| 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 |
|---|---|---|---|---|---|---|
| Intake Camshaft Position Actuator Solenoid Control Circuit Bank 1 | 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<br>Ignition switch is in crank or run<br>11 volts < Ignition Voltage < 18 volts | 20 failures out of 25 samples<br><br>250ms loop continuous | DTC Type B |
| Intake Camshaft Position System Performance Bank 1 | 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)] > 6° (All Table Positions)<br><br>Table is a function of Engine RPM and Oil Temperature | Engine is running<br>VVT is enabled<br>Desired camshaft position > 0<br>Δ Desired Camshaft position < 3° for 3.0 seconds (Table is a function of Engine RPM and Oil Temperature)<br>11 volts ≤ System voltage ≤ 18 volts<br>Power Take Off (PTO) not active<br>DTCs not active for the following sub-systems:<br>Cam sensors<br>Crank sensors<br>Cam to crank rationality<br>Cam phase output drivers | 135 fail counts out of 150 sample counts<br><br>100ms loop<br>Continuous | DTC Type B |
| Exhaust Camshaft Position Actuator Solenoid Control Circuit Bank 1 | P0013 | This DTC checks the circuit for electrical integrity during operation. | The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match. | Output driver commanded on<br>Ignition switch is in crank or run<br>11 volts < Ignition Voltage < 18 volts | 20 failures out of 25 samples<br>250ms loop continuous | DTC Type B |
| Exhaust Camshaft Position System Performance Bank 1 | P0014 | Detects a VVT system error by comparing the desired and actual cam positions when VVT is activated | Camshaft position error [absolute value of (desired position - actual position)] > 6° (All Table Positions)<br><br>Table is a function of Engine RPM and Oil Temperature | Engine is running<br>VVT is enabled<br>Desired camshaft position > 0<br>Δ Desired Camshaft position < 3° for 3.0 seconds (Table is a function of Engine RPM and Oil Temperature)<br>11 volts ≤ System voltage ≤ 18 volts<br>Power Take Off (PTO) not active<br>DTCs not active for the following sub-systems:<br>Cam sensors<br>Crank sensors<br>Cam to crank rationality | 135 fail counts out of 150 sample counts<br><br>100ms loop<br>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<br>• 11 volts < Ignition Voltage < 18 volts<br>• RPM > 425 | 120 failures out of 150 samples<br><br>Frequency:<br>250ms loop<br>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<br>• 11 volts < Ignition Voltage < 18 volts<br>• RPM > 425 | 120 failures out of 150 samples<br><br>Frequency:<br>250ms loop<br>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. | 2.6922 Ω < Calculated Heater resistance < 7.6922 Ω | Coolant – IAT < 8ºC<br>Engine Soak Time > 36000 Seconds<br>-30 ºC < Coolant Temp < 45ºC<br>Coolant Fault = Not Active<br>Ignition Off Fault = Not Active<br>Intake Air Temp Fault = Not Active<br>Ignition Voltage < 18 volts<br>• | 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. | 6.7695 Ω< Calculated Heater resistance < 17.404 Ω | Coolant – IAT < 8ºC<br>Engine Soak Time > 36000 Seconds<br>-30 ºC < Coolant Temp < 45ºC<br>Coolant Fault = Not Active<br>Ignition Off Fault = Not Active<br>Intake Air Temp Fault = Not Active<br>Ignition Voltage < 18 volts<br>• | Once per valid cold start. | DTC Type B |
| 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<br>• No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTCs<br>• Catalyst monitor diagnostic Intrusive Test = Not Active<br>• Post Oxygen Sensor Diagnostic Intrusive Test = Not Active<br>• Traction Control, AIR, Fuel, Idle, EGR, and Engine Not Overspeed Intrusive Tests = Not Active<br>• 10 volts < system voltage < 18 volts<br>• EGR, Idle, Fuel Inj., and AIR Device controls = Not Active<br>• Fuel level > 10 % during 30 sec<br>• Not Hybrid engine off<br>• 10 Voltage > system voltage > 18 voltage during 5 sec<br><br>Specific Enable Criteria<br>• 0.98047 ≤ Equivalence ratio ≤ 1.020020<br>• 15 % ≤ throttle position ≤ 50 %<br>• Fuel state = closed loop with no fault pending<br>• All fuel injectors = ON<br>• Traction Control = not active<br><br>All of the above met for at least 5 seconds | 240 test failures in a 300-sample test for 1 consecutive test(s)<br><br>Frequency:<br>Continuous<br>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 1 Sensor 1 | P0132 | This DTC determines if the O2 sensor or circuit is shorted to high. | O2 sensor voltage > 1200 millivolts to go fault pending<br><br>O2 sensor voltage > 1200 millivolts to set DTC | Common Enable Criteria<br>• No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTCs<br>• Catalyst monitor diagnostic Intrusive Test = Not Active<br>• Post Oxygen Sensor Diagnostic Intrusive Test = Not Active<br>• Traction Control, AIR, Fuel, Idle, EGR, and Engine Not Overspeed Intrusive Tests = Not Active<br>• 10 volts < system voltage < 18 volts<br>• EGR, Idle, Fuel Inj., and AIR Device controls = Not Active<br>• Fuel level > 10 % during 30 sec<br>• Not Hybrid engine off<br>• 10 Voltage < system voltage < 18 voltage during 5 sec<br><br>Specific Enable Criteria<br>• 0.98047 ≤ Equivalence ratio ≤ 1.020020<br>• 0 % ≤ throttle position ≤ 50 %<br>• Fuel state = closed loop with no fault pending<br>• All fuel injectors = ON<br>• Traction Control = not active<br><br>All of the above met for at least 5 seconds | 90 test failures in a 100 sample test for 1 consecutive tests<br><br>Frequency:<br>Continuous<br>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)"** In Lookup Tables section. | Common Enable Criteria<br>• No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTCs<br>• Catalyst monitor diagnostic Intrusive Test = Not Active<br>• Post Oxygen Sensor Diagnostic Intrusive Test = Not Active<br>• Traction Control, AIR, Fuel, Idle, EGR, and Engine Not Overspeed Intrusive Tests = Not Active<br>• 10 volts < system voltage < 18 volts<br>• EGR, Idle, Fuel Inj., and AIR Device controls = Not Active<br><br>Specific Enable Criteria<br>• O2 Heater on for ≥ 0 seconds<br>• B1S1 DTCs = Not Active<br>• B1S1 learned heater resistance is valid<br>• Misfire DTC = Not Active<br>• ECT > 70 °C<br>• IAT > -40 °C<br>• Engine run time > 200 seconds<br>• Engine run time since test enable > 5 seconds<br>• EVAP Canister purge duty cycle ≥ 0 %<br>• 15 grams per second ≤ MAF ≤ 50 grams per second<br>• 1000 ≤ RPM ≤ 3500<br>• Ethanol percentage < 85 %<br>• Baro > 70 kPa<br>• Throttle position ≥ 5 %<br>• Fuel Level > 10 %<br>• Fuel state = closed loop<br>• No fuel level data faults<br>• Transmission (automatic) not in Park, Reverse or Neutral<br>• Transmission gear selection is not defaulted<br>• Baro is not defaulted<br>• Not Hybrid engine off<br><br>All of the above met for at least 1 seconds. | 60 seconds<br><br>Frequency:<br>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 Circuit Insufficient Activity Bank 1 Sensor 1 | P0134 | This DTC determines if the O2 sensor circuit is open. | 400 millivolts < O2 sensor < 500 millivolts for regular open test<br><br>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<br>• No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTCs<br>• Catalyst monitor diagnostic Intrusive Test = Not Active<br>• Post Oxygen Sensor Diagnostic Intrusive Test = Not Active<br>• Traction Control, AIR, Fuel, Idle, EGR, and Engine Not Overspeed Intrusive Tests = Not Active<br>• 10 volts < system voltage < 18 volts<br>• EGR, Idle, Fuel Inj., and AIR Device controls = Not Active<br><br>Specific Enable Criteria<br>• Engine run time > 200 seconds<br>• Ethanol percentage > 84.899%<br>• No B1S1 heater related DTCs<br>• PCM State = run<br>• Fuel state = closed loop<br><br>Fast Pass:<br>• Engine run time > 100 seconds<br>• Engine run time since test enable > 5seconds<br><br>(Fast pass cannot report a fail; if Fast pass fails, the regular open test is run) | 240 test failures in a 300 test samples<br><br>Frequency:<br>Continuous for pre catalyst sensors<br>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 1 Sensor 1 | P0135 | This DTC determines if the O2 sensor heater is functioning properly by monitoring the current through the heater circuit. | O2 sensor heater current is < 0.25 amps or > 2.5 amps | Common Enable Criteria<br>• No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTCs<br>• Catalyst monitor diagnostic Intrusive Test = Not Active<br>• Post Oxygen Sensor Diagnostic Intrusive Test = Not Active<br>• Traction Control, AIR, Fuel, Idle, EGR, and Engine Not Overspeed Intrusive Tests = Not Active<br>• 10 volts < system voltage < 18 volts<br>• EGR, Idle, Fuel Inj., and AIR Device controls = Not Active<br><br>Specific Enable Criteria<br>• Engine Run Time ≥ 60 seconds<br>• Engine Run time since test enable ≥ 30 seconds<br>• ECT ≥ 70° C<br>• 500 ≤ Engine Rpm ≤ 3000<br>• 5 grams per second ≤ Mass Airflow ≤ 25 grams per second<br>• O2 heater not in Device control<br>• B1S1 O2 heater resistance DTC not active<br><br>All of the above met for at least 2 seconds | 45 test failures in 50 test samples<br><br>Frequency:<br>2 tests per trip<br>30 seconds delay between tests<br>30 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<br>• No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTCs<br>• Catalyst monitor diagnostic Intrusive Test = Not Active<br>• Post Oxygen Sensor Diagnostic Intrusive Test = Not Active<br>• Traction Control, AIR, Fuel, Idle, EGR, and Engine Not Overspeed Intrusive Tests = Not Active<br>• 10 volts < system voltage < 18 volts<br>• EGR, Idle, Fuel Inj., and AIR Device controls = Not Active<br>• Fuel level > 10 % during 30 sec<br>• Not Hybrid engine off<br>• 10 Voltage > system voltage > 18 voltage during 5 sec<br><br>Specific Enable Criteria<br>• 0.98047 ≤ Equivalence ratio ≤ 1.020020<br>• 15 % ≤ throttle position ≤ 50 %<br>• Fuel state = closed loop with no fault pending<br>• All fuel injectors = ON<br>• Traction Control = not active<br><br>All of the above met for at least 5 seconds | 240 test failures in a 300-sample test for 1 consecutive tests<br><br>Frequency:<br>Continuous<br>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 1 Sensor 2 | P0138 | This DTC determines if the O2 sensor or circuit is shorted to high or stuck in a normal voltage range and thereby can no longer be used for post oxygen sensor fuel control or for catalyst monitoring. | O2 sensor voltage > 1200 millivolts to go fault pending<br><br>O2 sensor voltage > 1200 millivolts to set DTC<br><br>OR<br><br>O2 sensor voltage > 100 millivolts during DFCO | Common Enable Criteria<br>• No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTCs<br>• Catalyst monitor diagnostic Intrusive Test = Not Active<br>• Post Oxygen Sensor Diagnostic Intrusive Test = Not Active<br>• Traction Control, AIR, Fuel, Idle, EGR, and Engine Not Overspeed Intrusive Tests = Not Active<br>• 10 volts < system voltage < 18 volts<br>• EGR, Idle, Fuel Inj., and AIR Device controls = Not Active<br>• Fuel level > 10 % during 30 sec<br>• Not Hybrid engine off<br>• 10 Voltage < system voltage < 18 voltage during 5 sec<br><br>Specific Enable Criteria for High voltage test<br>• 0.98047 ≤ Equivalence ratio ≤ 1.020020<br>• 0 % ≤ throttle position ≤ 50 %<br>• Fuel state = closed loop with no fault pending<br>• All fuel injectors = ON<br>• Traction Control = not active<br><br>All of the above met for at least 5 seconds<br><br>Specific Enable Criteria for DFCO test<br>• Engine run time > 255 seconds<br>• Ethanol percentage > 85%<br>• DFCO state = RampDone<br><br>All of the above met for at least 10 seconds | 320 test failures in a 400 sample test for 1 consecutive tests for High voltage test<br><br>45 test failures in a 50 sample test for 1 consecutive tests for DFCO test<br><br>Frequency:<br>Continuous<br>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. | 400 millivolts < O2 sensor < 500 millivolts for regular open test<br><br>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<br>• No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTCs<br>• Catalyst monitor diagnostic Intrusive Test = Not Active<br>• Post Oxygen Sensor Diagnostic Intrusive Test = Not Active<br>• Traction Control, AIR, Fuel, Idle, EGR, and Engine Not Overspeed Intrusive Tests = Not Active<br>• 10 volts < system voltage < 18 volts<br>• EGR, Idle, Fuel Inj., and AIR Device controls = Not Active<br><br>Specific Enable Criteria<br>• Engine run time > 200 seconds<br>• Ethanol percentage > 84.899%<br>• No B1S2 heater related DTCs<br>• PCM State = run<br>• Fuel state = closed loop<br><br>Fast Pass:<br>• Engine run time > 100 seconds<br>• Engine run time since test enable > 5seconds<br><br>(Fast pass cannot report a fail; if Fast pass fails, the regular open test is run) | 250 test failures in a 300 test samples<br><br>Minimum of 3 occurrences of a delta TP sensor ≥ 1 % during diagnostic test<br><br>(sample counts – failure counts) < 60 within 100 seconds of engine run time to fail the fast pass test (regular open test is run when fast pass fails; to fail DTC the regular open test must fail)<br><br>Frequency:<br>Once/trip for post catalyst sensors<br>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 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 > 2.5 amps | Common Enable Criteria<br>• No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTCs<br>• Catalyst monitor diagnostic Intrusive Test = Not Active<br>• Post Oxygen Sensor Diagnostic Intrusive Test = Not Active<br>• Traction Control, AIR, Fuel, Idle, EGR, and Engine Not Overspeed Intrusive Tests = Not Active<br>• 10 volts < system voltage < 18 volts<br>• EGR, Idle, Fuel Inj., and AIR Device controls = Not Active<br><br>Specific Enable Criteria<br>• Engine Run Time ≥ 60 seconds<br>• Engine Run time since test enable ≥ 30 seconds<br>• ECT ≥ 70° C<br>• 500 ≤ Engine Rpm ≤ 3000<br>• 5 grams per second ≤ Mass Airflow ≤ 25 grams per second<br>• O2 heater not in Device control<br>• B1S2 O2 heater resistance DTC not active<br><br>All of the above met for at least 2 seconds | 40 test failures in 50 test samples<br><br>Frequency:<br>2 tests per trip<br>30 seconds delay between tests<br>30 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. | The EWMA of long term fuel trim (LTM) samples ≥ 1.185<br><br>(Note: EWMA stands for "Exponentially Weighted Moving Average")<br><br>Notes:<br>1. At least 10 seconds of data must accumulate on each trip before the EWMA of LTM samples is considered usable and at least 35 seconds) of data in the current fuel trim cell must accumulate on each trip before the LTM for that cell is considered usable in the EWMA calculation. | • No Misfire DTCs<br>• No O2 Sensor DTCs<br>• No EVAP DTCs<br>• No Fuel Injector DTCs<br>• No Fuel Temperature or Composition DTCs<br>• No IAC, MAF, or MAP DTCs<br>• No ECT DTCs<br>• No EGR DTCs<br>• No A.I.R. DTCs<br>• No TP Sensor or TAC System DTCs<br>• Engine speed > 400 rpm but < 6100 rpm<br>• BARO > 70 kPa<br>• ECT > -38°C but < 130°C<br>• MAP > 15 kPa but < 105 kPa<br>• IAT > -20 °C but < 150°C<br>• Mass Airflow > 1.0g/s but < 512 g/s<br>• Vehicle speed < 132 kph<br>• Closed Loop Fueling<br>• Long Term Fuel Trim Learning enabled<br>• Not in Device Control<br>• Catalyst Monitor Diagnostic Intrusive Test = Not Active<br>• Post O2 Diagnostic Intrusive Test = Not Active<br>• Evap diagnostic is at any stage except the "tank pull down" portion of the test.<br>• Fuel Level > 10 % (must be < 10% for at least30 seconds to disable; default is to enable if fuel sender is broken) | Frequency:<br>Continuous<br>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. | The EWMA of long term fuel trim (LTM) samples $\leq$ 0.82<br><br>Once the above occurs, purge is ramped off to determine if excess purge is the cause. Therefore, the following must also occur to report a failure:<br><br>The EWMA of LTM samples with purge off $\leq$ 0.810 during 2 of 3 intrusive segments.<br><br>General Notes:<br>1. At least 10 seconds of data must accumulate on each trip before the EWMA of LTM samples is considered usable and at least 35 seconds of data in the current fuel trim cell must accumulate on each trip before the LTM for that cell is considered usable in the EWMA calculation.<br><br>Intrusive Notes:<br>1. Segments can last up to 60 seconds, and are separated by the smaller of a 20 second purge-on time or enough time to purge 6 grams of vapor.<br><br>2. A maximum of 3 completed segments are allowed for each intrusive test, and up to 30 intrusive attempts allowed per trip.<br><br>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 LTM samples $\geq$ 0.75 for at least 10 seconds, indicating that the canister has been purged. Performing intrusive tests too frequently may also affect EVAP and FTP emissions, and the execution frequency of other diagnostics. | • No Misfire DTCs<br>• No O2 Sensor DTCs<br>• No EVAP DTCs<br>• No Fuel Injector DTCs<br>• No Fuel Temperature or Composition DTCs<br>• No IAC, MAF, or MAP DTCs<br>• No ECT DTCs<br>• No EGR DTCs<br>• No A.I.R. DTCs<br>• No TP Sensor or TAC System DTCs<br>• Engine speed > 400 rpm but < 6100 rpm<br>• BARO > 70 kPa<br>• ECT > -38°C but < 130°C<br>• MAP > 15 kPa but < 105 kPa<br>• IAT > -20 °C but < 150°C<br>• Mass Airflow > 1.0g/s but < 512 g/s<br>• Vehicle speed < 132 kph<br>• Closed Loop Fueling<br>• Long Term Fuel Trim Learning enabled<br>• Not in Device Control<br>• Catalyst Monitor Diagnostic Intrusive Test = Not Active<br>• Post O2 Diagnostic Intrusive Test = Not Active<br>• Evap diagnostic is at any stage except the “tank pull down” portion of the test.<br>• Fuel Level > 10 % (must be < 10% for at least30 seconds to disable; default is to enable if fuel sender is broken)<br>Intrusive Enable Criteria<br>• The EWMA of long term fuel trim (LTM) samples $\leq$ 0.82<br>• RPM > 400<br>• Mass Airflow > 1.0 g/s but < 512 g/s<br>• MAP > 15.2 kPa but < 105 kPa<br><br>Temporary Intrusive Test Inhibit Criteria<br>• If intrusive test segment exceeds 60 consecutive seconds. (In this case, purge valve is opened for the smaller of 20 seconds or enough time to purge 6 grams vapor) | If rich fail counter is ≥ 2 before pass counter ≥ 2, diagnostic fails.<br><br>Frequency:<br>Continuous<br>100 ms loop | DTC Type B |
| Injector 1 Control Circuit | P0201 | 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<br>18 volts > Ignition voltage > 11 volts<br>Condition stable > 1 seconds | 20 failures out of 25 samples<br>250ms loop 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 |
|---|---|---|---|---|---|---|
| Injector 2 Control Circuit | P0202 | 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<br>18 volts > Ignition voltage > 11 volts<br>Condition stable > 1 seconds | 20 failures out of 25 samples<br>250ms loop continuous | DTC Type B |
| Injector 3 Control Circuit | P0203 | 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<br>18 volts > Ignition voltage > 11 volts<br>Condition stable > 1 seconds | 20 failures out of 25 samples<br>250ms loop continuous | DTC Type B |
| Injector 4 Control Circuit | P0204 | 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<br>18 volts > Ignition voltage > 11 volts<br>Condition stable > 1 seconds | 20 failures out of 25 samples<br>250ms loop continuous | DTC Type B |
| Fuel Pump Primary Circuit | 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. | Engine speed > 0 rpm.<br>Ignition voltage > 11 volts, but < 18 volts | 8 failures out of 10 samples<br>250ms loop continuous | DTC Type B |
| Knock Sensor (KS) Module Performance | P0324 | This diagnostic will detect a failed internal ECM component associated with knock control | The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match. | PTO not active | 50 fails out of 63 samples<br><br>100ms sample rate<br>Continuous | DTC Type B |
| Knock Sensor (KS) Circuit Bank 1 | P0325 | This diagnostic checks for an open to the knock sensor | The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match. | Coolant>60 C and<br>Engine Run Time > 30 sec<br>PTO not active | 50 fails out of 100 samples<br><br>100ms sample rate<br>Continuous | DTC Type B |
| Knock Sensor (KS) Performance Bank 1 | P0326 | This diagnostic checks for an overactive knock sensor caused by noisy engine components (e.g. lifters) | Fast Retard ≥ 8 degrees | Engine Speed ≥ 1800 RPM<br>MAP ≥ 55 kPa<br>No throttle fault<br>No PTO active<br>Fast spark retard active | 30 fails out of<br>63 samples<br><br>100ms sample rate<br>Continuous | DTC Type B |
| Knock Sensor (KS) Circuit Low Bank 1 | P0327 | This diagnostic checks for an out of range low knock sensor signal | The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match. | Coolant>60 C and<br>Engine Run Time > 30 sec<br>PTO not active | 50 fails out of 100 samples<br><br>100ms sample rate<br>Continuous | DTC Type B |
| Knock Sensor (KS) Circuit High Bank 1 | P0328 | This diagnostic checks for an out of range high knock sensor signal | The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match. | Coolant>60 C and<br>Engine Run Time > 30 sec<br>PTO not active | 50 fails out of 100 samples<br><br>100ms sample rate<br>Continuous | DTC Type B |
| Ignition Control #1 Circuit | P0351 | This DTC checks the circuit for electrical integrity during operation. Monitors EST for Cylinder 1 | The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match. | Ignition voltage > 6 Volts | 50 fails out of 63 samples<br><br>100ms sample rate<br><br>Continuous | DTC Type B |
| Ignition Control #2 Circuit | P0352 | This DTC checks the circuit for electrical integrity during operation. Monitors EST for Cylinder | The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match. | Ignition voltage > 6 Volts | 50 fails out of 63 samples<br><br>100ms sample rate<br><br>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 |
|---|---|---|---|---|---|---|
| Ignition Control #3 Circuit | P0353 | This DTC checks the circuit for electrical integrity during operation. Monitors EST for Cylinder | The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match. | Ignition voltage > 6 Volts | 50 fails out of 63 samples<br><br>100ms sample rate<br><br>Continuous | DTC Type B |
| Ignition Control #4 Circuit | P0354 | This DTC checks the circuit for electrical integrity during operation. Monitors EST for Cylinder 4 | The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match. | Ignition voltage > 6 Volts | 50 fails out of 63 samples<br><br>100ms sample rate<br><br>Continuous | DTC Type B |
| Evaporative Emission (EVAP) System Small Leak Detected (EONV) | 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:***<br>Engine Off Natural Vacuum (EONV) while the engine is off.<br>The total pressure change achieved during the test is normalized against a target value that is based upon fuel level and ambient temperature. (The pressure change for this application is set to 411 Pa for all fuel level and ambient conditions). 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.<br><br>Fail threshold = 0.6<br>Re-Pass threshold = 0.35 | ***TEST ENABLE :***<br>No MAP DTC's<br>No Thermostat Rationality DTC's<br>VS Sensor DTC's not active<br>No Fuel Tank Pressure Sensor circuit DTC's<br>No EVAP Canister Purge Solenoid circuit DTC's<br>No EVAP Canister Vent Solenoid circuit DTC's<br>No Fuel Level DTC's<br>Coolant Sensor DTC's not active<br>IAT Sensor DTC's not active<br>EVAP CCP stuck open DTC not active.<br>EVAP large leak DTC not active.<br>Ignition off timer DTC not active.<br>Canister Vent restriction DTC is not active<br>Fuel Level >15.0% but < 85.0%<br>Drive time >= 600 seconds.<br>**Drive length >= 16.1 kilometers.**<br>**Hybrid Engine Off time < 91 sec**<br>Coolant >= 70°C.<br>No fuel filling (fuel level increment >= 10%) During EONV test.<br>BARO > 74.0kPa<br>Estimated ambient temperature at end of drive > 0°C but < 34°C.<br><br>Estimate of Ambient Air Temperature Valid Conditions to be valid<br>• Cold Start<br>Startup Δ°C (ECT-IAT) < 8°C if ECT > IAT<br>OR<br>• Hot Restart<br>Sufficient drive length to get accurate estimate of ambient air temperature (at least a minimum of 16.1 kilometers and 16.1 kilometers) | Once per trip, during hot soak (up to 2400 sec.).<br>Time since last complete test >= 17 hours if EWMA is passing, or >= 10 hours if EWMA is failing.<br>No more than 2 attempts per day. | DTC Type A EWMA<br><br>Average run length is 5 under normal conditions<br><br>Run length is 2 to 6 trips after code clear or non-volatile reset |
| Evaporative Emission (EVAP) Purge Solenoid Control Circuit | 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. | Ignition voltage > 11 volts, but < 18 volts | 20 Failures out of 25 samples<br><br>250 msec / sample<br>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 |
|---|---|---|---|---|---|---|
| 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 > 12 in of water for 5 seconds<br>BEFORE Purge Volume > 6 liters<br><br>OR<br><br>Vented Vacuum < -2.5 in of water or Vented Vacuum > 5 in of water for 60 seconds<br><br>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<br>• No MAP DTCs<br>• No TP Sensor DTCs<br>• No VSS DTCs<br>• No IAT DTCs<br>• No ECT DTCs<br>• No Fuel Tank Pressure Sensor DTCs<br>• No Evap Canister Purge solenoid DTCs<br>• No EVAP Canister Vent Solenoid DTCs<br>• No Thermostat Rationality DTCs<br>• 15 % < Fuel Level < 85. %<br>• 11.00 V < System Voltage < 18.00 V<br>• 4 °C < Startup IAT < 30°C<br>• Startup ECT < 35 °C<br>• BARO > 74.00 kPa (8000 ft) | Once per trip<br><br>Time is dependent on driving conditions<br><br>Max. before test abort is 1000 seconds | DTC Type B |
| Evaporative Emission (EVAP) Vent Solenoid Control Circuit | 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. | Ignition voltage > 11 volts, but < 18 volts | 20 failures out of 25 samples<br>250 msec /test<br><br>Continuous. | DTC Type B |
| Fuel Tank Pressure (FTP) Sensor Circuit Performance | P0451 | The DTC will be set if the fuel tank vacuum sensor is out of range when it tries to re-zero prior to the phase-1 or phase-2 portions of the engine-off natural vacuum small leak test. | The tank vacuum sensor voltage is compared to a window about the nominal sensor voltage offset (~1.5 volts)<br><br>Upper voltage threshold (voltage addition above the nominal voltage): 0.2 volts<br><br>Lower voltage threshold (voltage subtraction below the nominal voltage): 0.2 volts<br><br>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 an 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.<br><br>**Fail threshold = 0.730**<br>Re-Pass threshold = 0.400 | 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.<br><br>The length of the test is determined by the refueling rationality test that can take up to 600 seconds to complete. | DTC Type A<br><br>Average run length: 6<br><br>Used on EONV Applications |

