Component Procedures: Computers and Control Systems

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Component Procedures: Computers and Control Systems

Parts and Labor (itype_189)

Labor

Operation	Qualifier Path	Skill	Std Hrs	Wty Hrs
Test	Powertrain Control > Pinpoint, Test	B	0.4	0.0
Remove & Replace	Controls > Control Module, R&R > Body Control	B	0.8	0.6
Remove & Replace	Powertrain Control > Camshaft Position Sensor?	B	0.5	0.4
Remove & Replace	Powertrain Control > Camshaft Position Sensor?	B	0.3	0.2
Remove & Replace	Powertrain Control > Coolant Temp Sensor, R&R	B	1.5	0.0
Remove & Replace	Powertrain Control > Crankshaft Position Sens?	B	0.5	0.3
Remove & Replace	Powertrain Control > ECM, R&R	B	0.6	0.5
Remove & Replace	Powertrain Control > Knock Sensor, R&R > One ?	B	0.5	0.3
Remove & Replace	Powertrain Control > Knock Sensor, R&R > Both?	B	0.7	0.0
Remove & Replace	Powertrain Control > Mass Air Flow Sensor, R&R	B	0.3	0.2
Remove & Replace	Powertrain Control > Oxygen Sensor, R&R > Fro?	B	0.3	0.2
Remove & Replace	Powertrain Control > Oxygen Sensor, R&R > Fro?	B	0.4	0.3
Remove & Replace	Powertrain Control > Oxygen Sensor, R&R > Rea?	B	0.3	0.2
Remove & Replace	Powertrain Control > Vehicle Speed Sensor, R&R	B	0.6	0.0
Inspect	Powertrain Control > Diagnostic Circuit, Insp?	B	0.5	0.0
Inspect	Powertrain Control > Diagnostic Circuit, Insp?		0.9	
Reprogram	Powertrain Control > ECM, Reprogram	B	0.5	0.0

Camshaft Actuator System Description (Article 11084)

Figure 1: Camshaft Actuator System Overview

The camshaft actuator system enables the engine control module (ECM) to change camshaft timing of all 4 camshafts while the engine is operating. The camshaft position (CMP) actuator assembly (15) varies the camshaft position in response to directional changes in oil pressure. The CMP actuator solenoid valve controls the oil pressure that is applied to advance or retard a camshaft. Modifying camshaft timing under changing engine demand provides better balance between the following performance concerns:

- Engine power output
- Fuel economy
- Tailpipe emissions

The CMP actuator solenoid valve (7) is controlled by the ECM. The crankshaft position (CKP) sensor and the CMP sensor s are used to monitor changes in camshaft positions. The ECM uses the following information in order to calculate the desired camshaft positions:

- Engine coolant temperature
- Calculated engine oil temperature (EOT)
- Mass air flow (MAF)
- Throttle position (TP)
- Vehicle speed
- Volumetric efficiency

Operation

The CMP actuator assembly has an outer housing that is driven by an engine timing chain. Inside the assembly is a rotor with fixed vanes that is attached to the camshaft. Oil pressure that is applied to the fixed vanes will rotate a specific camshaft in relationship to the crankshaft. The movement of the intake camshafts will advance the intake valve timing. The movement of the exhaust camshafts will retard the exhaust valve timing. When oil pressure is applied to the return side of the vanes, the camshafts will return to 0 crankshaft degrees, or top dead center (TDC). The CMP actuator solenoid valve directs the oil flow that controls the camshaft movement. The ECM commands the CMP solenoid to move the solenoid plunger and spool valve until oil flows from the advance passage (11). Oil flowing thru the CMP actuator assembly from the CMP solenoid advance passage applies pressure to the advance side of the vanes in the CMP actuator assembly. When the camshaft position is retarded, the CMP actuator solenoid valve directs oil to flow into the CMP actuator assembly from the retard passage (3). The ECM can also command the CMP actuator solenoid valve to stop oil flow from both passages in order to hold the current camshaft position.

The ECM operates the CMP actuator solenoid valve by pulse width modulation (PWM) of the solenoid coil. The higher the PWM duty cycle, the larger the change in camshaft timing. The CMP actuator assembly also contains a lock pin (14) that prevents movement between the outer housing and the rotor vane assembly. The lock pin is

released by oil pressure before any movement in the CMP actuator assembly takes place. The ECM is continuously comparing CMP sensor inputs with CKP sensor input in order to monitor camshaft position and detect any system malfunctions. If a condition exists in either the intake or exhaust camshaft actuator system, the opposite bank, intake or exhaust, camshaft actuator will default to 0 crankshaft degrees.
Driving Condition Change in Camshaft Position Objective Result
Idle No Change Minimize Valve Overlap Stabilized Idle Speed
Light Engine Load Retarded Valve Timing Decrease Valve Overlap Stabled Engine Output
Medium Engine Load Advanced Valve Timing Increase Valve Overlap Better Fuel Economy with Lower Emissions
Low to Medium RPM with Heavy Load Advanced Valve Timing Advance Intake Valve Closing Improved Low to Mid-range Torque
High RPM with Heavy Load Retarded Valve Timing Retard Intake Valve Closing Improved Engine Output

