08 GRP11 Engine Control Module (ECM)

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 Actuator Solenoid Circuit	P0010	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	20 failures out of 25 samples 250ms loop continuous	DTC Type B
Camshaft Actuator Solenoid Performance	P0011	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)] > 8° .for engine oil temperatures >0C and < 128C. Error range increased at extreme Oil temperatures (see attachment)	Engine is running VVT is enabled Desired camshaft position > 0 Δ Desired Camshaft position < 7.5° for 3.35 seconds for oil temperature > 0C and <128C. Stable timer is increased for extreme oil temperature (see attachment) 11 volts < Ignition Voltage < 18 volts DTCs not active for the following sub-systems: Cam sensors Crank sensors Cam to crank rationality Cam phase output drivers	200 fail counts out of 1000 sample counts 100ms loop Continuous	DTC Type B
CAM to Crank timing incorrect	P0016	Detects cam to crank misalignment by monitoring if cam sensor pulse occurs during the incorrect crank position	Cam signal falling edge out of more than –11 or +11 degrees from corresponding crank falling edge. (Equates to ± 1 tooth)	• No 5 volt reference faults. • No camshaft position sensor circuit or performance faults. • No crankshaft position sensor circuit or performance faults • Engine is spinning • Crankshaft position signal is in sync. • Desired camshaft position is park.	2 failures out of 3 tests. A failed test is 4 failures out of 5 samples. And there is a delay of 1 second after the first failed test to allow the camshaft position to return to the park position. Frequency: 1 second Continuous	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).	• Ignition switch is in crank or run • 10 volts < Ignition Voltage < 18 volts RPM > 400	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).	• Ignition switch is in crank or run • 10 volts < Ignition Voltage < 18 volts RPM > 400	20 failures out of 25 samples Frequency: 250ms loop Continuous	DTC Type B
O2S Heater Control Circuit Bank 2 Sensor 1	P0050	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).	• Ignition switch is in crank or run • 10 volts < Ignition Voltage < 18 volts • RPM > 400	20 failures out of 25 samples Frequency: 250ms loop Continuous	DTC Type B
HO2S Heater Resistance Bank 1 Sensor 1	P0053	Detects an oxygen sensor heater having an incorrect or out of range resistance value.	2.185 Ohms< Calculated Heater resistance < 9.512 Ohms	• Coolant – IAT < 8ºC • Engine Soak Time > 36000 Seconds • -30 ºC < Coolant Temp < 45ºC • Coolant Fault = Not Active • Ignition Off Timer Fault = Not Active • Intake Air Temp Fault = Not Active • Ignition Voltage < 18 •	Once per valid cold start.	DTC Type B

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
HO2S Heater Resistance Bank 1 Sensor 2	P0054	Detects an oxygen sensor heater having an incorrect or out of range resistance value.	4.1191 Ohms < Calculated Heater resistance < 10.8105 Ohms	• Coolant – IAT < 8ºC • Engine Soak Time > 36000 Seconds • -30 ºC < Coolant Temp < 45ºC • Coolant Fault = Not Active • Ignition Off Timer Fault = Not Active • Intake Air Temp Fault = Not Active • Ignition Voltage < 18	Once per valid cold start.	DTC Type B
O2S Heater Control Circuit Bank 2 Sensor 2	P0056	This DTC checks the Heater Output Driver circuit for electrical integrity	Output state shorted or open Voltage low during driver open state (indicates short-to-ground or open circuit) or voltage high during driver closed state (indicates short to voltage).	• Ignition switch is in crank or run • 10 volts < Ignition Voltage < 18 volts • RPM > 400	20 failures out of 25 samples Frequency: 250ms loop Continuous	DTC Type B
HO2S Heater Resistance Bank 2 Sensor 1	P0059	Detects an oxygen sensor heater having an incorrect or out of range resistance value.	2.185 Ohms < Calculated Heater resistance < 9.512 Ohms	• Coolant – IAT < 8ºC • Engine Soak Time > 36000 Seconds • -30 ºC < Coolant Temp < 45ºC • Coolant Fault = Not Active • Ignition Off Timer Fault = Not Active • Intake Air Temp Fault = Not Active • Ignition Voltage < 18	Once per valid cold start.	DTC Type B
HO2S Heater Resistance Bank 2 Sensor2	P0060	Detects an oxygen sensor heater having an incorrect or out of range resistance value.	4.1191 Ohms < Calculated Heater resistance < 10.8105 Ohms	• Coolant – IAT < 8ºC • Engine Soak Time > 36000 Seconds • -30 ºC < Coolant Temp < 45ºC • Coolant Fault = Not Active • Ignition Off Timer Fault = Not Active • Intake Air Temp Fault = Not Active • Ignition Voltage < 18	Once per valid cold start.	DTC Type B

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
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	1. Difference between measured MAP and estimated MAP > MAP_Lim kPa OR V5B OOR OR After Throt Blade MAP sensor TFTKO, then MAP leg failed 2. Difference between measured MAF and estimated MAF > MAF_Lim grams/sec OR MAF sensor TFTKO OR Vbatt < 10 volts, then MAF leg failed. TPS MAP_Lim MAF_Lim 1 5% 21.4531 15.4297 2 10% 22.8125 19.7188 3 15% 22.5625 25.3203 4 20% 18.6875 26.8672 5 25% 19.5859 36.7891 6 30% 19.2265 45.0547 7 35% 100.000 255.000 8 40% 100.000 255.000 9 100% 100.000 255.000	Engine running, engine speed > 800 rpm Run/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts	Continuously fail MAP AND MAF legs for longer than 187.50 msec Continuous in the main processor	DTC Type A
Manifold Absolute Pressure – Barometric Pressure Correlation	P0069	Compares baro sensor to the calculated baro estimate (part throttle calculated or unthottled MAP)	Difference between Baro sensor reading and Estimated baro > 10 Kpa when distance since last estimated baro update < 2 kilometers Or Difference between Baro sensor reading and Estimated baro > 20 Kpa when distance since last estimated baro update > 2 kilometers	No Baro sensor circuit DTCs set No ECT, IAT, MAF, MAP, TP, or VSS DTCs set	20 of fail samples out of 25 samples Continuous 250 ms loop	DTC Type B
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 * X * Y > 10 grams/sec AND (Measured Manifold Air Pressure – Manifold Model 2 pressure) Filtered * Z > 15 kPa X = MAF Residual wt factor based on engine speed Y = MAF Residual wt factors based on MAF estimate Z = MAP2 Residual wt factor based on engine speed (see table “IFRD Residual Weighting Factors (P0101, P0106, P0121)” attached).	Engine rpm =>450 and <= 8000 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 < 125 deg C	Continuous The Mass Air Flow reading and Mass Air Flow calculation are performed during the same 12.5 ms loop	DTC Type B

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
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 ≤ 1126 Hz (~0.90 g/s)	Engine Running > 1 second Engine Speed ≥ 300 RPM System Voltage ≥ 9 volts The above must be present for a period of time greater than 1.0 second	400 test failures in 500 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 ≥ 14500 Hz (~1130 g/s)	Engine Running > 1 second Engine Speed ≥ 300 RPM System Voltage ≥ 9 volts The above must be present for a period of time greater than 1.0 second	400 test failures in 500 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 * X > 15 kPa AND (Measured MAP – Manifold Model 2 pressure) filtered * Y > 15 kPa X = MAP1 Residual wt factor based on engine speed Y = MAP2 Residual wt factor based on engine speed (see table “IFRD Residual Weighting Factors (P0101, P0106, P0121)” attached).	Engine rpm =>450 and <= 8000 Time in All Cylinder mode => 2 seconds 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 < 125 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	This DTC detects a continuous short to low or open in either the signal circuit or the MAP sensor.	MAP voltage < 2% of Vref (0.1 volts ~ 12.2 kPa)	TP Sensor DTCs not active MAF sensor DTCs not active Manifold pressure > 25 kpa	320 test failures in 400 test samples 1 sample/12.5 ms	DTC Type B
Manifold Absolute Pressure Sensor Circuit High	P0108	This DTC detects an open sensor ground or continuous short to high in either the signal circuit or the MAP sensor	MAP voltage > 98% of Vref (4.9 volts ~ 102.8kPa)	Engine Run Time based on power up ECT: ≥ 0 sec at ≥ 30°C ≥ 80 sec at 15°C ≥ 134 sec at 0°C ≥188 sec at -15°C ≥ 242 sec at -30° C; time is interpolated between temperature points TP sensor DTCs not active Manifold pressure < 80 kpa MAF sensor DTCs not active	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 (~ 150degC)	VS sensor DTCs not active ECT sensor DTCs not active Engine run time > 10 seconds ECT Temperature < 150°C VSS >= 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 > 420,000 Ohms (~ -60degC)	MAF sensor DTCs not active ECT sensor DTCs not active VS sensor DTCs not active Engine run time > 10 seconds ECT > -40 MAF > 512 gm/s 512 KPH >= VSS	50 test failures in 63 test samples 1 sample/100 msec	DTC Type B

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Engine Coolant Temp Sensor Rationality (High-Sided)	P0116	Detects ECT temp sensor stuck in mid range	A failure will be reported if any of the following occur: ECT at power up > IAT at power up by an IAT based table lookup (See "P0116: Fail if power up ECT exceeds IAT by these values. 6.0L (LFA) ") value after a minimum 8 hour soak (fast fail). ECT at power up > IAT at power up by 15°C after a minimum 8 hour soak and a block heater has not been detected. ECT at power up > IAT at power up by 15°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 5%.	No VSS DTC's No IAT DTC's No ECT sensor shorted DTC's ECM/PCM Internal Engine Off Timer Performance DTC not active Non-volatile memory failure has not been detected on power-up. Engine off time > 480 minutes (8 hours) Test run this trip = false Test aborted this trip = false IAT >= -7C Block heater detection: ECT at power up > IAT at power up by 15°C Power up IAT > -7°C Vehicle driven a minimum of 400 seconds above 24 kph and IAT drops more than 8° C from power up IAT.	1 failure 500 ms loop	DTC Type B
Engine Coolant Temp Sensor Circuit Low (High Temp)	P0117	This DTC detects a continuous short to ground in the ECT signal circuit or the ECT sensor.	Raw ECT < 45 ohms (~ 150° C)		5 test failures in a 6 sample test. 1 sec / sample	DTC Type B
Engine Coolant Temp Sensor Circuit High (Low Temp)	P0118	Circuit Continuity This DTC detects a continuous short to high or open in the ECT signal circuit or the ECT sensor.	Raw ECT > 450,000ohms(~ -60° C)	Engine run time > 10 seconds Or IAT < 50° C	5 test failures in a 6 sample test. 1 sec / sample	DTC Type B
Throttle Position (TP) Sensor 1 Circuit	P0120	Detects a continuous or intermittent short or open in TP sensor #1 circuit	0.325 Volts > TPS > 4.75 Volts	Ignition in unlock/accessory, run or crank Run/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts 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 Sensor Circuit Performance (Rationality)	P0121	The DTC determines if a TPS sensor is stuck within the normal operating range	Filtered throttle error * X > 150 kPa/grams per second X = TPS Residual wt factor based on engine speed (see table "IFRD Residual Weighting Factors (P0101, P0106, P0121)" attached).	Engine rpm =>450 and <= 8000 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 < 125 deg C	Continuous Calculations are performed every 12.5 ms	DTC Type B

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Throttle Position (TP) Sensor 1 Circuit Lo	P0122	Detects a continuous or intermittent OOR lo TPS	TPS < 0.325 Volts	Ignition in unlock/accessory, run or crank Run/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts 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 Run/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts 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 Below Stat Regulating Temperature	P0128	This DTC detects if the engine coolant temperature rises too slowly due to an ECT or cooling system fault	If actual accumulated airflow is > predicted accumulated airflow (See attached table "P0128: Maximum Accumulated Airflow for IAT and Start-up ECT conditions. 6.0L (LFA) ") before engine coolant reaches 75 °C when IAT is > 10° C, and before engine coolant reaches 55°C when IAT is ≤ 10°C but ≥ -7°C.	No MAF, MAP, TP Sensor, IAT, ECT shorted or open, VSS, ECT High Sided Rationality, or Fuel Compensation faults active ECT shorted or open faults not failing IAT ≥ -7°C 90seconds ≤ Engine runtime ≤ 1370 seconds ECT at start run ≤ 70°C for IAT above 10°C; ECT at start run ≤ 50°C for IAT ≤ 10°C but ≥ -7°C Minimum Average Airflow ≥ 10 gm/sec Vehicle speed ≥ 8 KPH for at least 2.4 Kilometers Maximum airflow added to actual accumulated airflow limited to 70 gm/sec Airflow added to actual accumulated airflow is considered 0 gm/sec below an actual 17 gm/sec. Airflow added to actual accumulated airflow is 0.5 times the actual airflow during AFM (half cylinder mode) due to increased thermal efficiencies. Airflow subtracted from actual accumulated airflow during Hybrid Engine Off (HEOff) at a rate of 7 gm/sec due to heat loss. Airflow subtracted at a rate of 2 times actual airflow during Decel Fuel Cut-off due to heat loss. Diagnostic will restart if ECT drops more than 3°C below start up ECT.	30 failures to set DTC <u>Frequency:</u> Once per ignition cycle 1 second loop	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	Common Enable Criteria • No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's • Catalyst monitor diagnostic Intrusive Test = Not Active • Post Oxygen Sensor Diagnostic Intrusive Test = Not Active • Fuel, Idle, and Engine Not Over speed Intrusive Tests = Not Active • 10 volts < system voltage < 18 volts • Idle, and Fuel Injector Device controls = Not Active • Fuel Level > 10 % or fuel level data fault active Specific Enable Criteria • 0.992 ≤ Equivalence ratio ≤ 1.014 • 100 ≤ Air Per Cylinder ≤ 800 • Fuel state = closed loop • All fuel injectors = ON All of the above met for at least 2 seconds	450 test failures in a 480 sample test Frequency: Continuous 100 ms loop	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 to go fault pending O2 sensor voltage > 1050 millivolts to set DTC	Common Enable Criteria • No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's • Catalyst monitor diagnostic Intrusive Test = Not Active • Post Oxygen Sensor Diagnostic Intrusive Test = Not Active • Fuel, Idle, and Engine Not Over speed Intrusive Tests = Not Active • 10 volts < system voltage < 18 volts • Idle and Fuel Injector Device controls = Not Active • Fuel Level > 10 % or fuel level data fault active Specific Enable Criteria • 0.992 ≤ Equivalence Ratio ≤ 1.014 • 100 ≤ Air Per Cylinder ≤ 800 • Fuel State = Closed loop All of the above met for at least 2 seconds	90 test failures in a 100 sample test Frequency: Continuous 100 ms loop	DTC Type B