| SENSED PARAMETER | FAULT CODE | MONITOR STRATEGY DESCRIPTION | MALFUNCTION CRITERIA AND THRESHOLD VALUE(S) | SECONDARY PARAMETERS AND ENABLE CONDITIONS | TIME LENGTH AND FREQUENCY | MIL ILLUMINATION TYPE |
|---|---|---|---|---|---|---|
| Fuel 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 < 0.1 volts produces a failing sample. Otherwise, the sample is considered passing. | • 0.10 second delay after sensor power up for sensor warm-up<br>• Engine is not cranking | 80 samples fail out of 100 samples<br><br>Continuous<br>100ms loop | 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 > 4.90 volts produces a failing sample. Otherwise, the sample is considered passing. | • 0.10 second delay after sensor power up for sensor warm-up<br>• Engine is not cranking | 80 samples fail out of 100 samples<br><br>Continuous<br>100ms loop | 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.<br><br>The abrupt change is defined as a change > 0.45 and < 1 in of water in the span of 1.0 seconds<br><br>A refueling event is confirmed if the fuel level has a persistent change of 10.0 % 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 once per engine-off period.<br><br>The length of the test is determined by the refueling rationality test that can take up to 600 seconds to complete.<br><br>1 sample fail out of 3 samples | DTC Type A<br><br>Used on EONV Applications |