Temperature Versus Resistance - Engine Coolant Temperature Sensor (Article 11474)

Temperature C°/F° Resistance Minimum Ohms Resistance Maximum Ohms
Engine Coolant Temperature (ECT)
−40/−40 40,490 50,136
−20/−4 14,096 16,827
−10/14 8,642 10,152
0/32 5,466 6,326
20/68 2,351 2,649
25/77 1,941 2,173
40/104 1,118 1,231
60/140 573 618
80/176 313 332
100/212 182 191
120/248 109 116
140/284 068 074

Altitude Versus Barometric Pressure (Article 11465)

Altitude Measured in Meters (m) Altitude Measured in Feet (ft) Barometric Pressure Measured in Kilopascals (kPa) Barometric Pressure Measured in Pounds Per Square Inch (PSI)
Determine your altitude by contacting a local weather station or by using another reference source.
4,267 14,000 56–64 8.1–9.3
3,962 13,000 58–66 8.4–9.6
3,658 12,000 61–69 8.8–10.0
3,353 11,000 64–72 9.3–10.4
3,048 10,000 66–74 9.6–10.7
2,743 9,000 69–77 10.0–11.2
2,438 8,000 71–79 10.3–11.5
2,134 7,000 74–82 10.7–11.9
1,829 6,000 77–85 11.2–12.3
1,524 5,000 80–88 11.6–12.8
1,219 4,000 83–91 12.0–13.2
914 3,000 87–95 12.6–13.8
610 2,000 90–98 13.1–14.2
305 1,000 94–102 13.6–14.8
0 0 Sea Level 96–104 13.9–15.1
−305 −1,000 101–105 14.6–15.2

All New Technical Service Bulletins (itype_432)

Tsbs
- Module Damage From Incorrect AFIT Usage On Vehicles With Direct Fuel Injection (PIP5569B, 2024/05/10)
- Do Not Swap Modules in Vehicles with Global Electrical Systems (25-NA-256, 2025/08/25)
- Warranty Administration - Warranty SPS Control Module Reprogramming (06-08-47-001O, 2019/06/11)
- Identifying Non-GM (Aftermarket) Engine Calibrations for Gasoline Engines Using Tech 2® or GDS 2 (25-NA-122, 2025/12/23)
- Service Programming (SPS) Best Practice and Programming Error Troubleshooting (24-NA-098, 2026/03/10)
- Stalling - Hesitation - Lack Of Performance P018B And/Or P2635 Setting In High Ambient Temperatures (PIP5507B, 2017/07/18)

- LIN Bus Diagnostic Information (PIT5698E, 2024/09/27)
- Identifying Non-GM (Aftermarket) Engine Calibrations for Gasoline Engines Using Tech 2® or GDS 2 (U.S., Canada, Australia, and New Zealand) (09-06-04-026Z, 2025/01/09)

All Technical Service Bulletins (itype_100)