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 Slow Response Bank 1 Sensor 1	P0133	This DTC determines if the O2 sensor response time is degraded	Refer to **"O2S Slow Response Bank 1 Sensor 1 (P0133), O2S Slow Response Bank 2 Sensor 1 (P0153) Pass/Fail Thresholds."** In Lookup Tables section.	Common Enable Criteria • No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's • Catalyst monitor diagnostic Intrusive Test = Not Active • Post Oxygen Sensor Diagnostic Intrusive Test = Not Active • Fuel, Idle and Engine Not Over speed Intrusive Tests = Not Active • 10 volts < system voltage < 18 volts • Idle and Fuel Injector Device controls = Not Active • Fuel Level > 10 % or fuel level data fault active Specific Enable Criteria • O2 Heater on for ≥ 0 seconds • B1S1 DTCs = Not Active • Learned heater resistance is valid • Misfire DTC = Not Active • ECT > 60 °C • IAT > -40 °C • Engine run time > 160 seconds • EVAP Canister purge duty cycle ≥ 0 % • 20 gm/sec ≤ MAF ≤ 55 gm/sec • 1000 ≤ RPM ≤ 3000 • Air Per Cylinder > 150, Fuel State Closed Loop • Baro > 69.8 kPa • Throttle position ≥ 4.999 %Fuel state = closed loop • Baro is not defaulted All of the above met for at least 1 second.	40 seconds Frequency: Once per trip Green Sensor Delay Criteria • The diagnostic will not be enabled until the next ignition cycle after the following has been met: Airflow greater than 22 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) Note: this feature is only enabled when the vehicle is new and cannot be enabled in service	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.	350 millivolts < O2 sensor < 550 millivolts	Common Enable Criteria • No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's • Catalyst monitor diagnostic Intrusive Test = Not Active • Post Oxygen Sensor Diagnostic Intrusive Test = Not Active • Fuel, Idle, and Engine Not Over speed Intrusive Tests = Not Active • 10 volts < system voltage < 18 volts • Idle and Fuel Injector, Device controls = Not Active Specific Enable Criteria • Engine run time > 10 seconds • No B1S1 heater related DTCs • All of the above met for at least 300 seconds	285 test failures in a 300 test samples Frequency: Continuous for pre catalyst sensors 100 ms loop rate	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 > 3.125 amps	Common Enable Criteria • No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's • Catalyst monitor diagnostic Intrusive Test = Not Active • Post Oxygen Sensor Diagnostic Intrusive Test = Not Active • Fuel, Idle, and Engine Not Over speed Intrusive Tests = Not Active • 10 volts < system voltage < 18 volts • Idle and Fuel Injector Device controls = Not Active Specific Enable Criteria • Engine Run Time ≥ 5 Secs. • O2 heater not in Device control • B2S1 O2 heater resistance DTC not active • All of the above met for at least 120 seconds	8 test failures in 10 test samples Frequency: 1 tests per trip 5 seconds delay between tests 1 second execution rate	DTC Type B

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 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	Common Enable Criteria • No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's • Catalyst monitor diagnostic Intrusive Test = Not Active • Post Oxygen Sensor Diagnostic Intrusive Test = Not Active • Fuel, Idle, and Engine Not Over speed Intrusive Tests = Not Active • 10 volts < system voltage < 18 volts • Idle and Fuel Injector Device controls = Not Active • Fuel Level > 10 % or fuel level data fault active Specific Enable Criteria • 0.992 ≤ Equivalence ratio ≤ 1.014 • 100 ≤ Air Per Cylinder ≤ 800 • Fuel state = closed loop • All fuel injectors = ON All of the above met for at least 2 seconds	570 test failures in a 600 sample test Frequency: Continuous 100 ms loop	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 to go fault pending O2 sensor voltage > 1050 millivolts to set DTC	Common Enable Criteria • No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's • Catalyst monitor diagnostic Intrusive Test = Not Active • Post Oxygen Sensor Diagnostic Intrusive Test = Not Active • Fuel, Idle, and Engine Not Over speed Intrusive Tests = Not Active • 10 volts < system voltage < 18 volts • Idle and Fuel Injector Device controls = Not Active • Fuel Level > 10 % or fuel level data fault active Specific Enable Criteria • 0.992 ≤ Equivalence Ratio ≤ 1.014 • 100 ≤ Air Per Cylinder ≤ 800 • Fuel State = Closed loop All of the above met for at least 2 seconds	570 test failures in a 600 sample test Frequency: Continuous 100 ms loop	DTC Type B

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.	410 millivolts < O2 sensor < 490 millivolts for regular open test 350 millivolts < O2 sensor < 550 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)	Common Enable Criteria • No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's • Catalyst monitor diagnostic Intrusive Test = Not Active • Post Oxygen Sensor Diagnostic Intrusive Test = Not Active • Fuel, Idle, and Engine Not Over speed Intrusive Tests = Not Active • 10 volts < system voltage < 18 volts • Idle and Fuel Injector Device controls = Not Active Specific Enable Criteria • No B1S2 heater related DTCs • PCM State = run Fast Pass: • Engine run time ≤ 200 seconds (Fast pass cannot report a fail; if Fast pass fails, the regular open test is run) Regular Open Test • Engine run time > 300 seconds • Fuel state = closed loop	1450 test failures in a 1500 samples test (sample counts – failure counts) < 550 within 200 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) Frequency: Once/trip for post catalyst sensors 100 ms loop	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 > 2.875 amps	Common Enable Criteria • No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's • Catalyst monitor diagnostic Intrusive Test = Not Active • Post Oxygen Sensor Diagnostic Intrusive Test = Not Active • Fuel, Idle, and Engine Not Over speed Intrusive Tests = Not Active • 10 volts < system voltage < 18 volts • Idle and Fuel Injector Device controls = Not Active Specific Enable Criteria • Engine Run Time ≥ 5 Secs. • O2 heater not in Device control • B2S1 O2 heater resistance DTC not active All of the above met for at least 120 seconds	8 test failures in 10 test samples Frequency: 1 tests per trip 5 seconds delay between tests 1 second execution rate	DTC Type B

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 Low Voltage Bank 2 Sensor 1	P0151	This DTC determines if the O2 sensor circuit is shorted to low	O2 sensor voltage < 50 millivolts	Common Enable Criteria • No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's • Catalyst monitor diagnostic Intrusive Test = Not Active • Post Oxygen Sensor Diagnostic Intrusive Test = Not Active • Fuel, Idle, and Engine Not Over speed Intrusive Tests = Not Active • 10 volts < system voltage < 18 volts • Idle and Fuel Injector Device controls = Not Active • Fuel Level > 10 % or fuel level data fault active Specific Enable Criteria • 0.992 ≤ Equivalence ratio ≤ 1.014 • 100 ≤ Air Per Cylinder ≤ 800 • Fuel state = closed loop • All fuel injectors = ON All of the above met for at least 2 seconds	450 test failures in a 480 sample test Frequency: Continuous 100 ms loop	DTC Type B
O2S Circuit High Voltage Bank 2 Sensor 1	P0152	This DTC determines if the O2 sensor or circuit is shorted to high.	O2 sensor voltage > 1050 millivolts to go fault pending O2 sensor voltage > 1050 millivolts to set DTC	Common Enable Criteria • No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's • Catalyst monitor diagnostic Intrusive Test = Not Active • Post Oxygen Sensor Diagnostic Intrusive Test = Not Active • Fuel, Idle, and Engine Not Over speed Intrusive Tests = Not Active • 10 volts < system voltage < 18 volts • Idle and Fuel Injector Device controls = Not Active • Fuel Level > 10 % or fuel level data fault active Specific Enable Criteria • 0.992 ≤ Equivalence Ratio ≤ 1.014 • 100 ≤ Air Per Cylinder ≤ 800 • Fuel State = Closed loop All of the above met for at least 2 seconds	90 test failures in a 100 sample test Frequency: Continuous 100 ms loop	DTC Type B

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 Slow Response Bank 2 Sensor 1	P0153	This DTC determines if the O2 sensor response time is degraded	Refer to **"O2S Slow Response Bank 1 Sensor 1 (P0133), O2S Slow Response Bank 2 Sensor 1 (P0153) Pass/Fail Thresholds."** In Lookup Tables section.	Common Enable Criteria • No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's • Catalyst monitor diagnostic Intrusive Test = Not Active • Post Oxygen Sensor Diagnostic Intrusive Test = Not Active • Fuel, Idle, and Engine Not Over speed Intrusive Tests = Not Active • 10 volts < system voltage < 18 volts • Idle and Fuel Injector Device controls = Not Active • Fuel Level > 10 % or fuel level data fault active Specific Enable Criteria • O2 Heater on for ≥ 0 seconds • B2S1 DTCs = Not Active • Learned heater resistance is valid • Misfire DTC = Not Active • ECT > 60 °C • IAT > -40 °C • Engine run time > 160 seconds • EVAP Canister purge duty cycle ≥ 0 % • 20 gm/sec ≤ MAF ≤ 55 gm/sec • 1000 ≤ RPM ≤ 3000 • Baro > 69.8 kPa • Air Per Cylinder > 150, Fuel State Closed Loop • Baro is not defaulted All of the above met for at least 1 second.	40 seconds Frequency: Once per trip Green Sensor Delay Criteria • The diagnostic will not be enabled until the next ignition cycle after the following has been met: Airflow greater than 22 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) Note: this feature is only enabled when the vehicle is new and cannot be enabled in service	DTC Type B
O2S Circuit Insufficient Activity Bank 2 Sensor 1	P0154	This DTC determines if the O2 sensor circuit is open.	350 millivolts < O2 sensor < 550 millivolts	Common Enable Criteria • No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's • Catalyst monitor diagnostic Intrusive Test = Not Active • Post Oxygen Sensor Diagnostic Intrusive Test = Not Active • Fuel, Idle, and Engine Not Over speed Intrusive Tests = Not Active • 10 volts < system voltage < 18 volts • Idle and Fuel Injector Device controls = Not Active Specific Enable Criteria • Engine run time > 10 seconds • No B2S1 heater related DTCs • All of the above met for at least 300 seconds	285 test failures in a 300 test samples Frequency: Continuous for pre catalyst sensors 100 ms loop rate	DTC Type B

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 Heater Performance Bank 2 Sensor 1	P0155	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 > 3.125 amps	Common Enable Criteria • No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's • Catalyst monitor diagnostic Intrusive Test = Not Active • Post Oxygen Sensor Diagnostic Intrusive Test = Not Active • Fuel, Idle, and Engine Not Over speed Intrusive Tests = Not Active • 10 volts < system voltage < 18 volts • Idle and Fuel Injector Device controls = Not Active Specific Enable Criteria • Engine Run Time ≥ 5 Secs. • O2 heater not in Device control • B2S1 O2 heater resistance DTC not active • All of the above met for at least 120 seconds	8 test failures in 10 test samples Frequency: 1 tests per trip 5 seconds delay between tests 1 second execution rate	DTC Type B
O2S Circuit Low Voltage Bank 2 Sensor 2	P0157	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	Common Enable Criteria • No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's • Catalyst monitor diagnostic Intrusive Test = Not Active • Post Oxygen Sensor Diagnostic Intrusive Test = Not Active • Fuel, Idle, and Engine Not Over speed Intrusive Tests = Not Active • 10 volts < system voltage < 18 volts • Idle and Fuel Injector Device controls = Not Active • Fuel Level > 10 % or fuel level data fault active Specific Enable Criteria • 0.992 ≤ Equivalence ratio ≤ 1.014 • 100 ≤ Air Per Cylinder ≤ 800 • Fuel state = closed loop • All fuel injectors = ON All of the above met for at least 2 seconds	570 test failures in a 600 sample test Frequency: Continuous 100 ms loop	DTC Type B

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 High Voltage Bank 2 Sensor 2	P0158	This DTC determines if the O2 sensor or circuit is shorted to high by checking for a rich condition during steady throttle.	O2 sensor voltage > 1050 millivolts to go fault pending O2 sensor voltage > 1050 millivolts to set DTC	Common Enable Criteria • No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's • Catalyst monitor diagnostic Intrusive Test = Not Active • Post Oxygen Sensor Diagnostic Intrusive Test = Not Active • Fuel, Idle, and Engine Not Over speed Intrusive Tests = Not Active • 10 volts < system voltage < 18 volts • Idle and Fuel Injector Device controls = Not Active • Fuel Level > 10 % or fuel level data fault active Specific Enable Criteria • 0.992 ≤ Equivalence Ratio ≤ 1.014 • 100 ≤ Air Per Cylinder ≤ 800 • Fuel State = Closed loop All of the above met for at least 2 seconds	570 test failures in a 600 sample test Frequency: Continuous 100 ms loop	DTC Type B

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 2 Sensor 2	P0160	This DTC determines if the O2 sensor is open.	410 millivolts < O2 sensor < 490 millivolts for regular open test 350 millivolts < O2 sensor < 550 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)	Common Enable Criteria • No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's • Catalyst monitor diagnostic Intrusive Test = Not Active • Post Oxygen Sensor Diagnostic Intrusive Test = Not Active • Fuel, Idle, and Engine Not Over speed Intrusive Tests = Not Active • 10 volts < system voltage < 18 volts • Idle and Fuel Injector Device controls = Not Active • Fuel Level > 10 % or fuel level data fault active Specific Enable Criteria • No B1S2 heater related DTCs • PCM State = run Fast Pass: Engine run time ≤ 200 seconds (Fast pass cannot report a fail; if Fast pass fails, the regular open test is run) Regular Open Test • Engine run time > 300 seconds Fuel state = closed loop	1450 test failures in a 1500 test samples (sample counts – failure counts) < 550 within 200 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) Frequency: Once/trip for post catalyst sensors 100 ms loop	DTC Type B
O2S Heater Performance Bank 2 Sensor 2	P0161	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 > 2.875 amps	Common Enable Criteria • No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's • Catalyst monitor diagnostic Intrusive Test = Not Active • Post Oxygen Sensor Diagnostic Intrusive Test = Not Active • Fuel, Idle, and Engine Not Over speed Intrusive Tests = Not Active • 10 volts < system voltage < 18 volts • Idle and Fuel Injector Device controls = Not Active Specific Enable Criteria • Engine Run Time ≥ 5 Secs • O2 heater not in Device control • B2S1 O2 heater resistance DTC not active All of the above met for at least 120 seconds	8 test failures in 10 test samples Frequency: 1 tests per trip 5 seconds delay between tests 1 second execution rate	DTC Type B

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	Determines if the fuel control system is in a lean condition, based on the EWMA of long-term fuel trim (LONG FT). (Note: EWMA stands for "Exponentially Weighted Moving Average")	The EWMA of LONG FT samples ≥ 1.325	• No Misfire, pre-cat O2S, or EVAP DTC's • No Fuel Injector DTC's • No IAC, MAF, MAP, ECT DTC's • No TP Sensor or TAC System DTC's • Engine speed > 375 RPM but < 7000 RPM • BARO > 70 kpa • ECT > -40 °C but < 150 °C • MAP > 10 kpa but < 255 kpa • IAT > -20°C but < 150 °C • MAF > 1 g/s but < 510 g/s • VSS < 83 mph (134 km/h) • Closed Loop and LONG FT enabled • Not in Device Control • Catalyst Monitor Diag. Intrusive Test = Not Active • Post O2 Diagnostic Intrusive Test = Not Active • EVAP diagnostic is at any stage except the "tank pull down" portion of the test • Fuel Level > 10% (must be < 10 % for at least 30 seconds to disable; enable if fuel sender is faulty) General Notes: 1. At least 25-55 seconds of data must accumulate on each trip, with at least 15-45 seconds of data in the current fuel trim cell before a pass or fail decision can be made. 2. Development data indicates that the Fuel Adjustment System Diagnostic (FASD) is typically enabled during 85% of the EPAIII Drive cycle. This is also typical of the real-world driving, however values will vary (higher or lower) based on the actual conditions present during the drive cycle	The EWMA of LONG FT samples ≥ 1.325 for ≥ 100 ms Frequency: Continuous 100 ms loop	DTC Type B

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	Determines if the fuel control system is in a rich condition, based on the EWMA of long-term fuel trim (LONG FT). (Note: EWMA stands for "Exponentially Weighted Moving Average")	There exists both a Passive and, if needed, Intrusive rich test. Passive: The EWMA of purge-off LONG FT samples $\leq$ 0.68 Intrusive: If a passive decision cannot be made, and the EWMA of purge-on LONG FT samples $\leq$ 0.685, purge is ramped off to determine if excess purge is the cause. Therefore, the following must also occur to report a failure: The EWMA of LONG FT samples with purge off $\leq$ 0.68 for at least 6 seconds during each of 3 intrusive segments. Intrusive Notes: 1. Segments can last up to 30 seconds, and are separated by the smaller of a 20 second purge-on time or enough time to purge 16 grams of vapor. 2. A maximum of 5 completed segments or 20 intrusive attempts are allowed for each intrusive test. 3. After an intrusive test report is completed, another intrusive test cannot occur for 300 seconds to allow sufficient time to purge excess vapors from the canister. During this period, fuel trim will pass if the EWMA of LONG FT samples > 0.685 for at least 200 seconds, indicating that the canister has been purged. Performing intrusive tests too frequently may also affect EVAP and EPAIII emissions, and the execution frequency of other diagnostics.	• No Misfire, pre-cat O2S, or EVAP DTC's • No Fuel Injector DTC's • No IAC, MAF, MAP, or ECT DTC's • No TP Sensor or TAC System DTC's • Engine speed > 375 RPM but < 7000 RPM • BARO > 70 kpa • ECT > -40 ^{o}C but < 150 °C • MAP > 10 kpa but < 255 kpa • IAT > -20°C but < 150 °C • MAF > 1 g/s but < 510 g/s • VSS < 83 mph (134 km/h) • Closed Loop and LONG FT enabled • Not in Device Control • Catalyst Monitor Diag. Intrusive Test = Not Active • Post O2 Diagnostic Intrusive Test = Not Active • EVAP diagnostic is at any stage except the "tank pull down" portion of the test • Fuel Level > 10% (must be < 10 % for at least 30 seconds to disable; enable if fuel sender is faulty) General Notes: 1. At least 25-55 seconds of data must accumulate on each trip, with at least 15-45 seconds of data in the current fuel trim cell before a pass or fail decision can be made. 2. Development data indicates that the Fuel Adjustment System Diagnostic (FASD) is typically enabled during 85 % of the EPAIII drive cycle. This is also typical of real-world driving, however values will vary (higher or lower) based on the actual conditions present during the drive cycle. 3. In addition to the above, the Intrusive Test requires at least 58 more seconds of LTM data before a pass or fail decision can be made.	Passive: The EWMA of purge-off LONG FT samples $\leq$ 0.68for $\geq$ 100ms Intrusive: If rich fail counter is $\geq$ 3 before pass counter $\geq$ 3, the diagnostic fails. <u>Frequency:</u> Continuous 100 ms loop Determines if the fuel control system is in a rich condition, based on the EWMA of long-term fuel trim (LONG FT). (Note: EWMA stands for "Exponentially Weighted Moving Average")	DTC Type B

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 (Cont)				Intrusive Enable Criteria • Insufficient purge-off data prior to purge-on operation, such as often occurs after a hot start (or if the passive test is not used on this application). • The EWMA of purge-on LONG FT samples ≤ 0.685 • RPM > 375 RPM • Mass Airflow > 1 g/s but < 510 g/s • MAP > 18 kpa but 255 kpa Temporary Intrusive Test Inhibit Criteria: If the duration of an intrusive test segment reaches 30 seconds before a pass or fail count is registered, the purge valve is opened for the smaller of 10 seconds or enough time to purge16 grams vapor.		