| SENSED PARAMETER | FAULT CODE | MONITOR STRATEGY DESCRIPTION | MALFUNCTION CRITERIA AND THRESHOLD VALUE(S) | SECONDARY PARAMETERS AND ENABLE CONDITIONS | TIME LENGTH AND FREQUENCY | MIL ILLUMINATION TYPE |
|---|---|---|---|---|---|---|
| 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 > 30.00 liters<br>BEFORE<br>Tank vacuum < 11 in of water<br><br>2 liters of fuel must be consumed after setting the DTC active the first time to the DTC active the second time.<br><br>Weak Vacuum Follow-up Test<br>(fuel cap replacement test)<br><br>Weak Vacuum Test failed previous trip and this trip.<br>Passes if tank vacuum > 11 in of water.<br><br>Note: Weak vacuum Follow-up Test can only report a pass. | General Test Enable<br>• No MAP DTC's<br>• No TP Sensor DTC's<br>• No VSS DTC's<br>• No IAT DTC's<br>• No ECT DTC's<br>• No Fuel Tank Pressure circuit Sensor DTC's<br>• No Evap Canister Purge solenoid circuit DTC's<br>• No EVAP Canister Vent Solenoid circuit DTC's<br>• No Thermostat Rationality DTC's<br>• Engine is running<br>• 15 % < Fuel Level < 85. %<br>• 11.00 V < System Voltage < 18.00 V<br>• 4 °C < IAT < 30°C<br>• ECT when power up < 35 °C<br>• BARO > 74.00 kPa (8000 ft)<br><br>Cold Start Test<br>• IAT < 30°C<br>• Cold temperature Δ(ECT-IAT):<br>< 8 °C if ECT > IAT when power up<br>• Cold Test Timer < 1000 seconds | Once per cold start<br><br>Time is dependent on driving conditions<br><br>Max. before test abort is 1000 seconds<br><br>Weak Vacuum Follow-up Test<br>On 2nd trip 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. | IF Delta Fuel Volume change less than 10 liters over an accumulated 160 Kilometers. | No VSS DTC's set<br>Engine Running | Frequency:<br>Continuous 100ms loop | DTC Type B |
| Fuel Level Sensor 1 Circuit Low Voltage | P0462 | This DTC will detect a fuel sender stuck out of range low. | Fuel level Sender % of 5V range less than 10 % | Runs continuously | Frequency:<br>Continuous 100ms loop<br><br>240 failures out of 300 samples<br>1 sample = 100 ms | DTC Type B |
| Fuel Level Sensor 1 Circuit High Voltage | P0463 | This DTC will detect a fuel sender stuck out of range high. | Fuel level Sender % of 5V range > than 70% | Runs continuously | Frequency:<br>Continuous 100ms loop<br><br>240 failures out of 300 samples<br>1 sample = 100 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 |
|---|---|---|---|---|---|---|
| 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 is confirmed, then the test sample is considered passing. Otherwise, the sample is considered failing indicating an intermittent signal problem.<br><br>The refuel event is defined as a change of 10.0 % fuel level during the engine-off test.<br><br>A refueling event is confirmed if the fuel level has a persistent change of 10.0 % for 30 seconds.<br><br>The test will report a failure if 1 out of 3 samples are failures. | 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 once per engine-off period.<br><br>The length of the test is determined by the refueling rationality test that can take up to 600 seconds to complete. | DTC Type A<br><br>Used on EONV Applications |
| 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 > 10 in of water for 5.00 sec<br>BEFORE<br>Test time > 60 seconds (cold start) | • 0.10 second delay after sensor power up for sensor warm-up<br>• Engine is running<br>• -2.5 in of water < filtered tank vacuum pressure when power up < 5 in of water | Once per trip<br><br>100 msec | DTC Type B |
| Malfunction Indicator Lamp (MIL) Control Circuit | P0650 | This DTC checks the circuit for electrical integrity during operation. | The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match. | Ignition voltage > 11 volts, but < 18 volts<br>No remote start vehicle | 20 failures out of 25 samples<br><br>250ms loop continuous | DTC Type B<br><br>No MIL |
| Control Module Power Relay Control Circuit | P0685 | This DTC checks the circuit for electrical integrity during operation. | The ECM detects that the commanded state of the driver and the actual state of the control circuit do not match. | Ignition voltage > 11 volts, but < 18 volts | 8 failures out of 10 samples<br>250ms loop continuous | DTC Type B |
| Control Module Power Relay Feedback Circuit High Voltage | P0690 | This DTC is a check to determine if the Powertrain relay is functioning properly | Stuck Test:<br>The Powertrain relay feedback voltage is > 2 volts when it has been commanded "OFF" for longer than 1 seconds | Powertrain relay commanded "ON"<br>No Powertrain Relay Control output driver fault | Stuck Test:<br>100 msec / sample<br>Continuous failures ≥ 2 seconds | 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 |
|---|---|---|---|---|---|---|
| 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 < 50<br>OR<br>Half cycle R/L switches < 50<br><br>OR<br><br>Slope Time L/R switches < 5<br>OR<br>Slope Time R/L switches < 5 | Common Enable Criteria<br>• No TP Sensor, MAP, ECT, MAF, IAT, Evap, Fuel Injector DTCs<br>• Catalyst monitor diagnostic Intrusive Test = Not Active<br>• Post Oxygen Sensor Diagnostic Intrusive Test = Not Active<br>• Traction Control, AIR, Fuel, Idle, EGR, and Engine Not Overspeed Intrusive Tests = Not Active<br>• 10 volts < system voltage < 18 volts more than 5 seconds<br>• EGR, Idle, Fuel Inj., and AIR Device controls = Not Active<br><br>Specific Enable Criteria<br>• O2 Heater on for ≥ 0 seconds<br>• B1S1 DTCs = Not Active<br>• B1S1 learned heater resistance is valid<br>• Misfire DTC = Not Active<br>• ECT > 70 °C<br>• IAT > -40 °C<br>• Engine run time > 200 seconds<br>• Engine run time since begin run > 5 seconds<br>• EVAP Canister purge duty cycle ≥ 0 %<br>• 15 grams per second ≤ MAF ≤ 50 grams per second<br>• Air temp is not in default mode<br>• 1000 ≤ RPM ≤ 3500<br>• Ethanol percentage < 84.899 %<br>• Baro > 70 kPa<br>• Throttle position ≥ 5 %<br>• Fuel Level > 10 %<br>• Fuel state = closed loop<br>• No fuel level data faults<br>• Transmission (automatic) not in Park, Reverse or Neutral<br>• Transmission gear selection is not defaulted<br>• Baro is not defaulted<br>• Not hybrid engine off<br><br>All of the above met for at least 1 seconds. | 60 seconds<br><br>Frequency:<br>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 |
|---|---|---|---|---|---|---|
| ECM/PCM Internal Engine Off Timer Performance | P2610 | This DTC determines if the engine off timer does not meet specification | Phase 1:<br>A failure will be reported if the following occurs 3 times:<br>Ignition off timer < 0 sec<br>OR<br>Ignition off timer > 10 sec<br><br>Phase 2:<br>A failure will be reported if any of the following occurs 8 times out of 10 test:<br>• Time since last ignition off timer increment > 1.375 seconds<br>• Current ignition off time < old ignition off time<br>• Time between ignition off timer increments < 0.75<br>• Time between ignition off timer increments > 1.25<br>• Current ignition off timer minus old ignition off timer ≠ 1.0 | ECM is powered down<br>DTC sets on next key cycle if failure detected<br>Test has not run during current key cycle<br>-40°C ≤ IAT ≤ 125°C | Once every key down<br>12.5ms loop rate<br>8 failures out of 10 samples<br><br>Reports 1 sample / second | DTC Type B |
| O2 Sensor Circuit Range/Performance Bank 1 Sensor 1 | P2A00 | This DTC determines if the O2 sensor voltage is not meeting the voltage criteria to enable closed loop fueling. | Closed loop fuel control O2 sensor Ready flag set to "Not Ready."<br><br>O2 sensor voltage must be > 550 millivolts or < 350 millivolts to set closed loop fuel O2 Ready flag.<br>Once set to "Ready," the O2 sensor voltage cannot be > 350 millivolts and < 550 millivolts for > 5 seconds or the O2 Ready flag will be reset to "Not Ready." | • No TP Sensor, MAF, MAP, IAT, ECT, EVAP, Secondary Air, Injector DTCs<br>• No B1S1 or B2S1 O2 DTCs<br>• Engine Run Time ≥ 100 seconds<br>• ECT ≥ 70° C<br>• Engine Metal Overtemp = Not Active<br>• Traction Control = Not Active<br>• No default throttle action<br>• Not in Catalyst Protection Mode<br>• No hybrid engine off<br>• 10 volts ≤ Ignition Voltage ≤ 18 volts more than 3 seconds<br>• 1000 ≤ Engine Speed ≤ 3400<br>• 10 grams per second ≤ Mass Airflow ≤ 30 grams per second<br>• Not in Decel Fuel Cutoff Mode<br>• Not in Power Enrichment<br>• Predicted O2 temp ≥ 0 °C<br><br>All of the above met for 5 seconds. | 550 test failures in a 600 test sample<br><br><u>Frequency:</u><br>Continuous<br>100ms loop | DTC Type B |

