTC Type B

### Look up Tables

**TABLE - O2S Slow Response Bank 1 Sensor 1 (P0133)**

Lean-Rich Ave

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Rich-Lean Ave	Seconds	0.000	0.036	0.048	0.060	0.072	0.084	0.096	0.108	0.120	0.132	0.144	0.156	0.168	0.180	0.192	0.204	0.216
	0.000	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
	0.036	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
	0.048	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
	0.060	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
	0.072	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
	0.084	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
	0.096	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL	FAIL	FAIL	FAIL	FAIL
	0.108	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL	FAIL	FAIL	FAIL
	0.120	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL	FAIL	FAIL
	0.132	FAIL	FAIL	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL
	0.144	FAIL	FAIL	FAIL	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL
	0.156	FAIL	FAIL	FAIL	FAIL	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL
	0.168	FAIL	FAIL	FAIL	FAIL	FAIL	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL
	0.180	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL
	0.192	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL
	0.204	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL
	0.216	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL

### ADDENDUM -

The following Sensed Parameters are additional parameters that are not used for the LLR engine with Automatic transmissions but are used on manual transmission applications or on all the LL8 (6 cylinder) engine applications.

SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
Fuel Injector 6 Control Circuit (for LL8)	P0206	Detects fuel injector circuit continuity	Injector driver feedback indication = fault	Engine Running 18 volts > System Voltage > 9 volts Condition Stable > 5sec	10/20 counts 4 counts/sec  Continuous check	DTC Type B

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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
Knock Sensor (KS) Circuit Bank 2 (for LL8)	P0330	This diagnostic checks for an open to the knock sensor	Gated Low Pass Filter Voltage > 4V or < 1.24 V	Coolant > -40 C and Engine Run Time > 2 Minutes PTO not active.  Temporarily disabled ('Indeterminate' state reported) for samples in which P0332 or P0333 report 'Failed' state.	50 Counts out of 63 Counts  100ms sample rate Continuous	DTC Type B
Knock Sensor (KS) Circuit Low Bank 2 (for LL8)	P0332	This diagnostic checks for an out of range low knock sensor signal	Sensor Input Signal Line > 2.86 V or Sensor Return Signal Line < 1.48 V	Coolant > -40 C and Engine Run Time > 2 Minutes PTO not active	50 Counts out of 63 Counts  100ms sample rate Continuous	DTC Type B
Knock Sensor (KS) Circuit High Bank 2 (for LL8)	P0333	This diagnostic checks for an out of range high knock sensor signal	Sensor Input Signal Line < 2.02 V or Sensor Return Signal Line > 3.76 V	Coolant > -40 C and Engine Run Time > 2 Minutes PTO not active	50 Counts out of 63 Counts  100ms sample rate Continuous	DTC Type B
IGNITION CONTROL #6 CIRCUIT (for LL8)	P0356	This DTC checks the circuit for electrical integrity during operation. Monitors EST for Cylinder 6	The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match.	Ignition voltage > 6 Volts	50 Counts out of 63 Counts  100ms sample rate Continuous	DTC Type B
Vehicle Speed Sensor (VSS) Circuit: Low Voltage (manual trans. applications)	P0502	0 RPM to 8192 RPM  Low Output Speed with high Input Speed in a Drive range with high Engine Torque	Output Speed ≤ 58 RPM	8 V ≤ Ignition Voltage ≤ 18 V 500 < Engine Speed < 7500 for 5.0 sec PTO not active Transmission Fluid Temp > -40° C Torque valid 68 N-m ≤ Engine Torque ≤ 8192 N-m TPS valid; Throttle Position ≥ 3.5% 1500 ≤ Engine Speed ≤ 6500 RPM No VSS P0503 DTC	4.5 sec  Continuous  Type B	DTC Type B
Vehicle Speed Sensor (VSS) Circuit: Intermittent (manual trans. applications)	P0503	0 RPM to 8192 RPM  Unrealistic DROP in Output Speed.	ΔOutput Speed ≥ 351 RPM	8 V ≤ Ignition Voltage ≤ 18 V 500 < Engine Speed < 7500 for 5.0 sec PTO not active Trans Output Speed > 292 RPM for 2.0 sec ΔTrans Output Speed ≤ 146 RPM for 2.0 sec 4WD Range Change ≥ 6.0 sec	3.25 sec  Continuous  Type B	DTC Type B

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SENSED PARAMETER	FAULT CODE	MONITOR STRATEGY DESCRIPTION	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)	SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY	MIL ILLUMINATION TYPE
Clutch Pedal Position Sensor Circuit Range/Performance	P0806	Detects if Clutch Pedal Position Sensor is Stuck in a range indicative of a vehicle NOT in gear, when the vehicle is determined to be in gear.	Filtered Clutch Pedal Position Error is greater than 1.0% (versus a reference calibration) when the vehicle is determined to be in gear.	No Clutch Pedal Out-of-Range DTCs Active No VSS DTC Active No Crank Sensor DTC Active N/V Ratio must Match Actual Gear (i.e. Vehicle in Gear) Transfer Case not in 4WD Low range	25 ms loop Continuous	DTC Type A
Clutch Pedal Position Sensor Circuit Low	P0807	Detects Continuous Circuit Short to Low or Open	Clutch Position Sensor Circuit < 4% of Vref	No active 5 Volt reference DTCs Engine Not Cranking System Voltage > 10 volts	200 failures out of 250 samples  25 ms loop Continuous	DTC Type A
Clutch Pedal Position Sensor Circuit High	P0808	Detects Continuous Circuit Short to High	Clutch Position Sensor Circuit >96% of Vref	No active 5 Volt reference DTCs Engine Not Cranking System Voltage 10 volts	200 failures out of 250 samples  25 ms loop Continuous	DTC Type A
Clutch Pedal Position Not Learned	P080A	Monitor for Valid Clutch Pedal Fully Applied Learn Position values	Clutch Fully Applied Learn Position less than 6% of Vref or greater than 34% of Vref	OBD Manufacturer Enable Counter = 0 Clutch Pedal Position Not Learned	250 ms loop Continuous	DTC Type B