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 2	P0174	Determines if the fuel control system is in a lean condition, based on the EWMA of long-term fuel trim (LTM). (Note: EWMA stands for "Exponentially Weighted Moving Average")	The EWMA of LONG FT samples ≥ 1.325	• No Misfire, pre-cat O2S, or EVAP DTC's • No Fuel Injector DTC's • No IAC, MAF, MAP, or ECT DTC's • No TP Sensor or TAC System DTC's • Engine speed > 375 RPM but < 7000 RPM • BARO > 70 kpa • ECT > -40 °C but < 150 °C • MAP > 10 kpa but < 255 kpa • IAT > -20°C but < 150 °C • MAF > 1 g/s but < 510 g/s • VSS < 83 mph (134 km/h) • Closed Loop and LONG FT enabled • Not in Device Control • Catalyst Monitor Diag. Intrusive Test = Not Active • Post O2 Diagnostic Intrusive Test = Not Active • EVAP diagnostic is at any stage except the "tank pull down" portion of the test • Fuel Level > 10% (must be < 10 % for at least 30 seconds to disable; enable if fuel sender is faulty) General Notes: 1. At least 25-55 seconds of data must accumulate on each trip, with at least 15-45 seconds of data in the current fuel trim cell before a pass or fail decision can be made. 2. Development data indicates that the Fuel Adjustment System Diagnostic (FASD) is typically enabled during 85% of the EPAIII Drive cycle. This is also typical of the real-world driving, however values will vary (higher or lower) based on the actual conditions present during the drive cycle	The EWMA of LONG FT samples ≥ 1.325 for ≥ 100 ms Frequency: Continuous 100 ms loop	DTC Type B

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 2	P0175	Determines if the fuel control system is in a rich condition, based on the EWMA of long-term fuel trim (LTM). (Note: EWMA stands for "Exponentially Weighted Moving Average")	There exists both a Passive and, if needed, Intrusive rich test. Passive: The EWMA of purge-off LONG FT samples $\leq$ 0.68 Intrusive: If a passive decision cannot be made, and the EWMA of purge-on LONG FT samples $\leq$ 0.685, purge is ramped off to determine if excess purge is the cause. Therefore, the following must also occur to report a failure: The EWMA of LONG FT samples with purge off $\leq$ 0.68 for at least 6 seconds during each of 3 intrusive segments. Intrusive Notes: 1. Segments can last up to 30 seconds, and are separated by the smaller of a 20 second purge-on time or enough time to purge 16 grams of vapor. 2. A maximum of 5 completed segments or 20 intrusive attempts are allowed for each intrusive test. 3. After an intrusive test report is completed, another intrusive test cannot occur for 300 seconds to allow sufficient time to purge excess vapors from the canister. During this period, fuel trim will pass if the EWMA of LONG FT samples > 0.685 for at least 200 seconds, indicating that the canister has been purged. Performing intrusive tests too frequently may also affect EVAP and EPAIII emissions, and the execution frequency of other diagnostics.	• No Misfire, pre-cat O2S, or EVAP DTC's • No Fuel Injector DTC's • No IAC, MAF, MAP, or ECT DTC's • No TP Sensor or TAC System DTC's • Engine speed > 375 RPM but < 7000 RPM • BARO > 70 kpa • ECT > -40 °C but < 150 °C • MAP > 10 kpa but < 255 kpa • IAT > -20°C but < 150 °C • MAF > 1 g/s but < 510 g/s • VSS < 83 mph (134 km/h) • Closed Loop and LONG FT enabled • Not in Device Control • Catalyst Monitor Diag. Intrusive Test = Not Active • Post O2 Diagnostic Intrusive Test = Not Active • EVAP diagnostic is at any stage except the "tank pull down" portion of the test • Fuel Level > 10% (must be < 10 % for at least 30 seconds to disable; enable if fuel sender is faulty) General Notes: 1. At least 25-55 seconds of data must accumulate on each trip, with at least 15-45 seconds of data in the current fuel trim cell before a pass or fail decision can be made. 2. Development data indicates that the Fuel Adjustment System Diagnostic (FASD) is typically enabled during 85% of the EPAIII drive cycle. This is also typical of real-world driving, however values will vary (higher or lower) based on the actual conditions present during the drive cycle. 3. In addition to the above, the Intrusive Test requires at least 58 more seconds of LTM data before a pass or fail decision can be made.	Passive: The EWMA of purge-off LONG FT samples $\leq$ 0.68for $\geq$ 100ms Intrusive: If rich fail counter is $\geq$ 3 before pass counter $\geq$ 3, the diagnostic fails. Frequency: Continuous 100 ms loop Determines if the fuel control system is in a rich condition, based on the EWMA of long-term fuel trim (LONG FT). (Note: EWMA stands for "Exponentially Weighted Moving Average")	DTC Type B

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 2 (Cont)				Intrusive Enable Criteria • Insufficient purge-off data prior to purge-on operation, such as often occurs after a hot start (or if the passive test is not used on this application). • The EWMA of purge-on LONG FT samples ≤ 0.76 • RPM > 375 RPM • Mass Airflow > 1 g/s but < 510 g/s • MAP > 18 kpa but 255 kpa Temporary Intrusive Test Inhibit Criteria: If the duration of an intrusive test segment reaches 30 seconds before a pass or fail count is registered, the purge valve is opened for the smaller of 10 seconds or enough time to purge16 grams vapor.		
Injector Control Circuit (Cylinders 1-8) (Odm)	P0201 – P0208	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.	Engine running and 18 volts > Ignition voltage > 11 volts for more than 1 second	8 failures out of 10 samples 250ms loop continuous	DTC Type B
Throttle Position (TP) Sensor 2 Circuit	P0220	Detects a continuous or intermittent short or open in TP sensor #2 circuit	0.250 Volts > TPS > 4.59 Volts	Ignition in Unlock/accessory, run, crank Run/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts 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 < 0.250 Volts	Ignition in Unlock/accessory, run, crank Run/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts 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 Run/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts 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 ms / sample Continuous	DTC Type B

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 Detected Cylinder 2 Misfire Detected Cylinder 3 Misfire Detected Cylinder 4 Misfire Detected Cylinder 5 Misfire Detected Cylinder 6 Misfire Detected Cylinder 7 Misfire Detected Cylinder 8 Misfire Detected	P0300 P0301 P0302 P0303 P0304 P0305 P0306 P0307 P0308	These DTC's will determine if a random or a cylinder specific misfire is occurring by monitoring crankshaft velocity.	Deceleration index Vs Engine speed Vs Load Emission Failure Threshold = 1.5% Catalyst Damage Threshold = 5%	• Engine run time > 2 crankshaft revolutions. • DTCs not active for VSS, CKP, TP, MAP, ECT, IAT and MAF sensors. • No CAM to Crank Timing faults. • No Camshaft actuator solenoid faults. • No engine protection faults. • No Electronic Throttle Control Faults. • P0315 (Crankshaft Position System Variation Not Learned) not active or engine speed < 1000 RPM. • Fuel cutoff not active. • Fuel level > 10% (disablement ends 500 after a low fuel level condition ceases, and fuel disable does not occur with a fuel sensor DTC). • -7°C < ECT < 130°C. • If ECT at startup < -7°C, then disable until ECT > 21°C. • 375 RPM < Engine speed < 5600 RPM. • 9 volts < System voltage < 18 volts. • + Throttle position delta < 75% per 25 ms. • - Throttle position delta < 75% per 25 ms. • Abnormal engine speed is not present. • ABS rough road not detected. • ABS/TCS is not active. • Positive and zero torque (except the CARB approved 3000 rpm to redline triangle). Positive and zero torque is detected when both is true: 1) engine load > zero torque cal (cal a function of engine speed and barometric pressure). • Detectable engine speed and engine load region. • CAM sensor is in sync with CKP sensor. • Crankshaft Ring Filter inactive (after a low level misfire, another misfire may not be detectable until crankshaft ringing ceases) • Not an automatic transmission shift with a Throttle position >94.999%. • Active Fuel Management transition is not in progress.	Emission Exceedence = (5) failed 200 revolution blocks of 16. Failure reported with (1) Exceedence in 1st (16) 200 revolution block, or (4) Exceedences thereafter. 1st Catalyst Exceedence = Number of 200 revolution blocks as data supports for catalyst damage. 2nd and subsequent Catalyst Exceedences = (1) 200 revolution block with catalyst damage. Frequency: Continuous	DTC Type B (MIL Flashes with Catalyst Damaging Misfire)
Crankshaft Position System Variation Not Learned	P0315	Monitor for valid crankshaft error compensation factors	Sum of Compensation Factors are ≥ 4.001 or ≤ 3.999	OBD Manufacturer Enable Counter = 0	0.50 seconds Frequency: Continuous 100 ms loop	DTC Type A
Knock Sensor Module Performance	P0324	This diagnostic will detect a failed internal ECM component associated with knock control	Any Cylinder's Avg Gain Signal > 4.5 if RPM>1500 OR All Cylinder's Actual Signals < 0.2 if RPM>1500	Air Per Cylinder >200 mg per engine cycle per cylinder Temporarily disabled ('Indeterminate' state reported) for samples in which P0325, P0327, P0328, P0330, P0332, or P0333 report 'Failed' state.	50 out of 63 100ms sample rate Continuous	DTC Type A

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 Circuit	P0325	This diagnostic checks for an open to the knock sensor	Gated Low Pass Filter Voltage > 4V or < 1.24 V	ECT>-40 and Engine Run Time > 2 RPM > 400 Temporarily disabled ('Indeterminate' state reported) for samples in which P0327 or P0328 report 'Failed' state.	50 out of 63 100ms sample rate Continuous	DTC Type B
Knock Sensor Performance Bank 1	P0326	This diagnostic checks for an overactive knock sensor caused by noisy engine components (e.g. lifters)	Fast Retard > 12	Engine Speed ≥ 500 MAP ≥ 50 No throttle fault Fast spark retard active	50 out of 63 100ms sample rate Continuous	DTC Type B
Knock Sensor 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	ECT> -40 and Engine Run Time > 2 secs	50 out of 63 100ms sample rate Continuous	DTC Type B
Knock Sensor 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	ECT> -40 and Engine Run Time > 2	50 out of 63 100ms sample rate Continuous	DTC Type B
Knock Sensor Circuit Bank 2	P0330	This diagnostic checks for an open to the knock sensor	Gated Low Pass Filter Voltage > 4V or < 1.24 V	ECT> -40 and Engine Run Time > 2 RPM > 400 Temporarily disabled ('Indeterminate' state reported) for samples in which P0332 or P0333 report 'Failed' state.	50 out of 63 100ms sample rate Continuous	DTC Type B
Knock Sensor Circuit Low Bank 2	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	ECT> -40 and Engine Run Time > 2	50 out of 63 100ms sample rate Continuous	DTC Type B
Knock Sensor Circuit High Bank 2	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	ECT> -40 and Engine Run Time > 2	50 out of 63 100ms sample rate Continuous	DTC Type B

08 GRP11 Engine Control Module (ECM)

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 (Ckp) Sensor A Circuit	P0335	This diagnostic determines whether a fault exists with crank position sensor signal	1. No crankshaft position sensor pulses received for 4 seconds 2. No crankshaft position sync 3. No crankshaft position sensor pulses received	1. Engine cranking and either CMP pulses being received or MAF > 3 grams per second 2. Engine is spinning and no 5V reference DTCs set 3. Engine is spinning and no 5V reference or cam position sensor DTCs set 4.	1. While starter is engaged 2. Continuous – 75 ms 3. Continuous - 2 test failures out of 10 samples	DTC Type A
Crankshaft Position (Ckp) Sensor A Performance	P0336	This diagnostic determines whether a performance fault exists with crank position sensor signal	1. Unable to achieve crank sync 2. Twenty five crank resyncs occur within 20 seconds 3. 53 > number of crank pulses received in one engine revolution >63	1. Engine cranking and either CMP pulses being received or MAF >3 grams per second 2. Engine speed > 450 RPM 3. Engine is spinning and no 5V reference or cam position sensor DTCs set	1. While starter engaged – 1.5s 2. Continuous – 1 test failures 3. Continuous – 8 test failures out of 10 samples	DTC Type A
Camshaft Position (Cmp) Sensor Circuit Bank 1 Sensor A	P0340	This diagnostic will detect if a fault exists on the camshaft position sensor signal.	1. No Cam pulses received during first 24 MEDRES events 2. No Cam pulses received for 100 engine cycles 3. No Cam pulses received while starter is engaged 4. No Cam pulses received	1. Crank is synchronized and no 5V ref DTCs set 2. Crank is synchronized and no 5V ref DTCs set 3. Engine is cranking and either crank pulses are received or MAF > 3 grams per second 4. Engine is spinning and no 5V ref DTCs set	1. One time while starter is engaged 2. Continuous – 8 test failures out of 10 samples 3. Continuous – 4 seconds while starter is engaged 4. Continuous - 3 seconds	DTC Type B
Camshaft Position (Cmp) Sensor Performance Bank 1 Sensor A	P0341	Detects cam sensor performance malfunctions by monitoring for the incorrect number of cam sensor pulses in a given number of crank sensor pulses	1. 2 > number of cam pulses received in 24 MEDRES events > 8 2. 398> number of cam pulses received in 100 engine cycles > 402	1. Crank is synchronized and no 5V ref DTCs set Crank is synchronized and no 5V ref DTCs set	1. One time while starter is engaged 2. Continuous – 8 test failures out of 10 samples	DTC Type B
Ignition Control (Cylinders 1 through 8) (ODM)	P0351 – P0358	This DTC checks the circuit for electrical integrity during operation. Monitors EST for each cylinder	The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match.	Ignition voltage > 6V	50 out of 63 100ms sample rate Continuous	DTC Type B