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|---|---|---|---|---|---|---|
| O2 Sensor Circuit Range/Performance Bank 1 Sensor 2 | P2A01 | This DTC determines if the post catalyst O2 sensor is stuck in a normal 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 or reduces delivered fuel to achieve the required rich or lean threshold. | Post catalyst O2 sensor cannot achieve voltage ≥ 730 millivolts or voltage ≤ 250 millivolts | Common Enable Criteria<br>• Engine Runtime ≥ 255 seconds<br>• Engine runtime since Beginrun > 5seconds<br>• No O2 circuit, response, heater current, or heater resistance DTC's active<br>• No TP Sensor, ETC, MAF, ECT, MAP, IAT, EVAP, Secondary Air, Fuel Injector DTC's<br>• 10 volts < system voltage < 18 volts<br>• Learned heater resistance is valid<br>• ICAT MAT Burnoff delay is not active<br><br>Specific Enable Criteria:<br>• No Fuel Trim or Misfire DTC's active<br>• 1000 rpm ≤ Engine Speed ≤ 3500 rpm<br>• 5 gps ≤ Airflow ≤ 50 gps<br>• 40 kph ≤ Vehicle Speed ≤ 132 kph<br>• 0.96 ≤ Short term fuel trim ≤ 1.04<br>• Fuel state = closed loop<br>• EVAP diagnostic not in control of purge<br>• Ethanol Estimate is not in progress<br>• Fuel Level > 10 %<br>• Post Cell Enabled<br>• PTO is not active<br>• EGR diagnostic is not in control of EGR<br><br>All of the above met for at least 5 seconds, and then:<br><br>Purge Solenoid = 0 %<br>For 15 seconds | Up to 400 grams of accumulated air flow for the Lean Test and 600 grams of accumulated air flow for the Rich Test.<br><br>Frequency:<br>Once per trip | DTC Type B |
| Brake Booster Pressure Sensor Performance | P0556 | This DTC will detect a leak in the brake booster system. | During throttle is closed(<1 %), the abnormal non-increasing time is measured that pressure delta between engine vacuum and brake booster vacuum is higher than threshold(6 kPa). The abnormal non-increasing time is normalized value against total non-increasing time.<br>The normalized value is entered into EWMA (with 0= perfect pass and 1=perfect fail). Once EWMA exceeds the fail threshold, the DTC code is illuminated.<br>The DTC code can be turned off if the EWMA falls below the re-pass threshold for 3 consecutive times.<br><br>Fail threshold = 0.664<br>Re-Pass threshold = 0.5 | No MAP DTC's<br>No TPS sensor DTC's<br>TPS < 1%<br>Brake booster pressure is not increasing more than 0.3 kPa during 0.2 sec. | Continuous<br>Throttle < 1% more than 1 second<br><br>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 |
|---|---|---|---|---|---|---|
| Brake Booster Pressure Sensor Circuit Low Voltage | P0557 | This DTC will detect a Brake booster pressure sensor stuck out of range low. | Brake Booster Pressure sensor percentage < 5 percent | Runs continuously | 50 test failures in a 100 test sample<br><br>Frequency:<br>Continuous<br>12.5ms loop | DTC Type B |
| Brake Booster Pressure Sensor Circuit High Voltage | P0558 | This DTC will detect a Brake booster pressure sensor stuck out of range high. | Brake Booster Pressure sensor percentage > 95 percent | Runs continuously | 20 test failures in a 100 test sample<br><br>Frequency:<br>Continuous<br>12.5ms 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 |
|---|---|---|---|---|---|---|
| Catalyst System Low Efficiency Bank 1 | P0420 | Oxygen Storage Capacity (OSC)<br><br>(Stored Oxygen Release Monitor) | OSC Mass EWMA ≤<br>1.017 grams Air<br><br>OSC Period = HO2S2 Resp Time – HO2S1 Resp Time – Inert Catalyst Transport Delay.<br><br>OSC Mass =<br>∫{ MAF(Bank,t) * [EquivalenceRatio(t)/FuelTrim LT – 1]}∂t, t=0 to OSC Period.<br><br>Normalized OSC Mass =<br>OSC Mass *Catalyst Temperature Compensation Factor.<br><br>OSC Mass EWMA(n) = OSC Mass EWMA(n-1) + EWMAcoef* { Normalized OSC Mass(n) – OSC Mass EWMA(n-1)}<br><br>OSC Worst Pass Thresh =<br>1.104 grams Air | Trip Enable Criteria<br>No VSS, Throttle, Purge control, Purge Circuit, Oxygen sensor, Misfire, IAT, MAP, Injector, ESC Control, Coolant, Crank sensor, Cam sensor, Air flow, IAC, or Fuel trim DTC's failing<br>Test Enable Conditions<br>Green Converter Delay = Not Active<br>Predicted Catalyst Temperature ≥ 590C for ≥ 60 sec<br>590 C ≤ Predicted Catalyst Temperature ≤ 800 C<br>Min learn enable time for stable BLM & PLM ≥ 60 sec (≥ 400 sec if tank level increased by ≥10% or after code clear)<br>Barometric Pressure ≥ 74 kPa<br>-7 ≤ IAT ≤ 51°C<br>71°C ≤ ECT ≤ 130°C<br>Tests Attempted this trip < 12<br>Tests Attempted this DFCO period < 1<br>Gear is stable during measurement<br>Fuel level ≥ 10 % (Fuel Level Fault not active) or<br>Fuel level ≥ 0 % (Fuel Level Fault active)<br>VSS > 29 km/hr & RPM ≥ 1200 for ≥ 60 sec<br>Valid DFCO Period Criteria<br>Trip & Test Enable Criteria Met<br>DFCO Period ≥ 1.75 sec<br>HO2S1 ≤ 300 mV (prior to DFCO exit)<br>HO2S2 ≤ 100 mV for 1.25 sec (prior to DFCO exit)<br>Valid DFCO Exit Period Criteria<br>Trip & Test Enable Criteria Met<br>Step-in TPS ≥ 0 %<br>TPS travel < 30 %<br>Equivalence Ratio ≥ 1.00<br>Test Completion Criteria<br>HO2S1 ≥ 600 mV & HO2S2 ≥ 200 mV (or)<br>HO2S2 Resp Time – HO2S1 Resp Time > 1.65 sec<br>Fast Initial Response Criteria<br>Test has not reported as Passed or Failed yet.<br>Rapid Step Response (RSR) Enable Criteria<br>Min OSC Change For RSR ≥ 0.409 grams<br>Normalized OSC Mass ≤ 1.104 grams | 1 test attempted per exit from valid deceleration fuel cut-off (DFCO) period<br><br>Minimum of 1 test per trip.<br><br>Fast Initial Response(FIR) or Rapid Step Response(RSR) Maximum of 6 tests per trip.<br><br>Maximum of 6 trips to detect failure when Rapid Step Response is enabled<br><br>frequency: 12.5 ms continuous<br><br>Green Converter Delay Criteria<br>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 >= 500° C for 3600 seconds cumulative non-continuously.<br>Note: this feature is only enabled at the factory when the vehicle is new and cannot be enabled in service | 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 |
|---|---|---|---|---|---|---|
| | | | | | | |

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

### Lean-Rich Ave

**Rich-Lean Ave**

| Seconds | 0.000 | 0.030 | 0.040 | 0.050 | 0.060 | 0.070 | 0.080 | 0.090 | 0.100 | 0.110 | 0.120 | 0.130 | 0.140 | 0.150 | 0.160 | 0.170 | 0.180 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0.000** | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL |
| **0.030** | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL |
| **0.040** | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL |
| **0.050** | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL |
| **0.060** | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL |
| **0.070** | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL |
| **0.080** | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL |
| **0.090** | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL |
| **0.100** | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | FAIL | FAIL | FAIL | FAIL | FAIL |
| **0.110** | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | PASS | FAIL | FAIL | FAIL | FAIL |
| **0.120** | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | PASS | PASS | PASS | PASS | PASS | PASS | FAIL | FAIL | FAIL |
| **0.130** | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | PASS | PASS | PASS | PASS | PASS | PASS | FAIL | FAIL |
| **0.140** | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | PASS | PASS | PASS | PASS | PASS | PASS | FAIL |
| **0.150** | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | PASS | PASS | PASS | PASS | PASS | PASS |
| **0.160** | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | PASS | PASS | PASS | PASS | PASS |
| **0.170** | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | PASS | PASS | PASS | PASS |
| **0.180** | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | FAIL | PASS | PASS | PASS |