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Catalyst System Low Efficiency Bank 1	P0420	Oxygen Storage Capacity (OSC) (Stored Oxygen Release Monitor or STORM)	OSC Mass EWMA ≤ 3.00 grams Air OSC Period = HO2S2 Resp Time – HO2S1 Resp Time – Inert Catalyst Transport Delay. OSC Mass = ∫{ MAF(Bank,t) * [EquivalenceRatio(t)/FuelTrim LT – 1]}∂t, t=0 to OSC Period. Normalized OSC Mass = OSC Mass *Catalyst Temperature Compensation Factor. OSC Mass EWMA(n) = OSC Mass EWMA(n-1) + EWMAcoef* { Normalized OSC Mass(n) – OSC Mass EWMA(n-1)} OSC Worst Pass Thresh = 3.00 grams Air .	Trip Enable Criteria No VSS, Baro, Pedal, Purge, Oxygen sensor, Post Oxygen Sensor, Misfire, IAT, MAP, Coolant, Crank sensor, Cam sensor, Air flow, or Fuel trim DTC's failing Test Enable Conditions o STORM is calibrated to run as a stand alone diagnostic (Not running following the Post Oxygen Performance Diagnostic or POPD) and STORM has not completed yet for the trip. o Green Converter Delay = Not Active o Predicted Catalyst Temperature ≥ 500C for ≥ 60 sec o 300 C ≤ Predicted Catalyst Temperature ≤ 900 C o Min learn enable time for stable BLM & PLM ≥ 100 sec ≥ 100 sec if tank level increased by ≥10% or after code clear) o Barometric Pressure ≥ 70 kPa o -20 ≤ IAT ≤ 100°C o 70°C ≤ ECT ≤ 128°C o Tests Attempted this trip < 255 o Transmission is stable during measurement. o Battery Voltage ≥ 11v Fuel level ≥ 10 % Fuel o Level Fault not active) or Fuel level ≥ 0 % (Fuel Level Fault active) o VSS > 43 km/hr & RPM ≥ 900 for ≥ 20 sec Valid DFCO Period Criteria Trip & Test Enable Criteria Met DFCO Period ≥ 1.75 sec HO2S1 ≤ 300 mV (prior to DFCO exit) HO2S2 ≤ 300 mV for 2.00 sec (prior to DFCO exit) Valid DFCO Exit Period Criteria Trip & Test Enable Criteria Met TPS travel < 30 % Equivalence Ratio ≥ 1.00 Test Completion Criteria HO2S1 ≥ 600 mV & HO2S2 ≥ 200 mV (or) HO2S2 Resp Time – HO2S1 Resp Time > 1.525 sec Fast Initial Response Criteria Test has not reported as Passed or Failed yet. Rapid Step Response (RSR) Enable Criteria Min OSC Change For RSR ≥ 2.41 grams Normalized OSC Mass ≤ 2.47 grams	Minimum of 1 test per trip. Fast Initial Response(FIR) or Rapid Step Response(RSR) Maximum of 8 tests per trip Maximum of 24 to detect failure when Rapid Step Response is enabled frequency: 12.5 ms continuous Green Converter Delay Criteria This is part of the check for the Test Enable Conditions section. The diagnostic will not be enabled until the following has been met: Predicted catalyst temperature >= 550° C for 3600 seconds cumulative non-continuously. Note: this feature is only enabled at the factory when the vehicle is new and cannot be enabled in service	DTC Type A

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Catalyst System Low Efficiency Bank 2	P0430	Oxygen Storage Capacity (OSC) (Stored Oxygen Release Monitor or STORM)	OSC Mass EWMA ≤ 3.00 grams Air OSC Period = HO2S2 Resp Time – HO2S1 Resp Time – Inert Catalyst Transport Delay. OSC Mass = ∫{ MAF(Bank,t) * [EquivalenceRatio(t)/FuelTrim LT – 1]}∂t, t=0 to OSC Period. Normalized OSC Mass = OSC Mass *Catalyst Temperature Compensation Factor. OSC Mass EWMA(n) = OSC Mass EWMA(n-1) + EWMAcoef* { Normalized OSC Mass(n) – OSC Mass EWMA(n-1)} OSC Worst Pass Thresh = 3.00 grams Air .	Trip Enable Criteria No VSS, Baro, Pedal, Purge, Oxygen sensor, Post Oxygen Sensor, Misfire, IAT, MAP, Coolant, Crank sensor, Cam sensor, Air flow, or Fuel trim DTC's failing Test Enable Conditions o STORM is calibrated to run as a stand alone diagnostic (Not running following the Post Oxygen Performance Diagnostic or POPD) and STORM has not completed yet for the trip. o Green Converter Delay = Not Active o Predicted Catalyst Temperature ≥ 500C for ≥ 60 sec o 300 C ≤ Predicted Catalyst Temperature ≤ 900 C o Min learn enable time for stable BLM & PLM ≥ 100 sec ≥ 100 sec if tank level increased by ≥10% or after code clear) o Barometric Pressure ≥ 70 kPa o -20 ≤ IAT ≤ 100°C o 70°C ≤ ECT ≤ 128°C o Tests Attempted this trip < 255 o Transmission is stable during measurement. o Battery Voltage ≥ 11v Fuel level ≥ 10 % Fuel o Level Fault not active) or Fuel level ≥ 0 % (Fuel Level Fault active) o VSS > 43 km/hr & RPM ≥ 900 for ≥ 20 sec Valid DFCO Period Criteria Trip & Test Enable Criteria Met DFCO Period ≥ 1.75 sec HO2S1 ≤ 300 mV (prior to DFCO exit) HO2S2 ≤ 300 mV for 2.00 sec (prior to DFCO exit) Valid DFCO Exit Period Criteria Trip & Test Enable Criteria Met TPS travel < 30 % Equivalence Ratio ≥ 1.00 Test Completion Criteria HO2S1 ≥ 600 mV & HO2S2 ≥ 200 mV (or) HO2S2 Resp Time – HO2S1 Resp Time > 1.525 sec Fast Initial Response Criteria Test has not reported as Passed or Failed yet. Rapid Step Response (RSR) Enable Criteria Min OSC Change For RSR ≥ 2.41 grams Normalized OSC Mass ≤ 2.47 grams	Minimum of 1 test per trip. Fast Initial Response(FIR) or Rapid Step Response(RSR) Maximum of 8 tests per trip Maximum of 24 to detect failure when Rapid Step Response is enabled frequency: 12.5 ms continuous Green Converter Delay Criteria This is part of the check for the Test Enable Conditions section. The diagnostic will not be enabled until the following has been met: Predicted catalyst temperature >= 550° C for 3600 seconds cumulative non-continuously. Note: this feature is only enabled at the factory when the vehicle is new and cannot be enabled in service	DTC Type A

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Evaporative Emission (EVAP) System Small Leak Detected	P0442	This DTC will detect a small leak (≥ 0.020") in the EVAP system between the fuel fill cap and the purge solenoid. The engine off natural vacuum method (EONV) is used.	***SMALL LEAK TEST FAIL:*** 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 497.00 to 497.00 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. Fail threshold = 0.65 Re-Pass threshold = 0.35	***TEST ENABLE :*** 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 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% ≤ Fuel Level ≤ 90% Drive time ≥ 600 seconds. Drive length ≥ 5 kilometers. ECT ≥ 70°C. No fuel filling (fuel level increment ≥ 10%) During EONV test. BARO ≥ 74.0 kPa Estimate of Ambient Air Temperature Valid Estimated ambient temperature at end of drive ≥ 0°C but ≤ 34°C. Odometer ≥ 16.1 kilometers Engine not run time before key off must be ≤ refer to "P0442: Engine Off Time Before Vehicle Off Maximum as a Function of Temperature table" in Lookup Tables Section Note: Conditions for Estimate of Ambient Air Temperature to be valid 1. Cold Start Startup Δ°C(ECT-IAT) ≤ 8°C if ECT > IAT OR 2. Hot Restart Sufficient drive length to get accurate estimate of ambient air temperature (at least a minimum of 4 minutes and 4 kilometers)	Once per trip, during hot soak (up to 2400 sec.). Time since last complete test ≥ 17 hours if normalized result and EWMA is passing, or ≥ 10 hours if normalized result or EWMA is failing. No more than 2 attempts per day.	DTC Type A EWMA Average run length is 7 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 ≤ Ignition ≤ 18 volts)	20 failures out of 25 samples 250 ms /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 > 3481 Pa for 5 seconds BEFORE Purge Volume ≥ 10 liters OR Vented Vacuum < -623 Pa or Vented Vacuum > 1245 Pa for 120 seconds 2 liters of fuel must be consumed after setting the DTC active the first time to set the DTC active the second time.	General Test Enable: 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 circuit DTC's No EVAP Canister Vent Solenoid circuit DTC's No Thermostat Rationality DTC's 10% ≤ Fuel Level ≤ 90% 11 volts ≤ System Voltage ≤ 18 volts 4°C ≤ Startup IAT ≤ 30°C Startup ECT ≤ 35°C BARO ≥ 74.0 kPa (8000 ft)	Once per Cold Start Time is dependent on driving conditions Max. before test abort is 1200 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 ≤ Ignition ≤ 18 volts)	20 failures out of 25 samples 250 ms / sample Continuous with solenoid operation	DTC Type A
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 is 6 under normal conditions Run length is 2 after code clear or non-volatile reset

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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 or ~ 1681 Pa) produces a failing sample. Otherwise, the sample is considered passing. The normal operating range of the fuel tank pressure sensor is 0.5 volts (~1245 Pa) to 4.5 volts (~ -3736 Pa).	• 0.10 second delay after sensor power up for sensor warm-up • ECM State ≠ crank	80 failures out of 100 samples 100 ms / sample Continuous	DTC Type B
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 or ~ -4172 Pa) produces a failing sample. Otherwise, the sample is considered passing. The normal operating range of the fuel tank pressure sensor is 0.5 volts (~1245 Pa) to 4.5 volts (~ -3736 Pa).	• 0.10 second delay after sensor power up for sensor warm-up • ECM state ≠ crank	80 failures out of 100 samples 100 ms / 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.	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. The abrupt change is defined as a change > 112 Pa and < 249 Pa vacuum in the span of 1.0 seconds. A refueling event is confirmed if the fuel level has a persistent change of 10% 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

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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.	Purge volume > 14 liters BEFORE Tank vacuum ≤ 2740 Pa 2 liters of fuel must be consumed after setting the DTC active the first time to set the DTC active the second time. Weak Vacuum Follow-up Test (fuel cap replacement test) Weak Vacuum Test failed. Passes if tank vacuum ≥ 2740 Pa. Note: Weak Vacuum Follow-up Test can only report a pass.	General Test Enable 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 circuit DTC's No EVAP Canister Vent Solenoid circuit DTC's No Thermostat Rationality DTC's 10% ≤ Fuel Level ≤ 90% 11 volts ≤ System Voltage ≤ 18 volts BARO ≥ 74.0 kPa (8000 ft) Purge Flow ≥ 3.75 % Cold Start Test • Startup temperature Δ(ECT-IAT): ≤ 8°C if ECT > IAT • Cold Test Timer ≤ 1200 seconds • 4°C ≤ Startup IAT ≤ 30°C • Startup ECT ≤ 35°C Weak Vacuum Follow-up Test This test can run following a weak vacuum failure or on a hot restart.	Once per cold start Time is dependent on driving conditions Max. before test abort is 1200 seconds Weak Vacuum Follow-up Test With large leak detected, the follow-up test is limited to 1300 seconds. Once the MIL is on, the follow-up test runs indefinitely.	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 < 3 liters over an accumulated 241.4 kilometers.	No VSS DTC's set Engine Running	250 ms / sample Continuous	DTC Type B
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 100 ms / 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 ≤ 18 volts)	240 failures out of 300 samples 100 ms / sample Continuous	DTC Type B

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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 re-fueling 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 event 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 10% fuel level during the engine-off test. A refueling event is confirmed if the fuel level has a persistent change of 10% 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
Cooling Fan 1 Relay Control Circuit (ODM)	P0480	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	20 failures out of 25 samples 250 ms / sample Continuous with fan operation	DTC Type B
Cooling Fan 2 Relay Control Circuit (ODM)	P0481	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	20 failures out of 25 samples 250 ms / sample Continuous with fan operation	DTC Type B
Cooling Fan 3 Relay Control Circuit (ODM)	P0482	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	20 failures out of 25 samples 250 ms / sample Continuous with fan operation	DTC Type B
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 sec BEFORE Test time ≥ refer to "P0496: Purge Valve Leak Test Engine Vacuum Test Time (Cold Start) as a Function of Fuel Level table" in Lookup Tables Section	<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 circuit DTC's No EVAP Canister Vent Solenoid circuit DTC's No Thermostat Rationality DTC's 10% ≤ Fuel Level ≤ 90% 11 volts ≤ System Voltage ≤ 18 volts 4°C ≤ Startup IAT ≤ 30°C Startup ECT ≤ 35°C BARO ≥ 74.0 kPa (8000 ft)	Once per cold start. Cold start: max time is 1200 seconds	DTC Type B

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Engine Oil Pressure Sensor Performance	P0521	This DTC determines if the engine oil pressure sensor is stuck/biased within the normal operation range	The filtered difference between actual engine oil pressure and predicted engine oil pressure (a function of engine speed and engine oil temperature): **Fail test if currently passing:** High threshold Filtered Weighted Residual > 50 Low threshold Filtered Weighted Residual < -50 **Pass test if currently failing:** High threshold Filtered Weighted Residual < 47 Low threshold Filtered Weighted Residual > -47	Oil Pressure Rationality Enabled Filtered test weighting (a function of engine speed, engine oil temperature, predicted oil pressure, and engine load stability) => 0.3 Engine speed (1000 to 5000 rpm) 20C < Oil temp < 140C Engine Load Stability < 5 mg APC Engine Predicted Pressure (270 to 450 kPa) No Crank Sensor DTC's active No Coolant Sensor DTC's active No Intake Air Temp Sensor Circuit DTC's active No MAF DTC's active No Oil Pressure Sensor Circuit DTC's active	Continuous 100 msec	DTC Type B
Engine Oil Pressure Circuit Low	P0522	This DTC detects a continuous short to low or open in either the signal circuit or the Oil Pressure sensor.	Oil Pressure sensor voltage < 5% Vref	Oil Pressure Sensor Present Oil Pressure Sensor Circuit Low Diag Enabled Engine Running = TRUE 9 V <= Ignition Voltage <= 18 V Enables if engine speed > 400 rpm Disables if engine speed < 350 rpm	50 failure counts out of 63 samples Continuous 100 msec/sample	DTC Type B
Engine Oil Pressure Circuit High	P0523	This DTC detects an open sensor ground or continuous short to high in either the signal circuit or the Oil Pressure sensor.	Oil Pressure sensor voltage > 85% Vref	Oil Pressure Sensor Present Oil Pressure Sensor Circuit High Diag Enabled Engine Running = TRUE 9 V <= Ignition Voltage <= 18 V	204 failure counts out of 255 samples Continuous 100 msec/sample	DTC Type B
Control Module Read Only Memory (Rom)	P0601	This DTC will be stored if any software or calibration check sum is incorrect	Calculated Checksum does not match stored checksum	Ignition in Run or Crank	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	Indicates that the ECM needs to be programmed	Fails if No Start Calibration is set to true which is only available on a new un-programmed ECM	Ignition in Run or Crank	Runs once at 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 in Run or Crank	1 failure <u>Frequency:</u> Once at power-up	DTC Type A
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