| 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)-Camshaft Position (CMP) Correlation Bank 1 Sensor A | P0016 | Detects cam to crank misalignment by monitoring if cam sensor pulse occurs during the incorrect crank position | Four cam sensor pulses more than +12/- 9 crank degrees away from nominal position in crank degrees in one cam revolution. | • No 5 volt reference, camshaft position sensor circuit, or crankshaft position sensor circuit DTCs set<br>• Engine speed < 1200 RPM<br>• Engine is spinning<br>• Crankshaft position signal is in sync.<br>• Cam phase state is learned or default | 25 failures out of 35 samples<br><br>Frequency:<br>1x per cam rotation<br>Continuous | DTC Type B |
| Crankshaft Position (CKP)-Camshaft Position (CMP) Correlation Bank 1 Sensor B | P0017 | Detects cam to crank misalignment by monitoring if cam sensor pulse occurs during the incorrect crank position | Four cam sensor pulses more than +12/- 9 crank degrees away from nominal position in crank degrees in one cam revolution. | • No 5 volt reference, camshaft position sensor circuit, or crankshaft position sensor circuit DTCs set<br>• Engine speed < 1200 RPM<br>• Engine is spinning<br>• Crankshaft position signal is in sync.<br>• Cam phase state is learned or default | 25 failures out of 35 samples<br><br>Frequency:<br>1x per cam rotation<br>Continuous | DTC Type B |
| Mass Airflow (MAF) Sensor Performance | P0101 | This DTC determines if the MAF sensor is stuck within the normal operating range | (Measured Flow – Modeled air Flow) Filtered > 15<br>AND<br>(Measured Manifold Air Pressure – Manifold Model 2 pressure) Filtered > 20 | Engine rpm =>400 and <= 8192<br>MAP sensor high/low DTCs not active<br>MAF sensor high/low DTCs not active<br>EGR Valve DTCs not active<br>Crank sensor DTCs not active<br>Engine Coolant DTCs not active<br>Intake Air Temp. DTCs not active<br>Engine Coolant > 70 deg C and < 125 deg C<br>Intake Air Temp > -7 deg C and < 125 deg C | Continuous<br><br>The diagnostic reports test results every 100 ms. | DTC Type B |
| Mass Air Flow (MAF) Sensor Circuit Low | P0102 | Detects a continuous short to low or a open in either the signal circuit or the MAF sensor | MAF ≤ 10 Hz | Engine Running > 1 seconds<br><br>Engine Speed ≥ 300 RPM<br>System Voltage ≥ 8 volts<br>The above must be present for a period of time greater than 1.0 seconds | 50 test failures in 63 test samples<br><br>1 sample every Lo Res event | DTC Type B |
| Mass Air Flow (MAF) Sensor Circuit High | P0103 | Detects a continuous short to high in either the signal circuit or the MAF sensor | MAF ≥ 11000 Hz | Engine Running > 1 seconds<br><br>Engine Speed ≥ 300 RPM<br>System Voltage ≥ 8 volts<br>The above must be present for a period of time greater than 1.0 seconds | 50 test failures in 63 test samples<br><br>1 sample every Lo Res event | DTC Type B |
| Manifold Absolute Pressure (MAP) Sensor Performance | P0106 | This DTC determines if the MAP sensor is stuck within the normal operation range | (Measured MAP - Manifold Model 1 pressure) filtered > 20<br>AND<br>(Measured MAP – Manifold Model 2 pressure) filtered > 20 | Engine rpm =>400and <= 8192<br>MAP sensor high/low DTCs not active<br>MAF sensor high/low DTCs not active<br>EGR Valve DTCs not active<br>Crank sensor DTCs not active<br>Engine Coolant DTCs not active<br>Intake Air Temp. DTCs not active<br>Engine Coolant > 70 deg C and < 125 deg C<br>Intake Air Temp > -7 deg C and < 125 deg C | Continuous<br><br>The diagnostic reports test results every 100 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 |
|---|---|---|---|---|---|---|
| Manifold Absolute Pressure (MAP) 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 < 1% of Vref (0.05 volts) | TP sensor DTCs not active<br>Engine Running ≤ 400 RPM<br>Throttle Position is ≥ 0% when engine speed is ≤ 1000 RPM<br>Or<br>Throttle Position is ≥ 12.5 % when engine speed is > 1000 RPM<br>No 5v ref. DTCs | 320 test failures in 400 test samples<br><br>1 sample/12.5 ms | DTC Type B |
| Manifold Absolute Pressure (MAP) 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) | Cold Start Run Time – Table value in seconds based on Powerup Coolant Temperature<br>***Run Test***<br>TP sensor DTCs not active<br>Engine Running<br>Throttle Position is ≤ 1 % when engine speed is ≤ 1200 RPM<br>Or<br>Throttle Position is ≤ 20 % when engine speed is > 1200 RPM | 320 test failures in 400 test samples<br><br>1 sample/12.5 ms | DTC Type B |
| Intake Air Temperature (IAT) Sensor Circuit Low | P0112 | This DTC detects a continuous short to ground in the IAT signal circuit or the IAT sensor | Raw IAT < 25 ohms | VS sensor DTCs not active<br>ECT sensor DTCs not active<br>Engine run time > 10 seconds<br>Coolant Temperature < 150°C | 50 test failures in 63 test samples<br><br>1 sample/100 msec | DTC Type B |
| Intake Air Temperature (IAT) Sensor Circuit High | P0113 | This DTC detects a continuous open or short to high in the IAT signal circuit or the IAT sensor | Raw IAT > 1,800,000 ohms | MAF sensor DTCs not active<br>ECT sensor DTCs not active<br>VS sensor DTCs not active<br>Engine run time > 10 seconds<br>Coolant Temperature > -40°C | 50 test failures in 63 test samples<br><br>1 sample/100 msec | DTC Type B |
| Engine Coolant Temperature (ECT) Sensor Performance | P0116 | Detects coolant temp sensor stuck in mid range | A failure will be reported if any of the following occur:<br><br>ECT at powerup > IAT at powerup by an IAT based table lookup value after a minimum 8 hour soak (fast fail).<br><br>ECT at powerup > IAT at powerup by 15.75°C after a minimum 8-hour soak and a block heater has not been detected.<br><br>ECT at powerup > IAT at powerup by 15.75°C after a minimum 8 hour soak and the time spent cranking the engine without starting is greater than 10 seconds with the fuel level being above a minimum level of 2.5%. | No VSS DTCs<br>No IAT DTCs<br>No ECT sensor shorted DTCs<br>ECM/PCM Internal Engine Off Timer Performance DTC not active<br>Non-volatile memory failure has not been detected on power-up.<br>Engine off time > 8 hours<br>Test run this trip = false<br>Test aborted this trip = false<br><br>Block heater detection:<br>ECT at powerup > IAT at powerup by 15.75°C<br>Powerup IAT > -7°C<br>Vehicle driven a minimum of 400 seconds above 24 kph and IAT drops more than 5° C from powerup IAT. | 1 failure<br><br>500 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 |
|---|---|---|---|---|---|---|
| Engine Coolant Temperature (ECT) Sensor Circuit Low | P0117 | This DTC detects a continuous short to ground in the ECT signal circuit or the ECT sensor. | Raw ECT < 25 ohms | Engine run time > 10 seconds<br>Or<br>IAT ≤ 50° C | 5 test failures in 6 test samples<br><br>1 sample/sec<br><br>Continuous | DTC Type B |
| Engine Coolant Temperature (ECT) Sensor Circuit High | P0118 | Circuit Continuity<br>This DTC detects a continuous short to high or open in the ECT signal circuit or the ECT sensor. | Raw IAT > 1,800,000 ohms | Engine run time > 10 seconds<br>Or<br>IAT ≥ 0° C | 5 test failures in 6 test samples<br><br>1 sample/sec<br><br>Continuous | DTC Type B |
| Throttle Position (TP) Sensor 1 Performance | P0121 | The DTC determines if a TPS sensor is stuck within the normal operating range | Filtered throttle error > 210 kPa/grams per second | Engine rpm =>400 and <= 8192<br>MAP sensor high/low DTCs not active<br>MAF sensor high/low DTCs not active<br>EGR valve DTCs not active<br>Crank sensor DTCs not active<br>Engine Coolant DTCs not active<br>Intake Air Temp. DTCs not active<br>Engine Coolant > 70 deg C and < 125 deg C<br>Intake Air Temp > -7 deg C and < 125 deg C | Continuous<br><br>The diagnostic reports test results every 100 ms. | DTC Type B |
| Engine Coolant Temperature (ECT) Below Thermostat Regulating Temperature | P0128 | Under driving conditions, target coolant temperature should be achieved based on amount of cumulative airflow ingested, and based on startup coolant temperature | A table defines maximum cumulative airflow based on startup coolant temperature and IAT at which target coolant temperature must have been reached<br>Target = 80 deg C for IAT startup temperatures >10 deg C; 70 deg C for IAT startup temperatures <=10 deg C | • Average airflow > 1 gram/second<br>• Engine runtime < 1800 seconds before test completes<br>• Engine runtime > 30 seconds<br>• 54.5 C > IAT > -7°C<br>• Vehicle speed > 8 kph for 0.5 kilometers<br>• Startup ECT<75 deg C for IAT startup temperatures >10 deg C; 65 deg C for IAT startup temperatures <=10 deg C<br>• No ECT, Throttle, IAT, VSS, MAF or MAP faults | Once per trip<br><br>Time based on total airflow | 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 |
|---|---|---|---|---|---|---|
| Misfire Detected | P0300 | These DTCs will determine if a random or a cylinder specific misfire is occurring by monitoring crankshaft velocity. | Deceleration index<br>Vs<br>Engine speed<br>Vs<br>Load and Camshaft Position<br><br>Emission Failure Threshold = 1.00%<br><br>Catalyst Damage Threshold = 5%. – 22.5% | • Engine run time > 2 crankshaft revolutions.<br>• DTCs not active for VSS, CKP, TP, MAP, ECT, IAT, and MAF sensors.<br>• No engine protection faults.<br>• P0315 (Crankshaft Position System Variation Not Learned) not active or engine speed < 1000 RPM.<br>• Fuel cutoff not active.<br>• Power management is not active.<br>•<br>• Brake torque management not active.<br>• Fuel level > 10% (disablement ends 500 after a low fuel level condition ceases, and fuel disable does not occur with a fuel sensor DTC).<br>• -7°C < ECT < 125 °C.<br>• If ECT at startup < -7°C, then disable until ECT > 21°C.<br>• 450 RPM < Engine speed < 7000 RPM.<br>• 9 volts < System voltage < 18 volts.<br>• + Throttle position delta < 95% per 100 ms.<br>• - Throttle position delta < 95% per 100 ms.<br>• Abnormal engine speed is not present.<br><br>• Not an abusive engine speed condition Abusive engine speed = 7500 RPM.<br>• 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 temperature)<br>• Detectable engine speed and engine load region.<br>• Misfire Diag. is not requesting to disable TCC when transmission is in hot mode.<br>• Crankshaft Ring Filter inactive (after a low level misfire, another misfire may not be detectable until crankshaft ringing ceases) | Emission Exceedence = (5) failed 200 revolution blocks of 16. Failure reported with (1) Exceedence in 1st (16) 200-revolution block, or (4) Exceedences thereafter.<br><br>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. Failure reported with (3) Exceedences in FTP, or (1) Exceedence outside FTP.<br><br>Frequency: Continuous | DTC Type B<br><br>(MIL Flashes with Catalyst Damaging Misfire) |
| Crankshaft Position System Variation Not Learned (CASE) | P0315 | Determines if the Crankshaft Position System Variation has not been learned. | Sum of Compensation Factors ≤ 1.996 or 2.004 | OBD Manufacturer Enable Counter = 0 | Frequency:<br>Continuous<br>100 ms loop | DTC Type A |
| 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<br>2. No crankshaft position sync<br>3. No crankshaft position sensor pulses received | 1. Engine cranking and either CMP pulses being received or MAF > 3 grams per second<br>2. Engine is spinning and no 5V reference DTCs set<br>3. Engine is spinning and no 5V reference or cam position sensor DTCs set | 1. While starter is engaged – 4s<br><br>2. Continuous – 100 ms<br>3. Continuous – 2 test failures out of 10 samples | 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 |
|---|---|---|---|---|---|---|
| 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<br>2. Twenty crank resyncs occur within 25 seconds<br>3. 51 > number of crank pulses received in one engine revolution >65 | 1. Engine cranking and either CMP pulses being received or MAF >3 grams per second<br>2. Engine speed > 450 RPM<br>3. Engine is spinning and no 5V reference or cam position sensor DTCs set | 1. While starter engaged – 1.5s<br>2. Continuous – 100 ms<br>3. Continuous – 8 test failures out of 10 samples | DTC Type B |
| 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 12 MEDRES events<br>2. No Cam pulses received for 100 engine cycles<br>3. No Cam pulses received<br>4. No Cam pulses received while starter is engaged. | 1. Crank is synchronized and no 5V ref DTCs set<br>2. Crank is synchronized and no 5V ref DTCs set<br>3. Engine is cranking and either crank pulses are received or MAF > 3 grams per second<br>4. Engine is spinning and no 5V ref DTCs set | 1. One time while starter is engaged.<br>2. Continuous – 8 test failures out of 10 samples<br>3. Continuous – 3 seconds<br>4. 4 seconds while starter is engaged. | 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. 4 > number of cam pulses received in 12 MEDRES events > 6<br>2. 398 > number of cam pulses received in 100 engine cycles > 402 | 1. Crank is synchronized and no 5V ref DTCs set<br>2. Crank is synchronized and no 5V ref DTCs set<br>Footnote: MEDRES events typically occur twice per cylinder event. | 1. One time while starter is engaged.<br>2. Continuous – 8 test failures out of 10 samples | DTC Type B |
| Camshaft Position (CMP) Sensor Circuit Bank 1 Sensor B | P0365 | This diagnostic will detect if a fault exists on the camshaft position sensor signal. | 1. No Cam pulses received during first 12 MEDRES events<br>2. No Cam pulses received for 100 engine cycles<br>3. No Cam pulses received<br>4. No Cam pulses received while starter is engaged. | 1. Crank is synchronized and no 5V ref DTCs set<br>2. Crank is synchronized and no 5V ref DTCs set<br>3. Engine is cranking and either crank pulses are received or MAF > 3 grams per second<br>4. Engine is spinning and no 5V ref DTCs set | 1. One time while starter is engaged.<br>2. Continuous – 8 test failures out of 10 samples<br>3. Continuous – 4 seconds<br>4. – 1.5 seconds while starter is engaged. | DTC Type B |
| Camshaft Position (CMP) Sensor Performance Bank 1 Sensor B | P0366 | Detects cam sensor performance malfunctions by monitoring for the incorrect number of cam sensor pulses in a given number of crank sensor pulses | 1. 4 > number of cam pulses received in 12 MEDRES events > 6<br>2. 398 > number of cam pulses received in 100 engine cycles > 402 | 1. Crank is synchronized and no 5V ref DTCs set<br>2. Crank is synchronized and no 5V ref DTCs set<br>Footnote: MEDRES events typically occur twice per cylinder event. | 1. One time while starter is engaged.<br>2. Continuous – 8 test failures out of 10 samples | DTC Type B |

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|---|---|---|---|---|---|---|
| Cooling Fan 1 Control Circuit | 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 | Engine speed greater than 400 rpm<br>Ignition voltage > 11 volts, but < 18 volts | 20 failures out of 25 samples<br>250msec /test<br><br>Continuous | DTC Type B |
| Cooling Fan 2 Control Circuit | 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 | Engine speed greater than 400 rpm<br>Ignition voltage > 11 volts, but < 18 volts | 20 failures out of 25 samples<br>250msec /test<br><br>Continuous | DTC Type B |
| Idle Air Control (IAC) System - RPM Too Low | P0506 | Determines if a low idle is a result of an engine mechanical problem | Idle Error from desired – Table value in RPM based on Coolant Temperature | No MAF, MAP, IAT, ECT, TP, Injector, Fuel System, Misfire, VSS or Purge DTC<br>Engine Run > 5 sec.<br>\|Engine Speed error\| ≤ 50 RPM<br>ECT ≥ -7 ° C<br>BARO > 72 kPa<br>IGN. voltage > 9 & < 18 volts<br>IAT > -7 ° C<br>Idle condition present | Must be outside the fail criteria continuously for three 5-second tests. Must be within pass criteria for 3 seconds continuously. | DTC Type B |
| Idle Air Control (IAC) System - RPM Too High | P0507 | Determines if a high idle is a result of an engine mechanical problem | Idle Error from desired – Table value in RPM based on Coolant Temperature | No MAF, MAP, IAT, ECT, TP, Injector, Fuel System, Misfire, VSS or Purge DTC<br>Engine Run > 5 sec.<br>\|Engine Speed error\| ≤ 50 RPM<br>ECT ≥ -7 ° C<br>BARO > 72 kPa<br>IGN. voltage > 9 & < 18 volts<br>IAT > -7 ° C<br>Idle condition present | Must be outside the fail criteria continuously for three 10-second tests. Must be within pass criteria for 3 seconds continuously. | DTC Type B |
| Intake Air Flow System Performance | P1101 | This DTC determines if there are multiple air induction problems affecting airflow and/or manifold pressure. | Filtered Throttle Error > 210 kPa/grams per second<br>And<br>Filtered Manifold2 Error > 20 kPa<br>And<br>Filtered Pressure1 Error > 20 kPa<br>OR<br>Filtered Airflow Error > 15 grams per second | Engine rpm =>400 and <= 8192<br>MAP sensor high/low DTCs not active<br>EGR circuit/performance DTCs not active<br>MAF sensor high/low DTCs not active<br>EGR valve DTCs not active<br>Crank sensor DTCs not active<br>Engine Coolant DTCs not active<br>Intake Air Temp. DTCs not active<br>Engine Coolant > 70 deg C and < 125 deg C<br>Intake Air Temp > -7 deg C and < 125 deg C | Continuous<br><br>The diagnostic reports test results every 100 ms. | DTC Type B |

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|---|---|---|---|---|---|---|
| Air Fuel Imbalance Bank 1 | P1174 | Determines if the air-fuel delivery system is imbalanced by monitoring the pre-catalyst O2 sensor voltage characteristics | The Bank 1 AFIM Filtered Length Ratio (EWMA) variable exceeds a value of 0.616 (automatic transmission)<br>Notes:<br>1. The AFIM Filtered Length Ratio is determined by calculating the difference between the measured O2 voltage length (accumulated O2 voltage over a 2.5 second period) and an emissions-correlated threshold value, divided by the threshold value. The resulting ratio is then filtered utilizing an Exponentially Weighted Moving Average (EWMA).<br>2. The AFIM Filtered Length Ratio is initialized to **–0.5**, if at the end of the previous key cycle, the AFIM Filtered Length Ratio was equal to or less than **–0.5**. The AFIM Filtered Length Ratio is initialized to **0.0**, if at the end of the previous key cycle, the AFIM Filtered Length Ratio was equal to or greater than **0.0**. The AFIM Filtered Length Ratio is initialized to its key-down value, if at the end of the previous key cycle, the AFIM Filtered Length Ratio was greater than **-0.5** and less than **0.0**.<br>3. The first report is delayed for 90 seconds to allow time for the AFIM Filtered Length Ratio variable to saturate. This minimizes the possibility of reporting a pass before a potential failure could be detected. | • No Misfire, Fuel Injector, A.I.R., or EVAP DTCs<br>• No ECT, MAF, MAP, or pre-cat O2 Sensor DTCs<br>• No Fuel Composition (Ethanol) DTCs<br>• Device Control = Not Active<br>• Intrusive Diagnostics = Not Active<br>• Engine Overspeed Protection = Not Active<br>• Reduced Power Mode (ETC DTC) = Not Active<br>• PTO = Not Active<br>• Traction Control = Not Active<br>• Fuel Control in A/F Closed Loop or Learn-Enabled<br>• System Voltage < 10.0 V or > 18.0 V for > 4.0 seconds<br>• Engine Run Time > 10 seconds<br>• ECT > 10°C<br>• Engine speed > 1000 rpm but < **7000 rpm**<br>• Mass Airflow > 5 g/s<br>• Percent Ethanol < 85 %<br>• Delta O2 voltage during previous 12.5ms > +5/-5 mV<br>• O2 sensor voltages crosses 450mV > 4 times during current 2.5 second sample period | EWMA variable is updated after every 2.5 seconds of valid data.<br><br>Frequency:<br>Continuous Monitoring of O2 voltage signal in 12.5ms loop | DTC Type B |

<table>
<tr><th>SENSED PARAMETER</th><th>FAULT CODE</th><th>MONITOR STRATEGY DESCRIPTION</th><th>MALFUNCTION CRITERIA AND THRESHOLD VALUE(S)</th><th>SECONDARY PARAMETERS AND ENABLE CONDITIONS</th><th>TIME LENGTH AND FREQUENCY</th><th>MIL ILLUMINATION TYPE</th></tr>
<tr><td>MAP/MAF/Throttle Position Correlation</td><td>P0068</td><td>Detect when manifold absolute pressure and measured airflow do not match estimated engine airflow as established by the TPS</td><td>1. Difference between measured MAP and estimated MAP > X kPa OR V5B OOR OR After Throt Blade MAP sensor TFTKO, then MAP leg failed.<br>2. Difference between measured MAF and estimated MAF > Y grams/sec OR MAF sensor TFTKO OR Vbatt < 10 volts, then MAF leg failed.<br>3. X, Y are defined based on Commanded Throttle Position, where X is:
<table>
<tr><td>TPS%</td><td>10.0</td><td>15.0</td><td>20.0</td><td>25.0</td></tr>
<tr><td>MAP Kpa</td><td>46.2</td><td>39.7</td><td>41.4</td><td>43.0</td></tr>
</table>
<table>
<tr><td>30.0</td><td>35.0</td><td>40.0</td><td>45.0</td><td>100</td></tr>
<tr><td>25.9</td><td>100</td><td>100</td><td>100</td><td>100</td></tr>
</table>
And Y is:
<table>
<tr><td>TPS%</td><td>10.0</td><td>15.0</td><td>20.0</td><td>25.0</td></tr>
<tr><td>MAF grams/sec</td><td>15.8</td><td>19.8</td><td>28.4</td><td>37.1</td></tr>
</table>
<table>
<tr><td>30.0</td><td>35.0</td><td>40.0</td><td>45.0</td><td>100</td></tr>
<tr><td>20.6</td><td>255</td><td>255</td><td>255</td><td>255</td></tr>
</table></td><td>Engine running, engine speed > 950 rpm<br>No throttle actuation DTCs<br>Both TPS circuits DTCs are set</td><td>Continuously fail MAP AND MAF legs for longer than 187.5 msec<br><br>Continuous in the Main processor</td><td>DTC Type A</td></tr>
<tr><td>Throttle Position (TP) Sensor 1 Circuit</td><td>P0120</td><td>Detects a continuous or intermittent short or open in TP sensor #1 circuit</td><td>0.325 Volts > TPS > 4.75 Volts</td><td>Ignition in unlock/accessory, run or crank<br>System voltage>5.23 V<br>No 5 Volt reference DTCs</td><td>78/158 counts; 52 counts continuous; 3.125 msec /count in the ECM Main processor<br><br>18/38 counts or 13 counts continuous; 12.5 msec/count in the MHC processor</td><td>DTC Type A</td></tr>
<tr><td>Throttle Position (TP) Sensor 1 Circuit Lo</td><td>P0122</td><td>Detects a continuous or intermittent OOR lo TPS</td><td>TPS < 0.325 Volts</td><td>Ignition in unlock/accessory, run or crank<br>System voltage>5.23 V<br>No 5 Volt reference DTCs</td><td>78/158 counts; 52 counts continuous; 3.125 msec /count in the ECM Main processor<br><br>18/38 counts or 13 counts continuous; 12.5 msec/count in the MHC processor</td><td>DTC Type A</td></tr>
</table>

| 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 Circuit Hi | P0123 | Detects a continuous or intermittent OOR lo TPS | TPS > 4.75 Volts | Ignition in unlock/accessory, run or crank<br>System voltage>5.23 V<br>No 5 Volt reference DTCs | 78/158 counts; 52counts continuous; 3.125 msec /count in the ecm Main processor<br><br>18/38 counts or 13 counts continuous; 12.5 msec/count in the MHC processor | DTC Type A |
| Throttle Position (TP) Sensor 2 Circuit | P0220 | Detects a continuous or intermittent short or open in TP sensor #2 circuit | 0.25 Volts > TPS > 4.59 Volts | Ignition in Unlock/accessory, run, crank<br>System voltage > 5.23 V<br>No 5 Volt reference DTCs | 78/158 counts; 52 counts continuous; 3.125 msec /count in the motor processor<br><br>18/38 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 < 0.25 Volts | Ignition in Unlock/accessory, run, crank<br>System voltage > 5.23 V<br>No 5 Volt reference DTCs | 78/158 counts ; 52 counts continuous; 3.125 msec /count in the ecm Main processor<br><br>18/38 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<br>System voltage > 5.23 V<br>No 5 Volt reference DTCs | 78/158 counts ; 52 counts continuous; 3.125 msec /count in the ecm Main processor<br><br>18/38 counts or 13 counts continuous; 12.5 msec/count in the MHC processor | DTC Type A |
| 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 voltage ≥ 5 volts | 1 failure if it occurs during the first ROM test of the ignition cycle, otherwise 5 failures<br><br>Frequency:<br>Runs continuously in the background | DTC Type A |
| Control Module Not Programmed | P0602 | This DTC will be stored if the PCM is a service PCM that has not been programmed. | Output state invalid | • PCM state = crank or run<br>• PCM is identified through calibration as a Service PCM | Test is run at Powerup | 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 voltage ≥ 5 volts | 1 failure<br><br>Frequency:<br>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 |

| 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 |
|---|---|---|---|---|---|---|
| Control Module EEPROM Error | P062F | Indicates that the NVM Error flag has not been cleared | Last EEPROM write did not complete | Ignition voltage ≥ 5 volts | 1 failure<br><br>Frequency:<br>Once at power-up | DTC Type A |
| Transmission Control Module (TCM) Requested MIL Illumination | P0700 | Monitors the TCM MIL request line to determine when the TCM has detected a MIL illuminating fault. | Transmission Emissions-Related DTC set | Time since power-up > 3 seconds | Continuous | DTC Type A<br><br>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 |
|---|---|---|---|---|---|---|
| PCM Processor<br><br>1. Processor Performance Check - Throttle limiting Fault<br>2. Processor Performance Check - ETC software is not executed in proper order<br>3. Processor Performance Check<br>4. Processor Performance Check - SPI failed<br>5. Processor Performance Check - motor processor state of health (Main)<br>6. Processor Performance Check - Learn Corruption Fault (Main&motor processor)<br>7. Processor Performance Check - Learn Corruption Fault MAIN & motor processor<br>8. Processor Performance Check - motor processor state of health (Main)<br>9. Processor Performance Check - MAIN state of health (motor processor) | P0606 | Indicates that the ECM has detected an ETC internal processor integrity fault | 1. MHC processor detects throttle limiting fault<br><br>2. Software tasks loops > schedule tasks loop<br><br>3. Loss of SPI communication from the motor processor<br><br>4. 1.5 msec < Average motor processor state of health toggle > 2.5 msec<br><br>5. TPS or APPS minimum learned values fail compliment check<br><br>6. TPS or APPS minimum learned values fail range check<br><br>7. Motor processor integrity check error occurs<br><br>8. Motor processor integrity check error of Main processor occurs | Ignition in unlock/accessory, run or crank<br>System voltage>5.23 V | 1. 187.5 ms in the MHC processor<br><br>2. Error > 5 times of loop time; loop time are 12.5, 25,50,100 and 250 ms in the Main processor<br><br>3. 159/400 counts or 15 counts continuous; 39 counts continuous @ initialization,<br><br>4. counts/ 10 counts at initialization, 50 msec/count in the Main processor, 487.5ms in MHC processor.<br><br>5. 187.5ms continuous/100 ms intermittent in the Main processor<br><br>6. 187.5ms continuous/100 msec intermittent 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 |
|---|---|---|---|---|---|---|
| Control Module Accelerator Pedal Position (APP) System Performance | P060D | Verify that the indicated accelerator pedal position calculation is correct | 1. PPS sensor switch fault<br><br>2. Difference between Main processor indicated accelerator pedal position and MHC processor indicated accelerator pedal position > 2.5% | 1. Ignitions in unlock/ accessory and run,<br>System voltage > 5.23 V<br>No ECM processor DTC<br><br>2. Ignition in unlock, accessory, run or crank<br>System voltage > 5.23 V<br>No ECM processor DTC, No Comm Fault w/ Main | 39 counts continuous; 12.5 msec/count in the MHC processor | 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 at the ECM Vref1 voltage divider circuit. | Ignition in unlock/accessory, run or crank<br>System voltage > 5.23 V | 19/39 counts or 187.5 msec continuous; 12.5 msec/count in Main /MHC processor | DTC Type A |
| 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 at the ECM Vref2 voltage divider circuit. | Ignition in unlock/accessory, run or crank<br>System voltage > 5.23 V | 19/39counts or 187.5 msec continuous; 12.5 msec/count in Main/MHC processor | DTC Type A |
| Throttle Actuator Control (TAC) Module - Throttle Actuator Position Performance | P1516 | 1. Detect a throttle positioning error.<br>2. Determine if the actuator has been miswired. | 1. \|throttle error\| >= \|2%\| after > 0.4875 sec stability with no change in error sign,<br><br>OR<br><br>\|throttle error\| > 8 %<br><br>2. TPS1< 1.966 Volts | Ignition in run or crank<br>[(RPM>0 and system voltage > 5.4 Volts) OR ( RPM=0 and not in battery<br>saver mode and System voltage > 11.0 Volts]<br>No comm. Fault w/ Main<br>TPS min learn not active<br><br>No ignition correlation DTC active | 187.5ms in the MHC processor | DTC Type A |
| Ignition Correlation | P1682 | Detect a continuous or intermittent OOC in the Run/Crank Ignition Voltage & ETC Run/Crank Ignition Voltage | \|Run/Crank – ETC Run/Crank\| > 3 V | Ignition in unlock/accessory, run or crank<br>System voltage >5.23 V & Powertrain Relay Commanded on. | 14/14 counts , 12.5msec loop time, in Main processor | DTC Type A |
| Control Module Throttle Actuator Position Performance | P2101 | 1. Detect a throttle positioning error<br>2. Detect excessive motor driver current (PWM) | 1. Difference between measured throttle position and modeled throttle position > 8 %<br>2. Motor driver PWM output > Thresh. Thresh based on system voltage. | 1. Ignition in run or crank<br>[(RPM>0 and system voltage > 5.5 Volts) OR ( RPM=0 and not in battery<br>saver mode and System voltage > 11.0 Volts)]<br>Throttle not at default position<br><br>2. NA<br><br>No ignition correlation DTC active | 1. 15/15 counts continuous<br><br>2. Check runs every 12.5 msec 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 |
|---|---|---|---|---|---|---|
| Accelerator Pedal Position (APP) Sensor 1 | P2120 | 1. Detect a continuous or intermittent short or open in the APP sensor #1 on Main processor<br>2. Detect a continuous or intermittent short or open in the APP sensor #1 on MHC processor | 1. APP1 < 0.325 V OR APP1 > 4.75 V<br>2. APP1< 0.325 V OR APP1 > 4.75 V | Ignition in unlock/accessory, run or crank<br>System voltage >5.23 V<br>No 5 Volt reference DTCs | 1. 18/38counts or 13counts continuous; 12.5 msec/count in the Main processor<br>2. 18/38counts or 13counts continuous; 12.5 msec/count in the MHC processor | DTC Type A |
| Accelerator Pedal Position (APP) Sensor 1 Lo | P2122 | Detect a continuous or intermittent short or open in the APP sensor #1 on Main processor | APP 1 < 0.325 V | Ignition in unlock/accessory, run or crank<br>System voltage >5.23 V<br>No 5 Volt reference DTCs | 18/38counts 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 V | Ignition in unlock/accessory, run or crank<br>System voltage >5.23 V<br>No 5 Volt reference DTCs | 18/38counts 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<br>2. Detect a continuous or intermittent short or open in the APP sensor #1 on MHC processor | 1. APP2 < 0.325 V OR APP2 > 4.75 V<br>2. APP2< 0.325 V OR APP2 > 4.75 V | Ignition in unlock/accessory, run or crank<br>System voltage >5.23 V<br>No 5 Volt reference DTCs | 1. 18/38counts or 13counts continuous; 12.5 msec/count in the Main processor<br>2. 18/38counts 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 V | Ignition in unlock/accessory, run or crank<br>System voltage >5.23 V<br>No 5 Volt reference DTCs | 18/38counts 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 V | Ignition in unlock/accessory, run or crank<br>System voltage >5.23 V<br>No 5 Volt reference DTCs | 18/38counts or 13 counts continuous; 12.5 msec/count in the Main processor | DTC Type A |
| Throttle Position (TP) Sensor 1-2 Correlation | P2135 | 1. Detects a continuous or intermittent correlation fault between TP sensor #1 and #2 | 1. Absolute difference between TPS1 displaced and TPS2 displaced > 6.4545 % offset at min. throttle position with an increasing window offset of 10% at max. throttle position for Main processor<br>2. Absolute difference between TPS1 displaced and TPS2 displaced > 6.4545% offset at min. throttle position with an increasing window offset of 10% at max. throttle position for MHC processor | Ignition in unlock/accessory, run or crank<br>System voltage >5.23 V<br>No 5 Volt reference DTCs<br>No TPS circuit DTCs | 1. 79/159 counts intermittent or 60 counts continuous; 3.125 msec/count in the Main processor<br>2. 19/39 counts intermittent or 15 counts continuous; 12.5 msec/count in the MHCprocessor | 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 1-2 Correlation | P2138 | Detect an invalid minimum mechanical position correlation between APP sensor #1 and #2 | 1. Absolute difference between PPS1 and PPS2 displaced > 8.0% offset at min. pedal position with an increasing window offset of 10% at max. pedal position for Main processor.<br><br>2. Absolute difference between PPS1 and PPS2 displaced > 8.0% offset at min. pedal position with an increasing window offset of 10% at max. pedal position for MHC processor.<br><br>OR<br><br>3. Absolute difference between min. learned PPS#1 and min. learned PPS#2 > 5.0% for the Main processor.<br><br>4. Absolute difference between min. learned PPS#1 and min. learned PPS#2 > 5.0% for the MHC processor. | 1. Ignition in unlock/accessory, run or crank<br>System voltage >5.23 V<br>No 5 Volt reference DTC's<br>No APS circuit DTCs<br><br>2. Ignition in unlock/accessory, run or crank<br>System voltage >5.23 V<br>No 5 Volt reference DTC's<br>No APS circuit DTCs | 1. 19/39 counts intermittent or 15 counts continuous, 12.5 msec/count in the Main processor<br><br>2. 19/39 counts intermittent or 15 counts continuous, 12.5 msec/count in the MHC processor<br><br>3. 19/39 counts intermittent or 15 counts continuous, 12.5 msec/count in the Main processor<br><br>4. 19/39 counts intermittent or 15 counts continuous, 12.5 msec/count in the MHC processor | DTC Type A |
| Sudden High Airflow Detected | P2172 | Sudden increase in engine RPM during Idle Speed Control. conditions | Idle Speed Control RPM error >= 500 RPM | Engine running >= 3.0 seconds<br>Ambient Air Pressure >= 0.0 kPa<br>Engine Coolant Temperature >= -40 deg C<br>Engine Induction Air Temperature >= -40 deg C<br>11 volts <= system voltage <= 18 volts<br><br>Idle Speed Control conditions >= 6.0 seconds<br><br>No throttle actuation DTCs<br>No TPS circuit DTCs<br>No Vehicle Speed errors or DTCs<br>No Catalyst Monitor Diagnostic Intrusive Mode present | 5/10 counts intermittent; 100 msec/count | 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 |
|---|---|---|---|---|---|---|
| Minimum Throttle Position Not Learned | P2176 | TP minimum learning not completed | 1. TPS > 0.764 Volts during TPS min learn on the Main processor<br><br>2. TPS > 0.764 Volts during TPS min learn on the MHC processor<br><br>OR<br><br>3. Obstruction Removal Cycles >= 10 counts during TPS min learn on the Main processor; 50 msec/count<br><br>OR<br><br>4. Obstruction Removal Cycle occurs during TPS min learn on the Main processor and Engine Coolant Temperature > 100 deg C. | Minimum TPS learn active state<br>Stable throttle position reading for 40 msec<br>Ignition in run or crank<br><br>No TPS circuit DTCs | 1. 1.8secs during first Ignition run initiation in the Main processor<br><br>2. 1.8secs during first Ignition run initiation in the Main processor<br>3. 1.8secs during first Ignition run initiation in the Main processor<br><br>4. 1.8secs during first Ignition run initiation in the Main processor | DTC Type A |
| Transmission Torque Reduction Signal Fault | P2544 | GMLAN corruption detected on specific Torque Reduction Request signals | Transmission Torque Signal Protection Error Sum >= 16 counts; 12.5 msec/count<br><br>Transmission Torque Signal Alive Error Sum >= 6 counts; 12.5 msec/count<br><br>Transmission Torque Signal RAM Error Sum >= 3 counts; 12.5 msec/count<br><br>Transmission Torque Signal Max. Range Exceeded Sum >= 3 counts; 12.5 msec/count | Engine running<br><br>No ECM/TCM Communication Faults | 2 counts/2 seconds intermittent; 100 msec/count | DTC Type B |