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PCM Processor Performance/Integrity Check 1. Main processor Arithmetic Logic Unit (ALU) fault 2. Main configuration register fault 3. Software timed loop execution 4. Communication (SPI bus) between processors failed 5. Processor state of health 6. TPS or APPS Learn corruption fault (both processors) 7. TPS or APPS Learn range fault (both processors) 8. Communication of Seed & Key values between processors	P0606	Indicates that the ECM has detected an ETC internal processor integrity fault	1. ALU not reporting as expected 2. Configuration register not reporting as expected 3. Software tasks loops > schedule tasks loop 4. Loss of SPI communication between main and secondary processors 5. 1.5 msec < Average processor state of health toggle > 2.5 msec 6. TPS or APPS minimum learned values fail compliment check 7. TPS or APPS minimum learned values fail range check 8. Returned values from Seed & Key algorithm different than expected	Ignition in unlock/accessory, run or crank Run/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts	1. In main processor, 50 ms 2. In main processor, 50 ms 3. Error > 5 times of loop time; loop time are 12.5, 25, 50, 100 and 250 ms in the main processor 4. In the main processor, (12.5 ms/count) 159 out of 400 counts intermittent or 15 counts continuous; 39 counts continuous @ initialization 5. In the MHC processor, 475 ms at initialization, 175 ms continuous or 20/200 intermittent. 6. 187.5ms continuous/100 ms intermittent in the main processor 7. 187.5ms continuous/100 ms intermittent in the main processor 8. 2 failures within 200 ms	DTC Type A
Control Module Accelerator Pedal Position (APP) System Performance	P060D	Verify that the indicated accelerator pedal position calculation is correct	1. Difference between Main processor indicated accelerator pedal position and MHC processor indicated accelerator pedal position > 2.5%	1. Ignitions in unlock/ accessory and run, Run/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts No PCM processor DTC 2. Ignition in unlock, accessory, run or crank Run/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts 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 EPROM Error	P062F	Indicates that the NVM Error flag has not been cleared	Last EEPROM write did not complete	Ignition on.	1 test failure Once on controller power-up	DTC Type A
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 Run/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts 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 (ODM)	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.	RunCrankIgnInRange (11 volts ≤ Ignition ≤ 18 volts) Remote Vehicle Start is not active	20 failures out of 25 samples 250 ms / sample Continuous	DTC Type B, No MIL

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
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 Run/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts No ECM processor DTCs	19/39counts or 187.5 msec continuous; 12.5 msec/count in main/MHC processor	DTC Type A
Powertrain Relay Control (ODM)	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.	RunCrankIgnInRange (11 volts ≤ Ignition ≤ 18 volts)	8 failures out of 10 samples 250 ms / sample Continuous	DTC Type B
Powertrain Relay Feedback Circuit High	P0690	This DTC is a check to determine if the Powertrain relay is functioning properly	Stuck Test: PT Relay feedback voltage is > 2 volts when commanded 'OFF'	Powertrain relay commanded "ON" No Powertrain Relay Control output driver fault	Stuck Test: 100 ms / sample Continuous failures ≥ 2 seconds	DTC Type B
Fuel System Control Module (FSCM) Requested MIL Illumination	P069E	Monitor Fuel System Control Module(FSCM) MIL Request to determine when the FSCM has detected a MIL illuminating fault.	Fuel System Control Module Emissions-Related DTC set requesting MIL illumination	Time since power-up > 3 seconds Time Since Code Clear > 2 seconds Diagnostic System not Disabled for Service Run Crank Active	Continuous 100ms Sample Rate	DTC Type A No MIL
Transmission Control Module (Tcm) Requested Mil Illumination	P0700	Monitor Transmission Control Module (TCM) MIL Request to determine when the TCM has detected a MIL illuminating fault.	Transmission Emissions-Related DTC set requesting MIL illumination	Time since power-up > 3 seconds Time Since Code Clear > 2 seconds Diagnostic System not Disabled for Service Run Crank Active	Continuous 100ms Sample Rate	DTC Type A No MIL
Traction Control Torque Request Circuit	P0856	Determines if torque request from the EBTCM is valid	1. Serial Communication 2's complement not equal for message $1CA 2. Serial Communication rolling count value shall be + 1 from previous $1CA message 3. Too many minimum limit torque requests transitions occur from TRUE to FALSE to TRUE within a time period	Secondary High Speed Bus is Present No Serial communication loss to EBCM (U1820) (CeDFIR_e_LostCommBSCM_BusB) Run Crank Active >= 3 s Propulsion System = Active Power Mode = Run Use serial data to detect traction and Traction Control System == Present for GMLAN from $4E9 (PPEI3) message	**Fail Criteria** 1. # of Protect Errors >= 10 2. # of Alive Rolling Errors >= 6 out of 10 Samples performed in the 12.5 ms loop 3. # of Multi Transition errors >= 3 **Pass Criteria** Received serial communication for > 0.625 s	Special DTC Type C

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
Motor Electronics Coolant Temperature Sensor Circuit Range/Performance	P0A01	Range/Performance	Cold Start Fail: Delta between powerup PECL temp and coolant temp > 30° C & Delta between powerup ECT and IAT<= 15.75 ° C Cold Start Pass: Delta between powerup PECL temp and coolant temp<= 15.75° C & Delta between powerup ECT and IAT<= 15.75° C	Engine off time> 36000 seconds No active DTC's: P0112,P0113,P0117,P0118,P0101,P0102,P0103,P0A02, P0A03	Once at powerup (12.5ms frequency)	DTC Type B
Motor Electronics Coolant Temperature Sensor Circuit Low	P0A02	Out of range low	Motor Electronics Coolant Temperature ≤ -60.5°C	Minimum IAT < 70ºC, Propulsion active time > 10 seconds, No active DTC's: P0112, P0113	3 seconds (30 fail/50 sample; 100 ms frequency)	DTC Type B
Motor Electronics Coolant Temperature Sensor Circuit Low	P0A03	Out of range high	Motor Electronics Coolant Temperature ≥ 162°C	Minimum IAT > -20ºC, Propulsion active time > 10 seconds, No active DTC's: P0112, P0113	3 seconds (30 fail/50 sample; 100 ms frequency)	DTC Type B
Hybrid Prowtrain Control Module	P0A1D	Indicates that the MCPA has detected an HCP Status Failure fault	ECM criteria to look for MCPA message: Run/Crank High for at least 500 msec	All other parameters and enable conditions are controlled by the PLD and MCPA processors in the HCP.	A Single GMLAN message from MCPA received	DTC Type A
Hybrid Prowertrain Control Module Request MIL Illumination	P0AC4	Monitor Hybrid Control Module (HCP) MIL Request to determine when the HCP has detected a MIL illuminating fault.	Hybrid Emissions-Related DTC set requesting MIL illumination	Time since power-up > 3 seconds Time Since Code Clear > 2 seconds Diagnostic System not Disabled for Service Run Crank Active	Continuous 100ms Sample Rate	DTC Type A No MIL

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
Inlet Airflow System Performance	P1101	This DTC determines if there are multiple air induction problems affecting airflow and/or manifold pressure.	Filtered Throttle Error * V > 150 kPa/grams per second AND (Measured MAP – Manifold Model 2 pressure) filtered * W > 15 kPa AND ((Measured MAP – Manifold Model 1 pressure) filtered * X > 15 kPa OR (Measured Flow – Modeled air Flow) Filtered * Y * Z > 10 grams/sec) V = TPS Residual wt factor based on engine speed W = MAP2 Residual wt factor based on engine speed X = MAP1 Residual wt factor based on engine speed Y = MAF Residual wt factor based on engine speed Z = MAF Residual wt factors based on MAF estimate (see table “IFRD Residual Weighting Factors (P0101, P0106, P0121)” attached).	Engine rpm =>450 and <= 8000 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 < 125 deg C	Continuous Evaluated every 12.5 ms	DTC Type B

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 Insufficient Switching Bank 1 Sensor 1	P1133	This DTC determines if the O2 sensor is no longer sufficiently switching.	Half cycle L/R switches < refer to: "O2s Insufficient Switching (Half Cycle) Back 1 Sensor 1 (P1133), O2 Insufficient Switching (Half Cycle) Bank 2 Sensor 1 (P1153) Pass/Fail Thresholds" in Lookup Tables Section. OR Slope Time L/R switches < 1 OR Slope Time R/L switches < 1	Common Enable Criteria • No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's • Catalyst monitor diagnostic Intrusive Test = Not Active • Post Oxygen Sensor Diagnostic Intrusive Test = Not Active • Fuel, Idle, and Engine Not Over speed Intrusive Tests = Not Active • 10 volts < system voltage < 18 volts • Idle, Fuel Injector, Device controls = Not Active Specific Enable Criteria • O2 Heater on for ≥ 0 seconds • B1S1 DTCs = Not Active • Learned heater resistance is valid • Misfire DTC = Not Active • ECT > 60 °C • IAT > -40 °C • Engine run time > 160 seconds • EVAP Canister purge duty cycle ≥ 0 % • 20 gm/sec ≤ MAF ≤ 55 gm/sec • 1000 ≤ RPM ≤ 3000 • Baro > 69.8 kPa • Air Per Cylinder > 150, Fuel State Closed Loop • Fuel Level > 10 % • Fuel state = closed loop • No fuel level data faults • Baro is not defaulted All of the above met for at least 1 second.	40 seconds Frequency: Once per trip	DTC Type B

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 Insufficient Switching Bank 2 Sensor 1	P1153	This DTC determines if the O2 sensor is no longer sufficiently switching.	Half cycle L/R switches < < refer to: "O2s Insufficient Switching (Half Cycle) Bank 1 Sensor 1 (P1133), O2 Insufficient Switching (Half Cycle) Bank 2 Sensor 1 (P1153) Pass/Fail Thresholds" in Lookup Tables Section. OR Slope Time L/R switches < 1 OR Slope Time R/L switches < 1	Common Enable Criteria • No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTC's • Catalyst monitor diagnostic Intrusive Test = Not Active • Post Oxygen Sensor Diagnostic Intrusive Test = Not Active • Fuel, Idle, and Engine Not Over speed Intrusive Tests = Not Active • 10 volts < system voltage < 18 volts • Idle, and Fuel Injector, Device controls = Not Active Specific Enable Criteria • O2 Heater on for ≥ 0 seconds • B2S1 DTCs = Not Active • Learned heater resistance is valid • Misfire DTC = Not Active • ECT > 60 °C • IAT > -40 °C • Engine run time > 160 seconds • EVAP Canister purge duty cycle ≥ 0 % • 20 gm/sec ≤ MAF ≤ 55 gm/sec • 1000 ≤ RPM ≤ 3000 • Baro > 69.8 • Air Per Cylinder > 150, Fuel State Closed Loop • Fuel Level > 10 • Fuel state = closed loop • No fuel level data faults • Baro is not defaulted All of the above met for at least 1 second.	40 seconds Frequency: Once per trip	DTC Type B
Engine Coolant Over Temperature - Protection Mode Active	P1258	Monitor for engine protection mode active.	ECT temperature > 124°C .	No ECT sensor DTCs.	Set immediately upon engine protection mode active.	DTC Type A
Abs Rough Road Malfunction	P1380	This diagnostic detects if the ABS controller is indicating a fault. When this occurs, misfire will continue to run.	ABS controller sends a message to PCM indicating that a failure has occurred in the ABS module	VS ≥ 8Kph RPM ≤ 8191 Engine Load ≤ 60%	40 failures out of 80 samples 100 msec loop continuous	DTC Special Type C (DTC can only set when a P0300 Light Request is True)

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
Abs System Rough Road Detection Communication Fault	P1381	This diagnostic detects if the rough road information is no longer being received from the ABS module. When this occurs, misfire will continue to run.	Serial data messages are lost	VS ≥ 8Kph RPM ≤ 8191 Engine Load ≤ 60%	40 failures out of 80 samples 100 msec loop continuous	DTC Special Type C (DTC can only set when a P0300 Light Request is True)
Cold Start Emissions Reduction System Fault	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.	(Average desired accumulated exhaust energy - Average estimated accumulated exhaust energy) < -6.15 kJ/s OR (Average desired accumulated exhaust energy - Average estimated accumulated exhaust energy) > 0.51 kJ/s	•Cold start emission reduction strategy is active. To enable the cold start emission reduction strategy the catalyst temperature must be < 300 and the engine coolant must be > 0. The strategy will exit when the catalyst temp is >= 600 and the engine run time is >= 10. The cold start emission reduction strategy may also exit if the engine run time is >= 90 •Vehicle speed < 2.0 kph •Driver foot is off accel pedal •TPS close delay time > 0.20 seconds •No DTCs set for the following systems: Throttle Position, MAP, MAF, IAT, ECT, Misfire, Transmission, Pedal Failure, Electronic Spark Timing, Crank sensor, Idle, Fuel Injection, Vehicle Speed, 5 volt reference, ECM Memory.	100 ms loop Runs once per trip when the cold start emission reduction strategy is active. Test completes after 15 seconds of accumulated qualified data.	DTC Type A
Throttle Actuator Control (TAC) Module - Throttle Actuator Position Performance	P1516	1. Detect a throttle positioning error. 2. Determine if the actuator has been miswired.	1. |throttle error| >= |2.0%| after > 0.4875 sec stability with no change in error sign, OR |throttle error| > 8.41 % 2. TPS1< 1.96 Volts	Ignition in run or crank [(RPM>0 and system voltage > 5.40Volts) OR (RPM=0 and not in battery saver mode and System voltage > 11.0 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
Hybrid Control Torque Request Circuit	P15F2	Determines if torque request from the HCP is valid	1. Serial Communication 2's complement not equal for message $0A9 2. Serial Communication rolling count value shall be + 1 from previous $0A9 message	Secondary High Speed Bus is Present No Serial communication loss to HCP (U1817) (CeDFIR_e_LostCommHPCM_BusB) Run Crank Active >= 200 ms	1. # of Protect Errors >= 5 out of 15 samples 2. # of Alive Rolling Errors >= 5 out of 15 samples Pass diagnostic if samples >= 15 12.5ms loop	DTC Type A

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
Ignition Correlation	P1682	1. Continuous: detect when run/crank ignition voltage exceeds ETC run/crank ignition voltage 2. Intermittent: detect when run/crank ignition voltage and ETC run/crank ignition voltage do not correlate	1. Run/Crank – ETC Run/Crank > 3.0 V 2. |Run/Crank – ETC Run/Crank| > 3.0 V	Ignition in unlock/accessory, run or crank Run/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts & Powertrain Relay Commanded on. Run/Crank Ignition ≥ 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	1. In main processor, 175 ms 2. In main processor, 240 out of 480 counts (12.5 ms per count).	DTC Type A
Internal Control Module Redundant Memory Performance See Appendix	P16F3	Detect Processor Calculation faults due to RAM corruptions, ALU failures and ROM failures	See Appendix	See Appendix	See Appendix	DTC Type A
Control Module Throttle Actuator Position Performance	P2101	Detect a throttle positioning error	Difference between measured throttle position and modeled throttle position > 8.41 %	Ignition in run or crank [(RPM>0 and system voltage > 5.5 Volts) OR (RPM=0 and not in batterysaver mode and System voltage > 11.0 Volts)] Throttle not at default position 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	1. Detect a continuous or intermittent short or open in the APP sensor #1 on Main processor 2. Detect a continuous or intermittent short or open in the APP sensor #1 on MHC processor	1. APP1 < 0.325 OR APP1 > 4.75 Volts 2. APP1< 0.325 OR APP1 > 4.75 Volts	Ignition in unlock/accessory, run or crank Run/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts No 5 Volt reference DTCs	1. 19/39counts or 13counts continuous; 12.5 msec/count in the main processor 2. 19/39counts or 13counts continuous; 12.5 msec/count in the MHC processor	DTC Type A

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 Lo	P2122	Detect a continuous or intermittent short or open in the APP sensor #1 on Main processor	APP 1 < 0.325 Volts	Ignition in unlock/accessory, run or crank Run/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts 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 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 Run/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts 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	1. Detect a continuous or intermittent short or open in the APP sensor #1 on Main processor 2. Detect a continuous or intermittent short or open in the APP sensor #1 on MHC processor	1. APP2 < 0.325 OR APP2 > 4.75 Volts 2. APP2< 0.325 OR APP2 > 4.75 Volts	Ignition in unlock/accessory, run or crank Run/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts No 5 Volt reference DTCs	1. 19/39counts or 13counts continuous; 12.5 msec/count in the main processor 2. 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 < 0.325 Volts	Ignition in unlock/accessory, run or crank Run/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts 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 Run/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts No 5 Volt reference DTCs	19/39counts or 13 counts continuous; 12.5 msec/count in the Main processor	DTC Type A

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
Throttle Position (TP) Sensor 1-2 Correlation	P2135	1. Detects a continuous or intermittent correlation fault between TP sensors #1 and #2 on Main processor 2. Detects a continuous or intermittent correlation fault between TP sensors #1 and #2 on MHC processor	1. Difference between TPS1 displaced and TPS2 displaced > 7.10% offset at min. throttle position with an increasing to 10% at max. throttle position 2. Different between (raw min TPS1) and (raw_min TPS2) > 5.0 % of Vref	Ignition in unlock/accessory, run or crank Run/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts No 5 Volt reference DTCs	1. 79/159 counts or 63 counts continuous; 3.125 msec/count in the main processor 2. 19/39 counts or 15 counts continuous; 12.5 msec/count in the MHCprocessor	DTC Type A
Accelerator Pedal Position (APP) Sensor 1-2 Correlation	P2138	Detect an invalid minimum mechanical position correlation between APP sensor #1 and #2	1. Difference between (raw min. learned PPS#1 voltage-raw min. PPS#1 voltage) and (raw PPS#2 voltage - raw min. learned PPS#2 voltage) > 9.50% offset at min. throttle position with an increasing to 10% (0.5v)at max. throttle position for Main processor. OR 2. Difference between the learned PPS1 min and PPS2 min > 5.0% Vref	1. Ignition in unlock/accessory, run or crank Run/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts No 5 Volt reference DTC's 2. Ignition in unlock/accessory, run or crankRun/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts No 5 Volt reference DTC's	1. 19/39 counts intermittent or 15 counts continuous, 12.5 msec/count in the main processor 2. 19/39 counts intermittent or 15 counts continuous, 12.5 msec/count in the MHC processor	DTC Type A
Vehicle Speed – Output Shaft Speed Correlation	P215B	Detect invalid vehicle speed source.	The absolute difference between wheel speed vehicle speed and TOS vehicle speed greater than 10kph.	CAN timer > 500msec Secure vehicle speed source is TOS vehicle speed or wheel speed vehicle speed	400/800 counts intermittent 25msec/count	DTC Type A
Vehicle Speed Sensor B Circuit Low	P2160	No signal from Transfer Case Speed Sensor	TCSS signal ≤ 50 RPM	60 ≤ Engine Torque ≤ 8192 N-m 5 ≤ Throttle Position ≤ 99% 1000 ≤ Input Speed ≤ 7500 RPM Transmission Range ≠ Park or Neutral Not in Reverse Inhibit state Not garage shifting No Engine Torque, Throttle Position, and Turbine Speed DTCs	5.0 sec	DTC Type B 4 Wheel Drive Only

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
Vehicle Speed Sensor B Intermittent/Erratic	P2161	Loss of signal from Transfer Case Speed Sensor	Output Speed signal is increasing (Current TCSS signal – Last Valid Output Speed) ≥ 475 RPM **OR** Output Speed signal is decreasing (Current TCSS signal – Last Valid Output Speed) ≤ 225 RPM	Engine Speed ≥ 1000 RPM Transmission Range ≠ Park or Neutral Not in Reverse Inhibit state Not garage shifting No Crank Sensor and P2160 DTCs	4.0 sec	DTC Type B 4 Wheel Drive Only
Minimum Throttle Position Not Learned	P2176	TP minimum learning not completed	1. TPS > 0.98 Volts during TPS min learn on the Main processor OR 2. TPS > 0.98 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 Run/crank voltage > 7.0 volts, or Powertrain relay voltage > 7.0 volts No TPS circuit DTCs No ignition correlation DTC active.	1.8secs	DTC Type A
Barometric Pressure (BARO) Sensor Performance	P2227	Determines stability of Barometric pressure sensor	Difference between the current Baro sensor reading and the previous Baro sensor reading is > 10 Kpa	No Baro circuit DTCs set No ECT, IAT, MAF, MAP, TP, or VSS DTCs set Ignition has been on > 10 seconds Vehicle speed < 100 KPH	20samples out of 25 samples Continuous 250 ms loop	DTC Type B
Barometric Pressure (BARO) Sensor Circuit Low Voltage	P2228	This DTC detects a continuous short to low or open in either the signal circuit or the Baro sensor.	Baro sensor voltage < 40% of Vref (2.00 volts)		20 Fail samples out of 25 Lim samples Continuous 250 ms loop	DTC Type B
Barometric Pressure (BARO) Sensor Circuit High Voltage	P2229	This DTC detects an open sensor ground or continuous short to high in either the signal circuit or the Baro sensor	Baro sensor voltage > 97% of Vref (4.85 volts)		20 Fail samples out of 25 Lim samples Continuous 250 ms loop	DTC Type B

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 ≥ 791 millivolts AND **Accumulated mass air flow monitored during the Stuck Lean Voltage Test > 80 grams.**	Common Enable Criteria • No O2 circuit, response, heater current, or heater resistance DTC's active • No TP Sensor, ETC, MAF, MAP, EVAP, Fuel Injector DTC's, Fuel Trim System DTCs, Misfire DTCs • 10 volts < system voltage < 18 volts • Learned heater resistance is valid • ICAT MAT Burn off delay is not active • Green O2 Sensor Condition is not present • Fuel Level > 10 % or fuel level data fault active • Engine run time (from key start) ≥ 225 secs Specific Enable Criteria: • No Fuel Trim or Misfire DTC's active • 900 rpm ≤ Engine Speed ≤ 2500 rpm • 3 gm/sec ≤ Airflow ≤ 20 gm/sec • 50 kph ≤ Vehicle Speed ≤ 120 kph • 0.74 ≤ Short term fuel trim ≤ 1.08 • Fuel state = closed loop • EVAP diagnostic not in control of purge • Post Cell Enabled • VaOXYC_b_O2_HeaterWarmUpDlyCmplt = TRUE for all post O2 sensors • 550 ºC ≤ Catalytic Converter Temperature ≤ 900 ºC All of the above met for at least 0.5 seconds, and then: ForceCatRich intrusive stage is requested.	Frequency: Once per trip Note: if NaPOPD_b_ResetFastRespFunc = FALSE for the given Fuel Bank OR NaPOPD_b_RapidResponseActive = TRUE, multiple tests per trip are allowed. Green Sensor Delay Criteria • The diagnostic will not be enabled until the next ignition cycle after the following has been met: Airflow greater than 22 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) Note: this feature is only enabled when the vehicle is new and cannot be enabled in service	DTC Type B

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 ≤ 100 millivolts AND **Accumulated mass air flow monitored during the Stuck Rich Voltage Test > 80 grams.**	Common Enable Criteria • No O2 circuit, response, heater current, or heater resistance DTC's active • No TP Sensor, ETC, MAF, MAP, EVAP, Fuel Injector DTC's, Fuel Trim System DTCs, Misfire DTCs, • 10 volts < system voltage < 18 volts • Learned heater resistance is valid • ICAT MAT Burn off delay is not active • Green O2 Sensor Condition is not present • Fuel Level > 10 % or fuel level data fault active • Engine run time (from key start) ≥ 225 secs Specific Enable Criteria: • The DFCO mode and no driver initiated throttle input. • Complete and PASS the following POPD tests: 1. P2270 and P2272	Frequency: Once per trip Note: if NaPOPD_b_ResetFastRespFunc = FALSE for the given Fuel Bank OR NaPOPD_b_RapidResponseActive = TRUE, multiple tests per trip are allowed. Green Sensor Delay Criteria • The diagnostic will not be enabled until the next ignition cycle after the following has been met: Airflow greater than 22 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) Note: this feature is only enabled when the vehicle is new and cannot be enabled in service	DTC Type B

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 2 Sensor 2	P2272	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 (B2S2) O2 sensor cannot achieve voltage ≥ 791 millivolts AND **Accumulated mass air flow monitored during the Stuck Lean Voltage Test > 80 grams.**	Common Enable Criteria • No O2 circuit, response, heater current, or heater resistance DTC's active • No TP Sensor, ETC, MAF, MAP, EVAP, Fuel Injector DTC's, Fuel Trim System DTCs, Misfire DTCs • 10 volts < system voltage < 18 volts • Learned heater resistance is valid • ICAT MAT Burn off delay is not active • Green O2 Sensor Condition is not present • Fuel Level > 10 % or fuel level data fault active • Engine run time (from key start) ≥ 225 secs Specific Enable Criteria: • No Fuel Trim or Misfire DTC's active • 900 rpm ≤ Engine Speed ≤ 2500 rpm • 3 gm/sec ≤ Airflow ≤ 20 gm/sec • 50 kph ≤ Vehicle Speed ≤ 120 kph • 0.74 ≤ Short term fuel trim ≤ 1.08 • Fuel state = closed loop • EVAP diagnostic not in control of purge • Post Cell Enabled • VaOXYC_b_O2_HeaterWarmUpDlyCmplt = TRUE for all post O2 sensors • 550 ºC ≤ Catalytic Converter Temperature ≤ 900 ºC All of the above met for at least 0.5 seconds, and then: ForceCatRich intrusive stage is requested.	Frequency: Once per trip Note: if NaPOPD_b_ResetFastRespFunc = FALSE for the given Fuel Bank OR NaPOPD_b_RapidResponseActive = TRUE, multiple tests per trip are allowed. Green Sensor Delay Criteria • The diagnostic will not be enabled until the next ignition cycle after the following has been met: Airflow greater than 22 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) Note: this feature is only enabled when the vehicle is new and cannot be enabled in service	DTC Type B

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 2 Sensor 2	P2273	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 (B2S2) O2 sensor cannot achieve voltage ≤ 100 millivolts AND Accumulated mass air flow monitored during the Stuck Rich Voltage Test > 80 grams.	Common Enable Criteria • No O2 circuit, response, heater current, or heater resistance DTC's active • No TP Sensor, ETC, MAF, MAP, EVAP, Fuel Injector DTC's, Fuel Trim System DTCs, Misfire DTCs • 10 volts < system voltage < 18 volts • Learned heater resistance is valid • ICAT MAT Burn off delay is not active • Green O2 Sensor Condition is not present • Fuel Level > 10 % or fuel level data fault active • Engine run time (from key start) ≥ 225 secs Specific Enable Criteria: • The DFCO mode and no driver initiated throttle input. • Complete and PASS the following POPD tests: 1. P2270 and P2272	Frequency: Once per trip Note: if NaPOPD_b_ResetFastRespFunc = FALSE for the given Fuel Bank OR NaPOPD_b_RapidResponseActive = TRUE, multiple tests per trip are allowed. Green Sensor Delay Criteria • The diagnostic will not be enabled until the next ignition cycle after the following has been met: Airflow greater than 22 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) Note: this feature is only enabled when the vehicle is new and cannot be enabled in service	DTC Type B
Engine Hood Switch Circuit	P254F	Circuit Performance	Hood Switch 1 State ≠ Hood Switch 2 State	Ignition Voltage ≤ 18V and ≥ 11V	0.5 seconds (100ms frequency)	DTC Type B
ECM/PCM Internal Engine Off Timer Performance	P2610	This DTC determines if the engine off timer does not initialize or count properly. Clock rate test: Checks the accuracy of the 1 second timer by comparing it with the 12.5 ms timer	Initial value test: Initial ignition off timer value < 0 sec OR Initial ignition off timer value > 10 sec Clock rate test: • Time between ignition off timer increments < 0.8 sec • Time between ignition off timer increments > 1.2 sec • Time since last ignition off timer increment ≥ 1.375 sec • Current ignition off time < old ignition off time • Current ignition off timer minus old ignition off timer ≠ 1.0	ECM is powered down DTC sets on next key cycle if failure detected -40°C ≤ IAT ≤ 125°C	Initial value test: 3 failures 1.375 sec / sample Clock rate test: 8 failures out of 10 samples 1 second / sample test runs once each key-off	DTC Type B

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
Four Wheel Drive (4WD) High Range Performance	P279A	Transfer Case Mode in GMLAN frame $2D1 = HIGH range **AND** Transfer Case ≠ HIGH range	(1.000 - Ratio Margin) ≤ Transfer Case Measured Ratio ≤ (1.000 + Ratio Margin) NOTE: Ratio constrained to 0 – 8 (See HIGH Ratio Margin Below)	200 RPM ≤ Engine Speed ≤ 7500 RPM for ≥ 5.0 sec Vehicle Speed ≤ 200 km/hr for ≥ 5.0 sec	10 Fail counts out of 16 Sample counts 12.5 msec loop, continuous	DTC Type Special C 4 Wheel Drive Only
Four Wheel Drive (4WD) Low Range Performance	P279B	Transfer Case Mode in GMLAN frame $2D1 = LOW range **AND** Transfer Case ≠ Low range	(2.790 - Ratio Margin) ≤ Transfer Case Measured Ratio ≤ (2.790 + Ratio Margin) NOTE: 1. Ratio constrained to 0 - 8 2. Ratio Margin = Table(Vehicle Speed, Engine Torque) (See LOW Ratio Margin Below)	200 RPM ≤ Engine Speed ≤ 7500 RPM for ≥ 5.0 sec Vehicle Speed ≤ 200 km/hr for ≥ 5.0 sec	10 Fail counts out of 16 Sample counts 12.5 msec loop, continuous	DTC Type Special C 4 Wheel Drive Only
Four Wheel Drive (4WD) u Range Performance	P279C	Transfer Case Mode in GMLAN frame $2D1 = NEUTRAL **AND** Transfer Case not in NEUTRAL	Transfer Case Measured Ratio ≠ High Range **AND** ≠ Low Range (See NETURAL Ratio Margin Below)	200 RPM ≤ Engine Speed ≤ 7500 RPM for ≥ 5.0 sec Vehicle Speed ≤ 200 km/hr for ≥ 5.0 sec	25 Fail counts out of 32 Sample counts 12.5 msec loop, continuous	DTC Type Special C 4 Wheel Drive Only

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
Deactivation System Performance	P3400	Detects a “failed to deactivate” condition	Manifold model 2 Lag – Manifold model 2 Lag in AFM > 10 and Manifold model 2 Lag < -10 while in AFM	**Deactivation Control Enable Conditions**: Valid and deactivation has lasted for => 2 seconds: Cylinder Deactivation Hardware Present Cylinder Deactivation Mode set to Normal Mode Engine RPM Enable based on Gear: (575 to 925 rpm) < RPM < 2800 rpm Powertrain Relay voltage: 11 V< Ign Voltage < 18 V Engine Run Time Enable: Continuous run time > 20 s one time after Key Starts Run time greater than StartupDelayTime = f(Engine off time (5 to 20 s) after Hybrid Autostarts Engine Coolant: 40 C < Coolant Temp deg C < 128 C Engine Oil Pressure: 187.4 kPa < Eng Oil Pressure < 455 kPa Engine Oil Temperature: 20 C < Eng Oil Temp < 128 C Throttle Area: Throttle Area < 28 % PRNDL Enable/Disable: Only enabled in Drive Transmission Gear Enable/Disable: Enabled in all gears except Park, Reverse and Neutral Vehicle Speed: VSS > 29 km/h Time since disabled for ETC security >= 60 s Re-enable Time since Half Cyl Mode Exit for max time in half cyl mode >= 60 s DFCO not active Fuel not shutoff for time > = 3 s Gear Shift not in progress Abort Counter < 4 out of 10 samples Hybrid controller requests Half Cylinder Mode **Deactivation Control Disable Conditions:** Engine RPM Enable based on Gear: (500 to 850 rpm) < 3000 rpm Powertrain Relay voltage: 11 V < Ign Voltage < 18 V Engine Oil Pressure: 172.4 kPa < Eng Oil Pressure < 470 kPa	100 Failures out of 200 samples where a sample is a 100 ms loop while in AFM mode.	DTC Type B

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
Deactivation System Performance (Cont)	P3400 (Cont)			Engine Oil Temperature: 18 C < Eng Oil Temp < 130 C Engine Coolant: 36 C < deg C < 132 C Vehicle Speed: VSS < 10 km/h Throttle Area: Throttle Area > 30 % Disable Half Cyl Mode Time >= 480 s ETC Security Time >= 60 s Engine Metal Overtemp Protection not active Catalytic Converter Overtemp Protection not active Cold Start Emissions Reduction not active Low Catalyst Temperature Protection not active Piston Protection not active Hot Coolant Enrichment not active Engine Overspeed Protection not active Engine Oil Aeration condition not present Heater Performance Request not active POSD intrusive test not active STRM Catalyst Diagnostic not active MAP sensor DTC's not active Crank or Cam sensor test not failed this key on Misfire test not failed this key on System Remedial Action Ring has disabled fuel Engine Coolant DTC's not active Intake Air Temp DTC's not active Vehicle Speed error not present Preload throttle area calculation error not present Preload throttle area calculation fault not active Eng Oil Pressure DTC's not active PT Relay DTC not active 4WD Low State not active and valid Trans gear not defaulted Deactivation System Performance test not failed this Key On Deactivation Solenoid DTC's not active Engine Power Limited not active Device Control Override not active Torque Estimation is valid Abort Counter >= 2 out of 4 samples Hybrid Controller requests All Cylinder Mode		