6

| Table MAP/MAF/Throttle Position Correlation (P0068) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Throttle Position | | | | | | | | |
| | 10.00061 | 14.99939 | 19.99969 | 25 | 30.00031 | 35.00061 | 39.99939 | 44.99969 | 99.99847 |
| MAF | 15.75781 | 19.75 | 28.4375 | 37.13281 | 20.59375 | 255 | 255 | 255 | 255 |
| MAP | 46.17969 | 39.73438 | 41.38281 | 43.03125 | 25.89844 | 100 | 100 | 100 | 100 |

| Table difference between IAT and ECT at start up (P0116) |
|---|

| 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 |
|---|---|---|---|---|---|---|

| | IAT | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -40 | -28 | -16 | -4 | 8 | 20 | 32 | 44 | 56 | 68 | 80 | 92 | 104 | 116 | 128 | 140 | 152 |
| Difference | 79.5 | 79.5 | 79.5 | 60 | 60 | 39.75 | 39.75 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |

| Table Engine Coolant Temperature Below Thermostat Regulating Temperature (P0128) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Startup IAT <= 10C, Target temp 70C | | | | | | | | | | |
| | Start up ECT | | | | | | | | | | |
| | -40 | -28 | -16 | -4 | 8 | 20 | 32 | 44 | 56 | 68 | 80 |
| Total Airflow | 12018 | 11332 | 10645 | 9959 | 9272 | 8586 | 7900 | 7213 | 6527 | 5840 | 5154 |
| | | | | | | | | | | | |
| | Startup IAT > 10C, Target temp 71C | | | | | | | | | | |
| | Start up ECT | | | | | | | | | | |
| | -40 | -28 | -16 | -4 | 8 | 20 | 32 | 44 | 56 | 68 | 80 |
| Total Airflow | 9732 | 9104 | 8476 | 7849 | 7222 | 6594 | 5966 | 5339 | 4711 | 4084 | 3456 |

| 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 |
|---|---|---|---|---|---|---|
| Replace Hybrid Battery Pack | P0A80 | This DTC indicates the Battery Pack resistance has increased such that it affects the hybrid vehicle performance. | Pack_Resistance> Resistance_Criteria<br><br>Where Resistance_Criteria = TempFactorLookup+ SOCFactorLookup;<br>Where TempFactorLookup(T) =<br>-40 .1<br>-30 .1<br>-20 .1<br>-10 .1<br>0 .1<br>10 .1<br>20 .055<br>30 .055<br>40 .055<br>50 .055<br>60 .055<br>70 .055<br>80 .055<br>90 .055<br>100 .055<br>110 .055<br>120 .055<br>Where SOCFactorLookup(SOC)=<br>0 .007<br>10 .007<br>20 .004<br>30 .003<br>40 .001<br>50 0<br>60 0<br>70 0<br>80 .0015<br>90 .003<br>100 .003 | Battery Voltage = VALID<br>Battery Current = VALID<br>Battery Temperature = VALID<br>Battery State of Charge = VALID<br>Battery Resistance Low = VALID<br>Battery Resistance Severe Low = VALID<br>Battery Resistance Calc. Regression = VALID<br>AND<br>All Current Sensor Faults = NOT FAIL<br>All Voltage Sensor Faults = NOT FAIL<br>AND NOT<br>Battery Temperature < -7 C<br>Battery State of Charge > 90 % | 1100 test failures in a 1150 test samples<br><br>Frequency:<br>1 sample/500 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 |
|---|---|---|---|---|---|---|
| SOH - Delta V - Voltage Deviation High | P1A59 | Checks the deviation of the voltage across the battery pack using the 3 module voltage sensors. If one module within the pack is bad, it will manifest itself in a high Delta – V. | If<br>ModuleVolt1 AND ModVolt2 AND ModVolt3 = VALID<br>MAX(ModuleVolt1, ModuleVolt2, ModuleVolt3)-MIN (ModuleVolt1, ModuleVolt2, ModuleVolt3) > 0.6 V<br><br>If 1 (qty) ModuleVolt = INVALID<br>AND<br>PackVoltage = VALID<br>Then<br>CorrectedModVolt = PackVoltage – Module VoltageX1 – ModuleVoltage X2<br>Where X1 and X2 are the VALID signal readings<br>Then<br>MAXcorrected (ModuleVolt1, ModuleVolt2, ModuleVolt3)-MINcorrected (ModuleVolt1, ModuleVolt2, ModuleVolt3) > 3 V | ModuleVolt1 = VALID<br>ModuleVolt2 = VALID<br>ModuleVolt3 = VALID<br>OR<br>1 ModuleVolt = INVALID<br>AND<br>PackVoltage = VALID | 60 test failures in a 100 test samples<br><br>Frequency:<br>1 sample/100 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 |
|---|---|---|---|---|---|---|
| SOH - Delta T - Temperature Deviation High | P1A5A | Checks the deviation of the temperature across the battery pack using the 6 temperature sensors. If one module within the pack is bad, it should manifest itself in a high Delta – T. | If \|ModuleTemp1a – ModuleTempsAvg\| > DeltaT_Threshold OR<br>\|ModuleTemp1b – ModuleTempsAvg\| > DeltaT_Threshold OR<br>\|ModuleTemp2a – ModuleTempsAvg\| > DeltaT_Threshold OR<br>\|ModuleTemp2b – ModuleTempsAvg\| > DeltaT_Threshold OR<br>\|ModuleTemp3a – ModuleTempsAvg\| > DeltaT_Threshold OR<br>\|ModuleTemp3b – ModuleTempsAvg\| > DeltaT_Threshold<br><br>Where DeltaT_Threshold (in: Tpack, out: temp thresh)=<br>[-40 4<br>-30 4<br>-20 4<br>-10 4<br>0 4<br>10 4<br>20 4<br>30 4<br>40 4<br>50 4<br>60 4] | BatteryModuleTemperature1a = VALID<br>BatteryModuleTemperature1b = VALID<br>BatteryModuleTemperature2a = VALID<br>BatteryModuleTemperature2b = VALID<br>BatteryModuleTemperature3a = VALID<br>BatteryModuleTemperature3b = VALID | 80 test failures in a 100 test samples<br><br>Frequency:<br>1 sample/100 ms | DTC Type B |
| Voltage Sensor 1 Ckt Performance | P1A25 | Rationality Check for the Module Voltage Sensor 1 Located at the ESCM | If \|ModuleVoltage1 – ModuleVoltsAvg\| > 6 V<br><br>ModuleVoltsAvg = MIDDLE(ModVolt1, ModVolt2, ModVolt3) + (PackVoltage/3) + PowerElectronicsVolt/3) / 3 | Pack Voltage = VALID<br>Startup Timer > 6 sec<br>Battery Current = VALID<br>-5 A < Battery Current < 5 A | Frequency:<br>1 sample/100 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 |
|---|---|---|---|---|---|---|
| Voltage Sensor 2 Ckt Performance | P1A2C | Rationality Check for the Module Voltage Sensor 2 Located at the ESCM | If \|ModuleVoltage2 – ModuleVoltsAvg\| > 6 V<br><br>ModuleVoltsAvg = MIDDLE(ModVolt1, ModVolt2, ModVolt3) + (PackVoltage/3) + PowerElectronicsVolt/3) / 3 | Pack Voltage = VALID<br>Startup Timer > 6 sec<br>Battery Current = VALID<br>-5 A < Battery Current < 5 A | Frequency:<br>1 sample/100 ms | DTC Type B |
| Voltage Sensor 3 Ckt Performance | P1A33 | Rationality Check for the Module Voltage Sensor 3 Located at the ESCM | If \|ModuleVoltage3 – ModuleVoltsAvg\| > 6 V<br><br>ModuleVoltsAvg = MIDDLE(ModVolt1, ModVolt2, ModVolt3) + (PackVoltage/3) + PowerElectronicsVolt/3) / 3 | Pack Voltage = VALID<br>Startup Timer > 6 sec<br>Battery Current = VALID<br>-5 A < Battery Current < 5 A | Frequency:<br>1 sample/100 ms | DTC Type B |
| Hybrid Battery Positive Contactor Circuit Stuck Open | P0AA2 | Checks if Battery Contactor is Stuck Open. | If Contactor Command = Closed AND<br>Contactor Close Timer > 0.2 sec AND<br>Contactor State != Closed | RunCrankActive = TRUE<br>Voltage Across Contactor < 2 V<br>PEB_Voltage > 0 V<br>BatteryPack_Voltage > 0 V | Once Per Contactor Close Command | DTC Type B |
| Temperature Sensor 1a Ckt Performance | P0A9C | Rationality Check for the Temperature Sensor 1a Located at the ESCM | If \|ModuleTemp1a – ModuleTempsAvg\| > BattRat_Thresh<br><br>Where BattRat_Thresh =<br>(in: Tpack, out: temp thresh)=<br>[-40 8<br>-30 8<br>-20 8<br>-10 8<br>0 8<br>10 8<br>20 8<br>30 8<br>40 8<br>50 8<br>60 8] | BatteryModuleTemperature1a = VALID | 30 test failures in a 40 test samples<br>Frequency:<br>1 sample/100 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 |
|---|---|---|---|---|---|---|
| Temperature Sensor 1b Ckt Performance | P0AC6 | Rationality Check for the Temperature Sensor 1b Located at the ESCM | If \|ModuleTemp1b – ModuleTempsAvg\| > BattRat_Thresh<br><br>Where BattRat_Thresh = (in: Tpack, out: temp thresh)= [-40 8<br>-30 8<br>-20 8<br>-10 8<br>0 8<br>10 8<br>20 8<br>30 8<br>40 8<br>50 8<br>60 8] | BatteryModuleTemperature1b = VALID | 30 test failures in a 40 test samples<br>Frequency:<br>1 sample/100 ms | DTC Type B |
| Temperature Sensor 2a Ckt Performance | P0ACB | Rationality Check for the Temperature Sensor 2a Located at the ESCM | If \|ModuleTemp2a – ModuleTempsAvg\| > BattRat_Thresh<br><br>Where BattRat_Thresh = (in: Tpack, out: temp thresh)= [-40 8<br>-30 8<br>-20 8<br>-10 8<br>0 8<br>10 8<br>20 8<br>30 8<br>40 8<br>50 8<br>60 8] | BatteryModuleTemperature2a = VALID | 30 test failures in a 40 test samples<br>Frequency:<br>1 sample/100 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 |
|---|---|---|---|---|---|---|
| Temperature Sensor 2b Ckt Performance | P0AE9 | Rationality Check for the Temperature Sensor 2b Located at the ESCM | If \|ModuleTemp2b – ModuleTempsAvg\| > BattRat_Thresh<br><br>Where BattRat_Thresh = (in: Tpack, out: temp thresh)= [-40 8<br>-30 8<br>-20 8<br>-10 8<br>0 8<br>10 8<br>20 8<br>30 8<br>40 8<br>50 8<br>60 8] | BatteryModuleTemperature2b = VALID | 30 test failures in a 40 test samples<br>Frequency:<br>1 sample/100 ms | DTC Type B |
| Temperature Sensor 3a Ckt Performance | P1A19 | Rationality Check for the Temperature Sensor 3a Located at the ESCM | If \|ModuleTemp3a – ModuleTempsAvg\| > BattRat_Thresh<br><br>Where BattRat_Thresh = (in: Tpack, out: temp thresh)= [-40 8<br>-30 8<br>-20 8<br>-10 8<br>0 8<br>10 8<br>20 8<br>30 8<br>40 8<br>50 8<br>60 8] | BatteryModuleTemperature3a = VALID | 30 test failures in a 40 test samples<br>Frequency:<br>1 sample/100 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 |
|---|---|---|---|---|---|---|
| Temperature Sensor 3b Ckt Performance | P1A1C | Rationality Check for the Temperature Sensor 3b Located at the ESCM | If \|ModuleTemp3b – ModuleTempsAvg\| > BattRat_Thresh<br><br>Where BattRat_Thresh = (in: Tpack, out: temp thresh)= [-40 8<br>-30 8<br>-20 8<br>-10 8<br>0 8<br>10 8<br>20 8<br>30 8<br>40 8<br>50 8<br>60 8] | BatteryModuleTemperature3b = VALID | 30 test failures in a 40 test samples<br>Frequency:<br>1 sample/100 ms | DTC Type B |
| Battery Pack Over Current | P1AB0 | Battery Pack Over Current. May have Cleared Fuse. | Battery Pack Current > 140<br>OR<br>Battery Pack Current < -330 | Battery Pack Current = VALID<br>Current Sensor Out of Range Diagnostics and Performance (P0AC0, P0AC1, P0AC2, P1A48, P1A48) = NOT FAIL | 40 test failures in a 42 test samples<br><br>Frequency:<br>1 sample/50 ms | DTC Type A |
| Pack Voltage Circuit Performance | P0ABB | Rationality Check for the Voltage Sensor Located in the ESCM | \|BatteryPackVoltage-PackRatMean_Volt\|> 5<br><br>PackRatMean_Volt = PowerElectronicsVolt + ModVolt1+ModVolt2+ModVolt3 / 2. | Battery Pack Voltage Validity = VALID<br>Startup Timer > 6 sec<br>Battery Current = VALID<br>-5 A < Battery Current < 5 A | 9 test failures in a 10 test samples<br><br>Frequency:<br>1 sample/100 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 |
|---|---|---|---|---|---|---|
| Auxilliary Transmission Fluid Pump Performance (Passive test) | P2797 | To detect the Auxiliary Transmission Fluid Pump is not creating enough pressure in the Transmission to keep the pressure switch closed. | Passive Test<br>This diagnostic checks to see if the transmission auxiliary pump is running. If the pump is determined to be off, using x out of y logic, then fail the test and set a DTC.<br>If we get 160 bad samples out of 320 then diagnostic fails using the RPND4 PSM switch to tell us that the auxiliary transmission fluid pump is on<br>If test runs to completion the Auxpump Test completed flag is set to true and the intrusive part of the test is not run during this ignition cycle. | Passive Test<br>IF<br>The diagnostic system has not been disabled, *and* The Diagnostic is enabled, *and* (hybrid engine off=TRUE, *and* Transmission temperature is is greater than **10c and** less than **100C**, *and* the run/crank ignition voltage is within range, *and the* PSM input PRND4 is valid, *and* on board prime is not active, *and* enough time has passed to allow the pump pressure to stabilize 2 seconds<br>Then<br>Set **diagnostic enable** equal to TRUE when all of the preceding conditions are met, otherwise Set equal to FALSE. | Passive Test<br>Runs during Hybrid Engine Off every 12.5ms 160 fails out of 320 samples It takes approximately 7 seconds to determine a pass or fail. | B |
| Auxilliary Transmission Fluid Pump Performance (Pump Prime) | P2797 | To detect the Auxiliary Transmission Fluid Pump is not creating enough pressure in the Transmission to keep the pressure switches closed. | On Board Prime<br>The three PSM switches are read during a hybrid engine off event while the aux pump is commanded on if all of switches do not read on then the voltage to the pump is increased for a calibrated amount of time (**30 seconds**) if the three switches are still off (0)then a fault is set. | On Board Prime<br>The following conditions must be met to enable On Board Prime.<br>SbHYBC_PumpPrimeNeeded == CbTRUE and (SeHYBC_b_EngineRunningPrev == CbFALSE)<br>and(LeHYBC_b_EngineRunning == CbTRUE) | On Board Prime<br>Runs during Hybrid Engine Off | 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 |
|---|---|---|---|---|---|---|
| Transmission Fluid Pressure (TFP) Position Switch - Stuck Off | P1808 | To determine if the PRND4 PSM switch circuit is open or stuck off | This function checks the PRND4 PSM switch to see if it is Off when it should be on.<br>Each time the function is called a sample timer is incremented,<br>If VeHYBI_b_DRI_D_Raw =FALSE then the fail counter is also incremented<br>If fail counter >= 80 counts out of sample counts 160<br>Then<br>Report test Fail<br>If sample count = 160 and fail count less than 80<br>Then report test pass | The PRND4 PSM Switch Stuck Off diagnostic is enabled under the following conditions:<br>Calibration KeHYBD_b_PRND4_StkOffEnbld == True<br>And GetEPSR_b_CrankSnsr_FA() == CbFALSE (no crank sensor faults)<br>and VeHYBI_b_DRI_D_R_StateVld == True<br>and VeEPSR_b_EngineRunning = = True<br>And VeHYBI_b_DRI_D_Raw == FALSE<br><br>This function uses the results of the PRND4 PSM Capture function which reads the value of the switch and determines if it is within the valid range. | Frequency -25ms<br>Continuously while engine is running | B |
| Transmission Fluid Pressure (TFP) Position Switch - Stuck On | P1809 | To determine if the PRND4 PSM switch circuit is short to ground or stuck on | This function checks the PRND4 PSM switch to see if it is On when it should be off.<br>If VeHYBI_b_DRI_D_Raw = TRUE for 2 seconds after key off then<br>Report test failed<br>If VeHYBI_b_DRI_D_RAW = False for 1 second<br>Then report test passed | The PRND4 PSM Switch Stuck On diagnostic is enabled under the following conditions:<br>VePMDR_b_RunCrankActive != TRUE, (KEy off)<br><br>And KeHYBD_b_PressNoPressEnbl = TRUE<br><br>And If ( VeHYBD_t_EnblPressIndDepress >= 5.5 seconds (wait 5.5 seconds after key off to let pressure settle)<br>And Vehicle Speed == 0.0<br>And Engine movement detected == FALSE<br>And VeHYBD_b_PRND4_ShutdownEnbld == CbFALSE | Frequency 25ms<br>Power mode not equal Run Crank | B |

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|---|---|---|---|---|---|---|
| Starter/Generator System No Crank at Restart | P1A6F | To determine performance failure of the Hybrid Motor Generator | This function performs the motor generator restart failed diagnostic.<br>If (VeENED_Cnt_MG_RestartFailedCntr >= 2 fails)<br>Then<br>Report Test Failed using CeDFIR_e_SGCM_NoCrankAtRestart | The Hybrid Restart Failed Diagnostic is enabled under the following conditions:<br><br>VeDRER_DiagSystemDsbl is equal to FALSE (the diagnostic system has not been disabled),<br><br>*And* The calibration KeENED_b_MG_RestartFailedEnbld is equal to TRUE (test is intended to run in this application),<br>*And* VeENED_b_HB_GenrPerf_FAis equal to FALSE (there are no belt slip faults),<br>*And* VePMDR_b_RunCrankActive does not equal False (the ignition switch is in the run/crank position),<br>*And* VeHYBR_b_MtrTorqDlvdPerf_FA is equal to FALSE (there are no MGU torque delivered faults)<br>And VeEONV_Pct_FuelLevel > KeENED_Pct_MinFuelRestart (10%)<br><br>then<br>Set VeENED_b_MG_RestartFailedEnbld equal to TRUE<br>esle VeENED_b_MG_RestartFailedEnbld equal to FALSE. | Always executes during Hybrid Engine Off at 25ms | B |

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|---|---|---|---|---|---|---|
| Hybrid Generator Performance | P0A92 | The monitor is used to determine if the mechanical drive belt connection the Engine and the Motor Generator has faulted. | If (25 < VeENED_n_MtrGenrWghtResdl EWMA < -25) | If VeDRER_DiagSystemDsbl is equal to FALSE (the diagnostic system has not been disabled)<br>*And* The calibration KeENED_b_BeltSlRatltyEnbld is equal to TRUE (rationality test is intended to run in this application),<br>*And* VeEPSR_b_CKP_SnsrFaultActive is equal to FALSE (there are no crank sensor faults),<br>*And* VeECTR_b_ECT_SnsrFA is equal to FALSE (there are no engine coolant temperature sensor faults),<br>*And* VeMAPR_b_MAP_SnsrFA is equal to FALSE (there are no mass air flow sensor faults),<br>*And* VeEITR_b_IAT_SnsrCktFA is equal to FALSE (there are no intake air temperature sensor faults),<br>*And* VeENER_b_MG_TempVldty is equal to TRUE (there are no motor/generator temperature faults),<br>*And* VeENER_b_MG_AnglrPstnVldty is equal to TRUE (there are no motor/generator position sensor faults),<br>*And* VeENER_b_MG_SpdVldty is equal to TRUE (there are no motor/generator speed faults),<br>*And* VeENER_b_MG_DlvdTorqVldty is equal to TRUE (there are no motor/generator torque delivered faults)<br>Then<br>Set VeENED_b_BeltSlRatltyEnbld = TRUE<br>Else<br>VeENED_b_BeltSlRatltyEnbld = FALSE. | Always Executes has conditional logic | B |

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|---|---|---|---|---|---|---|
| Base Brake Pressure (BPS) Sensor Performance | C1101 | This DTC Detects a BPS Input Value stuck in the valid range below the threshold that indicates the brake is on. Approximate threshold is 10% of full scale input. | Vehicle Speed above a threshold (approximately 40 kph) followed by Vehicle Stop indicated<br>**AND**<br>No indication that brake pressure went above the brake on threshold for a six consecutive samples | Run/Crank ignition in range<br>Engine Running<br>BPS sensor high/low DTCs not active<br>Vehicle Speed DTCs not active<br>Transmission in drive | Quasi-Continuous<br><br>A single sample consists of the Vehicle Speed above 40 kph followed by Vehicle Stop | DTC Type B |
| Base Brake Pressure (BPS) Sensor Circuit Low | C1102 | This DTC detects a continuous short to low or open in either the signal circuit or the BPS sensor. | BPS voltage < 3% of Vref (0.15 volts) | Run/Crank ignition in range | 80 test failures in 160 test samples<br><br>1 sample/12.5 ms | DTC Type B |
| Base Brake Pressure (BPS) Sensor Circuit High | C1103 | This DTC detects an open sensor ground or continuous short to high in either the signal circuit or the BPS sensor | BPS voltage > 97% of Vref (4.85 volts) | Run/Crank ignition in range | 80 test failures in 160 test samples<br><br>1 sample/12.5 ms | DTC Type B |
| Control Module Communication Bus Off<br><br>(Automatic transmission) | U0073 | Detects that a CAN serial data bus shorted condition has occurred to force the CAN device driver to enter a bus-off state. | CAN device driver has reported that it has entered a bus-off state. | | 5 seconds<br><br>Frequency:<br>Continuous<br>1 second loop | DTC Type B |
| Lost Communication with TCM<br><br>(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. | | 12 seconds<br><br>Frequency:<br>Continuous<br>1 second loop | DTC Type B |
| Lost Communication with Battery Energy Control Module (ESCM) | U0111 | Detects that CAN serial data communication has been lost with the ESCM. | Lost communication with the ESCM while the ignition switch is in the RUN power mode. | | 12 seconds<br><br>Frequency:<br>Continuous<br>1 second loop | DTC Type B |
| Lost Communication with Starter Generator Control Module (SGCM) | U0120 | Detects that CAN serial data communication has been lost with the SGCM. | Lost communication with the SGCM while the ignition switch is in the RUN power mode. | | 12 seconds<br><br>Frequency:<br>Continuous<br>1 second loop | DTC Type B |
| Lost Communication with ABS Control Module (EBCM) | U0121 | Detects that CAN serial data communication has been lost with the EBCM. | Lost communication with the EBCM while the ignition switch is in the RUN power mode. | | 12 seconds<br><br>Frequency:<br>Continuous<br>1 second loop | DTC Type B |