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
Deactivation System Performance (Cont)	P3400 (Cont)			**Diagnostic Enable Conditions:** Time in All Cylinder Mode => 2 seconds MAP sensor high/low DTC's not active MAF sensor high/low DTC's not active Crank sensor DTC's not active Engine Coolant DTC's not active Intake Air Temp. DTC's not active Engine Coolant > 70 deg C and < 125 deg C Intake Air Temp > -7 deg C and < 125 deg C Total residual weigh factors (filtered) => 0		
Cylinder 1 Deactivation Solenoid Control Circuit	P3401	Detects a Solenoid Control Circuit fault - Short/Open	Cylinder Deac Diag Enabled and 20 fail counts out of 25 sample counts	Engine Speed >= 400 rpm GetPMDR_b_RunCrankIgnInRange	250ms loop time	DTC Type B
Cylinder 4 Deactivation Solenoid Control Circuit	P3425	Detects a Solenoid Control Circuit fault - Short/Open	Cylinder Deac Diag Enabled and 20 fail counts out of 25 sample counts	Engine Speed >= 400 rpm GetPMDR_b_RunCrankIgnInRange	250ms loop time	DTC Type B
Cylinder 6 Deactivation Solenoid Control Circuit	P3441	Detects a Solenoid Control Circuit fault - Short/Open	Cylinder Deac Diag Enabled and 20 fail counts out of 25 sample counts	Engine Speed >= 400 rpm GetPMDR_b_RunCrankIgnInRange	250ms loop time	DTC Type B
Cylinder 7 Deactivation Solenoid Control Circuit	P3449	Detects a Solenoid Control Circuit fault - Short/Open	Cylinder Deac Diag Enabled and 20 fail counts out of 25 sample counts	Engine Speed >= 400 rpm GetPMDR_b_RunCrankIgnInRange	250ms loop time	DTC Type B
Control Module Communication Bus A 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 reported that it has entered a bus-off state for 3 failures out of 5 samples.		3 sec. Frequency: Continuous 1000 ms loop	DTC Type B
Control Module Communication Bus B Off	U0074	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 reported that it has entered a bus-off state for 3 failures out of 5 samples.		3 sec. Frequency: Continuous 1000 msec loop	DTC Type B
Lost Communication With TCM (Automatic Transmission)	U0101	Detects that CAN serial data communication has been lost with the TCM.	Lost communication with the TCM while the ignition switch is in the RUN power mode, for 375 msec		375 msec Frequency: Continuous 6.25 msec loop	DTC Type B
Lost Communication With TCCM (4 wheel drive applications only	U0102	Detects that CAN serial data communication has been lost with the TCCM.	Lost communication with the TCCM while the ignition switch is in the RUN power mode, for 750 msec		750 msec Frequency: Continuous 6.25 msec loop	DTC Type B

08 GRP11 Engine Control Module (ECM)

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
Lost Communication With Fuel Pump Control Module	U0109	Detects that CAN serial data communication has been lost with the fuel pump control module.	Lost communication with the fuel pump control module while the ignition switch is in the RUN power mode, for 188 msec		188 msec Frequency: Continuous 6.25 ms loop	DTC Type B
Lost Communication With Brake System Control Module	U0129	Detects that CAN serial data communication has been lost with the Brake system control Module	Lost communication with Brake system control moidule while the ignition switch is in the Run power mode, for 300 msec		300 msec Frequency: Continuous 6.25 ms loop	DTC Type B
Lost Communication With Hybrid Powertrain Control Module	U0293	Detects that CAN serial data communication has been lost with the HPCM	Lost communication Hybrid Powertrain Control Module while the ignition switch is in the Run power mode, for 188 msec		188 msec Frequency: Continuous 6.25 ms loop	DTC Type B
Lost Communication with MCPA on Bus B	U1815	Detects that CAN serial data communication has been lost MCPA on Bus B	Lost communication MCPA on Bus B while the ignition switch is in the Run power mode, for 750 msec		750 msec Frequency: Continuous 6.25 ms loop	DTC Type B
Lost Communication with Hybrid Powertrain Control Module on Bus B	U1817	Detects that CAN serial data communication has been lost with HPCM on Bus B	Lost communication with Hybrid Powertrain Control Module on Bus B while the ignition switch is in the Run power mode, for 188 msec		188 msec Frequency: Continuous 6.25 ms loop	DTC Type B
Lost Communication with Brake System Control Module on Bus B	U1820	Detects that CAN serial data communication has been lost with EBCM on Bus B	Lost communication with Brake System Control Module on Bus B while the ignition switch is in the Run power mode, for 150 msec		150 msec Frequency: Continuous 6.25 ms loop	DTC Type B

IFRD Residual Weighting Factors (P0101, P0106, P0121)

								Engine Speed									
	0	250	750	1250	1750	2250	2750	3250	3750	4250	4750	5250	5750	6250	6750	7250	9000
TPS residual weight factors based on engine speed	1.000	1.000	1.000	0.564	0.830	0.745	0.601	0.406	0.436	0.533	0.381	0.363	0.509	1.000	1.000	1.000	1.000
MAP2 Residual wt factors based on engine speed	1.000	0.550	0.573	0.373	0.595	0.495	0.415	0.462	0.445	0.587	0.524	0.460	0.359	0.416	1.000	1.000	1.000
MAP1 Residual wt factors based on engine speed	1.000	0.550	0.600	0.431	0.589	0.774	0.803	0.670	0.607	0.650	0.857	0.876	0.683	0.910	1.000	1.000	1.000
MAF Residual wt factors based on engine speed	1.000	1.000	1.000	1.000	0.491	0.559	0.390	0.353	0.187	0.305	0.276	0.220	0.176	0.193	1.000	1.000	1.000
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

P0116: Fail if power up ECT exceeds IAT by these values. 6.0L (LFA)

Difference ↓ / IAT →	-40	-28	-16	-4	8	20	32	44	56	68	80	92	104	116	128	140	152
Temperature Difference	65	55	45	35	25	25	25	25	25	25	15	15	15	15	15	15	15

P0128: Maximum Accumulated Airflow for IAT and Start-up ECT conditions. 6.0L (LFA)

IAT ↓ / Start-up ECT →	-40	-28	-16	-4	8	20	32	44	56	68	80
IAT > 10°C	17626	17626	17626	17626	17626	15882	14137	12392	10648	8903	7159

10°C ≤ IAT ≥ -7°C	16976	16976	16976	15517	14060	12600	11142	9684	8225	8225	8225

TABLE - O2S Slow Response Bank 1 Sensor 1 (P0133), O2S Slow Response Bank 2 Sensor 1 (P0153)

Lean-Rich Ave

Rich-Lean Ave \ Seconds	0	0.060	0.077	0.094	0.111	0.128	0.145	0.162	0.179	0.196	0.213	0.230	0.247	0.264	0.281	0.298	64.000
0	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
0.070	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
0.087	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
0.104	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
0.121	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
0.138	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL	FAIL	FAIL	FAIL	FAIL
0.155	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL	FAIL	FAIL	FAIL
0.172	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL	FAIL	FAIL
0.189	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL	FAIL
0.206	FAIL	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL
0.223	FAIL	FAIL	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL
0.240	FAIL	FAIL	FAIL	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL
0.257	FAIL	FAIL	FAIL	FAIL	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL
0.274	FAIL	FAIL	FAIL	FAIL	FAIL	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL
0.291	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL
0.308	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL
64.000	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL

P0300: Catalyst Damaging Misfire Percentages as a Function of Engine Speed and Load Table: 6.0L (LFA)

Eng. Load ↓ / Eng. RPM →	0 RPM	1000 RPM	2000 RPM	3000 RPM	4000 RPM	5000 RPM	6000 RPM	7000 RPM	8000 RPM
0 Load_In_Percent	5	5	5	5	5	5	5	5	5
10 Load_In_Percent	5	5	5	5	5	5	5	5	5
20 Load_In_Percent	5	5	5	5	5	5	5	5	5
30 Load_In_Percent	5	5	5	5	5	5	5	5	5
40 Load_In_Percent	5	5	5	5	5	5	5	5	5
50 Load_In_Percent	5	5	5	5	5	5	5	5	5
60 Load_In_Percent	5	5	5	5	5	5	5	5	5
70 Load_In_Percent	5	5	5	5	5	5	5	5	5

80 Load_In_Percent	5	5	5	5	5	5	5	5	5
90 Load_In_Percent	5	5	5	5	5	5	5	5	5
100 Load_In_Percent	5	5	5	5	5	5	5	5	5

P0300 Engine zero toque as a Function of Engine speed @ 100 KPa Baro table: 6.0L (LFA)

Engine rpm	400	500	600	700	800	900	1000	1100	1200	1400	1600	1800	2000
Engine Load, %	8.999634	8.538818	8.151245	7.925415	7.800293	7.879639	7.958984	8.041382	8.120728	8.279419	8.441162	8.599854	8.758545

Engine rpm	2200	2400	2600	2800	3000	3500	4000	4500	5000	5500	6000
Engine Load, %	8.920288	9.078979	9.240723	9.399414	9.561157	11.72791	13.89465	16.0614	18.2312	20.39795	22.5647

08 GRP11 LFA Hybrid Diagnostic Parameters

P0300 Engine (AFM) zero toque as a Function of Engine speed @ 100 KPa Baro table: 6.0L (LFA)

Engine rpm	400	500	600	700	800	900	1000	1100	1200	1400	1600	1800	2000
Engine Load, %	10.19897	9.79919	9.64965	9.54895	9.60083	9.64965	9.69846	9.75036	9.79914	9.94873	10.1013	10.2508	10.4003

Engine rpm	2200	2400	2600	2800	3000	3500
Engine Load, %	10.54993	10.69946	10.849	10.99854	11.15112	13.05237

P0300 Engine zero toque multiplier as a Function of Barometric Pressure table: 6.0L (LFA)

Baro (KPa)	65	70	75	80	85	90	95	100	105
Zero Torque Calibration Multiplier	0.824951	0.849976	0.875	0.900024	0.925049	0.949951	0.974976	1.0	1.025024

Knock Sensor Low Voltage Threshold (P0327

RPM Axis	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000	6500	7000
Threshold (Volts)	2.5940337	2.5940337	2.5940337	2.5940337	2.5940337	2.5940337	2.5940337	2.5940337	2.5940337	2.4414435	2.2888533	2.1362631	1.9836728	1.8310826

P0521 Engine Oil Pressure Rationality Weighting Factors								
Engine Speed								
0	500	900	1000	2000	3000	4000	5000	6000
0	0	0	0.45	0.45	0.45	0.46	0.44	0
Engine Load Stability								
0	5	10	20	30	50	100	200	399.25
1	1	0.5	0.30	0.00	0.00	0.00	0.00	0
Engine Oil Temperature								
-40	40	60	80	90	100	120	130	140
0.58	0.7	0.7	0.70	0.70	0.70	0.70	0.70	0
Engine Oil Pressure Predicted								
0	170	250	275	360	375	400	500	600
0	0	0.1	1.00	1.00	1.00	1.00	0.86	0

O2 Insufficient Switching (Half Cycle) Bank 1 Sensor 1 (P1133), O2 Insufficient Switching (Half Cycle) Bank 2 Sensor 2 (P1153)
Pass/Fail Thresholds - Number of Switches L-R or R-L as a function of Airflow and Ethanol Percentage

Airflow ↓ / Ethanol % →	0.0000%	9.9991%	19.9997%	50.000%	79.9988%
0.00 g/s	20	20	20	20	20
6.25 g/s	20	20	20	20	20

12.50 g/s	20	20	20	20	20
18.75 g/s	20	20	20	20	20
25.00 g/s	20	20	20	20	20
31.25 g/s	20	20	20	20	20
37.50 g/s	20	20	20	20	20
43.75 g/s	20	20	20	20	20
50.00 g/s	20	20	20	20	20
56.25 g/s	20	20	20	20	20
62.50 g/s	20	20	20	20	20
68.75 g/s	20	20	20	20	20
75.00 g/s	20	20	20	20	20
81.25 g/s	20	20	20	20	20
87.50 g/s	20	20	20	20	20
93.75 g/s	20	20	20	20	20
100.00 g/s	20	20	20	20	20

P0011 Stable position Timer vs Oil Temp

-16	**-4**	**8**	**20**	**32**	**44**	**56**	**68**	**80**	**92**	**104**	**116**	**128**	**140**	**152**	**Oil Temp**
20	8	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	5	7.5	9	**Time**

P0011 Error Offset vs Oil Temp

-16	**-4**	**8**	**20**	**32**	**44**	**56**	**68**	**80**	**92**	**104**	**116**	**128**	**140**	**152**	**Oil Temp**
															Error
10	8	8	8	8	8	8	8	8	8	8	8	8	10	10	**Limit**

P0442: Engine Off Time Before Vehicle Off Maximum as a Function of Temperature table

Temperature, deg C	-10	-4.375	1.25	6.875	12.5	18.125	23.75	29.375	35	40.625	46.25	51.875	57.5
Engine Off Time Before Vehicle Off Max, seconds	70	70	70	70	74	82	105	153	320	480	480	480	480

Temperature, deg C	63.125	68.75	74.375	80
Engine Off Time Before	480	480	480	480

Vehicle Off
Max, seconds

P0496: Purge Valve Leak Test Engine Vacuum Test Time (Cold Start) as a Function of Fuel Level table

Fuel Level, %	0	6.249905	12.49981	18.74971	24.99962	31.24952	37.49943	43.74933	49.99924	56.24914	62.49905	68.74895	74.99886
PVLT Eng Vacuum Test Time, seconds	60	60	60	60	60	60	60	60	50	50	50	50	50

Fuel Level, %	81.248766	87.498667	93.748567	99.998467
PVLT Eng Vacuum Test Time, seconds	40	40	40	40

Transfer Case HIGH Ratio Margin

Road Speed ► / Engine Torque ▼	0 km/hr	3 km/hr	5 km/hr	5.1 km/hr	12 km/hr	15 km/hr	18 km/hr	21 km/hr	24 km/hr
-200 N-m	8	8	8	0.1	0.1	0.1	0.1	0.1	0.1
-150 N-m	8	8	8	0.1	0.1	0.1	0.1	0.1	0.1
-100 N-m	8	8	8	0.1	0.1	0.1	0.1	0.1	0.1
-50 N-m	8	8	8	0.1	0.1	0.1	0.1	0.1	0.1
0 N-m	8	8	8	0.1	0.1	0.1	0.1	0.1	0.1
50 N-m	8	8	8	0.1	0.1	0.1	0.1	0.1	0.1
100 N-m	8	8	8	0.1	0.1	0.1	0.1	0.1	0.1
150 N-m	8	8	8	0.1	0.1	0.1	0.1	0.1	0.1
200 N-m	8	8	8	0.1	0.1	0.1	0.1	0.1	0.1

Transfer Case LOW Ratio Margin

Road Speed ►	0	3	5	5.1	12	15	18	21	24

Engine Torque ▼	km/hr	km/hr	km/hr	km/hr	km/hr	km/hr	km/hr	km/hr	km/hr
-200 N-m	8	8	8	0.1	0.1	0.1	0.1	0.1	0.1
-150 N-m	8	8	8	0.1	0.1	0.1	0.1	0.1	0.1
-100 N-m	8	8	8	0.1	0.1	0.1	0.1	0.1	0.1
-50 N-m	8	8	8	0.1	0.1	0.1	0.1	0.1	0.1
0 N-m	8	8	8	0.1	0.1	0.1	0.1	0.1	0.1
50 N-m	8	8	8	0.1	0.1	0.1	0.1	0.1	0.1
100 N-m	8	8	8	0.1	0.1	0.1	0.1	0.1	0.1
150 N-m	8	8	8	0.1	0.1	0.1	0.1	0.1	0.1
200 N-m	8	8	8	0.1	0.1	0.1	0.1	0.1	0.1

Transfer Case NEUTRAL Ratio Margin

Road Speed ► Engine Torque ▼	0 km/hr	3 km/hr	5 km/hr	5.1 km/hr	12 km/hr	15 km/hr	18 km/hr	21 km/hr	24 km/hr
-200 N-m	8	8	8	1	0.1	0.1	0.1	0.1	0.1
-150 N-m	8	8	8	1	1	1	0.5	0.5	0.5
-100 N-m	8	8	8	2	2	2	1	1	1
-50 N-m	8	8	8	4	4	4	2	2	2
0 N-m	8	8	8	8	8	8	8	8	8
50 N-m	8	8	8	4	4	4	2	2	2
100 N-m	8	8	8	2	2	2	1	1	1
150 N-m	8	8	8	1	1	1	0.5	0.5	0.5
200 N-m	8	8	8	1	0.1	0.1	0.1	0.1	0.1

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SENSED PARAMETER (P16F3)	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)		SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY			
	Sensed Value	Threshold		LoopRate	Fail Counter	Sample Counter	Time Length
Arbitrated predicted torque request	Desired engine torque request greater than redundant calculation plus threshold	67.78Nm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Cylinder deactivation mode	Cylinders active greater than commanded	1 cylinder	Engine speed greater than 0rpm and less than 3200rpm	LoRes	6	8	NA
Engine Minimum Capacity	Engine min capacity above threshold	67.78Nm	Ignition in unlock/accessory, run or crank	12p5ms	8	16	NA
No fast unmanaged retarded spark	No fast unmanaged retarded spark above the applied spark plus the threshold	3.42 crank degress	LoRes if engine rpm < 4500/4700rpm (hysteresis pair) 6.25ms if engine rpm >= 4500/4700rpm (hysteresis pair)	LoRes	6	8	NA
Temperature adjustment factor	Absolute difference of adjustment factor based on temperature and its dual store above threshold	2m/s	Ignition in unlock/accessory, run or crank	100ms	2	4	NA
1) Calculated engine speed 2) Lores event	1) Absolute difference of redundant calculated engine speed above threshold 2)Time between lores events and its dual store do not equal	1) Engine Speed RPM / Threshold (RPM) 0 / 1000 250 / 750 500 / 500 750 / 300 >1000 / 200	Engine speed greater than 0rpm	LoRes	6	8	NA
After throttle blade pressure	After throttle blade pressure and its dual store do not match	N/A	Ignition in unlock/accessory, run or crank	12p5ms	8	16	NA
Engine oil temperature	Engine oil temperature and its dual store do not equal	N/A	Ignition in unlock/accessory, run or crank	50ms	3	4	NA
Desired throttle position	Desired throttle position greater than redundant calculation plus threshold	8.41%	Ignition in unlock/accessory, run or crank	12p5ms	8	16	NA
Rate limited pre-throttle pressure	Absolute difference of the rate limited pre-throttle pressure and its redundant calculation greater than threshold	0.78 kpa/s	Ignition in unlock/accessory, run or crank	12p5ms	8	16	NA
Throttle desired torque	Throttle desired torque above desired torque plus threshold	1.0Nm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Desired filtered throttle torque	Desired filtered throttle torque exceeds the threshold plus the higher of desired throttle torque or modeled throttle torque	67.78Nm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Torque feedback proportional	Torque feedback proportional term is out of allowable range or its dual store copy does not match	High Threshold 33.89Nm Low Threshold -33.89Nm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA

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SENSED PARAMETER (P16F3)	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)		SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY			
	Sensed Value	Threshold		LoopRate	Fail Counter	Sample Counter	Time Length
Torque feedback integral	Torque feedback integral term magnitude or rate of change is out of allowable range or its dual store copy does not match	High Threshold 67.78Nm Low Threshold -67.78Nm Rate of change threshold 8.47Nm/loop	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Proportional/Integral Torque	Difference of Final Torque feedback proportional plus integral term and its redundant calculation is out of bounds given by threshold range	High Threshold 1.0Nm Low Threshold -1.0Nm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Torque desired throttle area	Difference of torque desired throttle area and its redundant calculation is out of bounds given by threshold range	High Threshold 0.5% Low Threshold -0.5%	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Torque model coefficients	Difference of torque model coefficients and its redundant calculation is out of bounds given by threshold range	High Threshold 1.0 Low Threshold -1.0	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Base friction torque	Difference of base friction torque and its redundant calculation is out of bounds given by threshold range	High Threshold 1.0Nm Low Threshold -1.0Nm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Accessory drive friction torque	Accessory drive friction torque is out of bounds given by threshold range	High Threshold 67.78Nm Low Threshold 0.0Nm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
AC friction torque	AC friction torque is out of bounds given by threshold range	High Threshold 67.78Nm Low Threshold 0.0Nm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Oil temperature delta firction torque	Difference of Oil temperature delta friction torque and its redundant calculation is out of bounds given by threshold range	High Threshold 1.0Nm Low Threshold -1.0Nm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Generator friction torque	Generator friction torque is out of bounds given by threshold range	High Threshold 67.78Nm Low Threshold 0.0Nm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Supercharger friction torque	Supercharger friction torque is out of bounds given by threshold range	High Threshold 67.78Nm Low Threshold 0.0Nm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Filtered Torque error	Filtered Torque error magnitude or its increase rate of change is out of allowable range or its dual store copy does not match	High Threshold 67.78Nm Low Threshold -67.78Nm Rate of change threshold 8.35Nm/loop	Engine speed >0rpm MAF, MAP and Baro DTCs are false	25ms	4	8	NA
Torque error compensation	Torque error compensation is out of bounds given by threshold range	High Threshold 67.78Nm Low Threshold 0.0Nm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Delta torque baro compensation	Delta Torque Baro compensation is out of bounds given by threshold range	High Threshold 16.34Nm Low Threshold -12.42Nm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA

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SENSED PARAMETER (P16F3)	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)		SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY			
	Sensed Value	Threshold		LoopRate	Fail Counter	Sample Counter	Time Length
	1) Difference of reserve torque value and its redundant calculation exceed threshold 2) Reserve request does not agree with operating conditions 2) Difference of final predicted torque and its redundant calculation exeed threshold 3) Rate of change of reserve torque exceeds threshold, increasing direction only 4) Reserve engine torque above allowable capacity by the threshold	1) 67.78Nm 2) NA 3) 67.78Nm 4) 67.78Nm	1&2) Torque reserve (condition when spark control greater than optimum to allow fast transitions for torque disturbances) > 10 3&4) Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Equivalence ratio spark	Absolute difference of the calculated spark offset for equivalence ratio and its redundant calculation greater than threshold	3.42 degress	Engine speed >0rpm	LoRes if engine rpm < 2900rpm 12.5ms if engine rpm >= 2900rpm	6	8	NA
Engine Vacuum	Engine Vacuum and its dual store do not match	N/A	Ignition in unlock/accessory, run or crank	12p5ms	8	16	NA
Intake Manifold Pressure	Absolute difference of the calculated Intake Mainfold Pressure during engine event versus during time event is greater than threshold	18 kPa	Engine speed >0rpm	LoRes	6	8	NA
Min. Axle Torque Capacity	Min. Axle Torque Capacity is greater than threshold	2088 Ntm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Predicted engine torque for zero pedal determination	Predicted torque for zero pedal determination is greater than threshold	30 Ntm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Commanded Predicted Axle Torque	Commanded Predicted Axle Torque and its dual store do not match	1 Ntm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Steady State Estimated Engine Torque	Steady State Estimated Engine Torque and its dual store are not equal	N/A	DoD not changing from Active to Inactive and preload torque not changing and one loop after React command Engine speed >0rpm	25ms	4	8	NA
Weighting factor for number of cylinders fueled	Difference of Weighting factor for number of cylinders fueled and its redundant calculation is above threshold	0.09	Engine run flag = TRUE > 1s	25ms	4	8	NA
minimum spark advance limit	Difference of minimum spark advance limit and its redundant calculation is out of bounds given by threshold range	3.421875 degrees	Ignition in unlock/accessory, run or crank	12.5ms if engine rpm < 4500rpm 50ms if engine rpm >=	6	8	NA

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SENSED PARAMETER (P16F3)	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)		SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY			
	Sensed Value	Threshold		LoopRate	Fail Counter	Sample Counter	Time Length
				4500rpm			
Commanded spark advance	Difference of commanded spark advance and adjusted delivered is out of bounds given by threshold range	3.421875 degrees	Engine speed >0rpm	LoRes if engine rpm < 4500/4700rpm (hysteresis pair) 6.25ms if engine rpm >= 4500/4700rpm (hysteresis pair)	6	8	NA
Estimated Engine Torque	Estimated Engine Torque and its dual store are not match	67.78 Ntm	Engine speed >0rpm	25ms	4	8	NA
Estimated Engine Torque without reductions due to torque control	Estimated Engine Torque without reductions due to torque control and its dual store are not match	67.78 Ntm	Engine speed >0rpm	25ms	4	8	NA
Commanded Engine Torque from Hybrid control module	Commanded Engine Torque from Hybrid control module and its dual store are not equal	N/A	Ignition in unlock/accessory, run or crank	12p5ms	5	15	NA
desired spark advance for managed torque	Difference of desired spark advance for managed torque and its redundant calculation is out of bounds given by threshold range	3.421875 degrees	Torque reserve (condition when spark control greater than optimum to allow fast transitions for torque disturbances) > 67.78	LoRes if engine rpm < 4500/4700rpm (hysteresis pair) 6.25ms if engine rpm >= 4500/4700rpm (hysteresis pair)	6	8	NA
Engine Capacity Minimum Running Immediate Brake Torque Excluding Cylinder Sensitivity	Absolute difference of Engine Capacity Minimum Running Immediate Brake Torque Excluding Cylinder Sensitivity and its redundant calculation is out of bounds given by threshold range	67.78 Ntm	Engine speed >0rpm	25ms	4	8	NA
One step ahead calculation of air-per-cylinder	One step ahead calculation of air-per-cylinder and its dual store do not match	41 gm/s	Engine speed >0rpm	LoRes	6	8	NA
One step ahead calculation of air-per-cylinder	One step ahead calculation of air-per-cylinder greater than two step ahead calculation by threshold for time	Threshold: Dynamically calculated based on current engine conditions Fault Pending Threshold: 100ms Fault Active Threshold: 175 ms	Engine speed > 500rpm	LoRes	NA	NA	175ms

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SENSED PARAMETER (P16F3)	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)		SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY			
	Sensed Value	Threshold		LoopRate	Fail Counter	Sample Counter	Time Length
Rate limited cruise axle torque request	Rate limited cruise axle torque request and its dual store do not match	261 Nm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Calculated accelerator pedal position	1) Absolute difference of Calculated accelerator pedal position compensated for carpet learn and error conditions and its redundant calculation is out of bounds given by threshold range 2) Absolute difference of Calculated accelerator pedal position compensated for carpet learn and error conditions and its dual store do not equal 3) Absolute difference of Calculated accelerator pedal position and its dual store do not equal	1) 1% 2) NA 3) NA	Ignition in unlock/accessory, run or crank	12p5ms	8	16	NA
Commanded axle torque	Commanded axle torque is greater than its redundant calculation by threshold	2088 Ntm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Commanded axle torque	Commanded axle torque is less than its redundant calculation by threshold	3158 Ntm	Ignition in unlock/accessory, run or crank Redundant commanded axle torque < -3158 Ntm	25ms	4	8	NA
Preload Throttle Area	Preload Throttle Area is greater than its redundant calculation by threshold	0.1%	Engine speed >0rpm	LoRes	6	8	NA
Preload timer	Preload timer and its redundant calculation do not equal	NA	Ignition in unlock/accessory, run or crank	LoRes	6	8	NA
Preload Throttle Area	Preload Throttle Area and its dual store do not equal	NA	Ignition in unlock/accessory, run or crank	LoRes	6	8	NA
Commanded engine torque due to fast actuators	Commanded engine torque due to fast actuators and its dual store do not equal	NA	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Commanded engine torque due to slow actuators	Commanded engine torque due to slow actuators and its dual store do not equal	NA	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Signed filtered defaulted output speed calculated from TOS	Signed filtered defaulted output speed calculated from TOS and its dual store do not equal	NA	Hybrid control module only Ignition in unlock/accessory, run or crank	25ms	5	15	NA
Arbitrated Air-Per-Cylinder filter coefficient	Arbitrated Air-Per-Cylinder filter coefficient is out of bounds given by threshold range	High Threshold 1.0 Low Threshold -1.0	Ignition in unlock/accessory, run or crank	25ms	4	8	NA

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SENSED PARAMETER (P16F3)	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)		SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY			
	Sensed Value	Threshold		LoopRate	Fail Counter	Sample Counter	Time Length
Shaped driver axle torque	Shaped driver axle torque is out of bounds given by threshold range	High Threshold 2088 Ntm Low Threshold -3132 Ntm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Launch spark active	Launch spark is active but the launch spark redundant path indicates it should not be active	NA	Engine speed < 4700 or 4500 rpm (hysteresis pair)	12p5ms	6	8	NA
Rate limited vehicle speed	Rate limited vehicle speed and its dual store do not equal	NA	Time since first CAN message with vehicle speed >= 500 ms	25ms	4	8	NA
transfer case neutral	transfer case neutral request from four wheel drive logic does not match with operating conditions	NA	Ignition in unlock/accessory, run or crank Transfer case range valid and not over-ridden	25ms	4	8	NA
transfer case neutral	transfer case neutral and its dual store do not equal	NA	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Throttle progression mode	Throttle progression mode and its dual store do not equal	NA	Ignition in unlock/accessory, run or crank	12p5ms	8	16	NA
TOS to wheel speed conversion factor	TOS to wheel speed conversion factor is out of bounds given by threshold range	High Threshold 1.1 Low Threshold 0.1	Ignition in unlock/accessory, run or crank		5	15	NA
TOS to wheel speed conversion factor	TOS to wheel speed conversion factor and its dual store do not equal	NA	Ignition in unlock/accessory, run or crank		5	15	NA
Fuel injectors commanded	Cylinders active greater than commanded	2 cylinders	Engine run flag = TRUE > 2s Number of cylinder events since engine run > 24 No fuel injector faults active	LoRes	4	8	NA
Friction torque	Absolute difference of Friction torque and its redundant calculation is out of bounds given by threshold range	67.78 Ntm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Accessory torque	Absolute difference of Accessory torque and its redundant calculation is out of bounds given by threshold range	67.78 Ntm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Filtered Air-per-cylinder	Absolute difference of Filtered Air-per-cylinder and its redundant calculation is out of bounds given by threshold range	41 mgm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Final spark advance	Absolute difference between the previous Final Advance and the current Final Advance not Adjusted for Equivalence Ratio is out of bounds given by threshold range	3.42 degress		LoRes if engine rpm < 4500/4700rpm (hysteresis pair) 6.25ms if engine rpm >= 4500/4700rpm (hysteresis pair)	6	8	NA

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SENSED PARAMETER (P16F3)	MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)		SECONDARY PARAMETERS AND ENABLE CONDITIONS	TIME LENGTH AND FREQUENCY			
	Sensed Value	Threshold		LoopRate	Fail Counter	Sample Counter	Time Length
Equivance Ratio torque compensation	Equivance Ratio torque compensation exceeds threshold	-67.78 Ntm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Equivance Ratio torque compensation	Absolute difference between Equivance Ratio torque compensation and its dual store out of bounds given bt threshold	67.78 Ntm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Zero pedal axle torque	Zero pedal axle torque is out of bounds given by threshold range	High Threshold 2088 Ntm Low Threshold -1500 Ntm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA
Creep Coast Axle Torque	Creep Coast Axle Torque is out of bounds given by threshold range	High Threshold 2088 Ntm Low Threshold -1500 Ntm	Ignition in unlock/accessory, run or crank	25ms	4	8	NA