Tsbs
- Engine Controls - Vehicle Stalls When Turning, No DTC's (15-06-04-003, 2015/07/31)
- Engine Controls - MIL ON, DTC's P0300/P0303 Set (PI1122B, 2014/02/10)
- Diagnostic Tips for Reduced Acceleration at Low Speed and/or Transmission Slipping from a Launch, DTC P0751 Set (PI1344C, 2019/07/16)
- Fuel System - MIL ON, Misfire, Injector DTC's Set (PIP4924D, 2014/01/21)
- LIN Bus Diagnostic Information (PIT5698E, 2024/09/27)
- Computers/Controls - Multiple Module Shared DTC's (05-06-04-060A, 2015/02/24)
- Engine Controls - P00C6, P228C Diagnostic Assistance (PIP5209A, 2014/08/18)
- Warranty Administration - Warranty SPS Control Module Reprogramming (06-08-47-001O, 2019/06/11)
- Identifying Non-GM (Aftermarket) Engine Calibrations for Gasoline Engines Using Tech 2® or GDS 2 (25-NA-122, 2025/12/23)
- Identifying Non-GM (Aftermarket) Engine Calibrations for Gasoline Engines Using Tech 2® or GDS 2 (U.S. and Canada) (09-06-04-026X, 2023/07/31)
- Information on Module Harvesting (22-NA-205, 2022/10/19)
- Identifying Non-GM (Aftermarket) Engine Calibrations for Gasoline Engines Using Tech 2® or GDS 2 (U.S., Canada, Australia, and New Zealand) (09-06-04-026Z, 2025/01/09)
- SES Light with Fuel Trim and or Oxygen Sensor Codes (PIP4925B, 2018/12/03)
- Module Damage From Incorrect AFIT Usage On Vehicles With Direct Fuel Injection (PIP5569B, 2024/05/10)
- EPA Summer Grade Gasoline Waiver Allows Use of Winter Grade Surplus Potential Drivability Concerns P0300 P0171 P0174 P228C Fuel Smell Odor Longer Extended Cranking Time Hesitation Engine Stalls (PIP5725A, 2021/03/19)
- Stalling - Hesitation - Lack Of Performance P018B And/Or P2635 Setting In High Ambient Temperatures (PIP5507B, 2017/07/18)
- Fuel System - Cold Start Misfire After Engine/Fuel Sys Repair (PI1296, 2014/08/19)
- A/T Controls - MIL ON/Multiple DTC's Stored in The TCM (PIP4653E, 2014/06/03)
- Engine Ticking Noise or oil pressure fluctuation On Cold Start (PIP5191C, 2018/11/06)
- Do Not Swap Modules in Vehicles with Global Electrical Systems (25-NA-256, 2025/08/25)
- EVAP Emissions Small Leak Diagnosis (DTC P0442) (PIT4943D, 2015/12/09)
- Service Programming (SPS) Best Practice and Programming Error Troubleshooting (24-NA-098, 2026/03/10)
- IPC Odometer Programming Method Quick Reference Guide (07-08-49-020R, 2023/09/21)
- DTC P0016 P0017 P0018 P0019 P0008 P0009 (PIP3423P, 2018/08/08)
- Premature Catalytic Converter Failures (PIP5232C, 2016/03/04)
- Engine - THIS BULLETIN HAS BEEN CANCELED (04-06-04-054E, 2012/08/06)
- Engine Controls - Single Cylinder Misfire Diagnostics (PIP5062C, 2014/05/02)

Customer Interest Bulletins (itype_109)

Tsbs
- Engine Controls - Vehicle Stalls When Turning, No DTC's (15-06-04-003, 2015/07/31)

Repair Tips (itype_110)

Tsbs
- A/T Controls - MIL ON/Multiple DTC's Stored in The TCM (PIP4653E, 2014/06/03)
- Engine Controls - MIL ON, DTC's P0300/P0303 Set (PI1122B, 2014/02/10)
- Fuel System - MIL ON, Misfire, Injector DTC's Set (PIP4924D, 2014/01/21)
- Fuel System - Cold Start Misfire After Engine/Fuel Sys Repair (PI1296, 2014/08/19)
- Computers/Controls - Multiple Module Shared DTC's (05-06-04-060A, 2015/02/24)
- Engine Controls - P00C6, P228C Diagnostic Assistance (PIP5209A, 2014/08/18)
- Engine Controls - Single Cylinder Misfire Diagnostics (PIP5062C, 2014/05/02)

Malfunction Indicator Lamp (MIL) Diagnosis (OBD II Emissions) (Article 11391)

Diagnostic Instructions
- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.

- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Circuit/System Description

The malfunction indicator lamp (MIL) illuminates to inform the driver that an emission system fault has occurred and the engine control system requires service. Ignition voltage is supplied directly to the MIL. The engine control module (ECM) turns the MIL ON by grounding the MIL control circuit when the emission system fault occurs. Under normal operating conditions, the MIL should be ON only when the ignition is ON and the engine is OFF.

Diagnostic Aids

If the condition is intermittent, move the related harnesses and connectors while monitoring the scan tool MIL control circuit status parameters. Perform this test with the ignition ON and the engine OFF, and with the engine running. The MIL control circuit status parameters will change from OK or Not Run to Malfunction. if there is a condition with the circuit or a connection.

Reference Information

Schematic Reference

- Engine Controls Schematics
- Instrument Cluster Schematics

Connector End View Reference

Component Connector End Views

Electrical Information Reference

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

- Ignition ON, command the MIL ON and OFF with a scan tool. The MIL should turn ON and OFF as commanded.
- Command the MIL ON and OFF with a scan tool while observing the control circuit status parameters listed below:
- The MIL Control Circuit Low Voltage Test Status
- The MIL Control Circuit Open Test Status
- The MIL Control Circuit High Voltage Test Status Each parameter should display OK or Not Run.
- Engine running, command the MIL ON and OFF with a scan tool while observing the following control circuit status parameters:

Circuit/System Testing

- Ignition OFF, disconnect the X1 harness connector at the K20 Engine Control Module .
- Ignition ON, the MIL should not illuminate.
- If the MIL is illuminated, test the MIL control circuit terminal X1 46 for a short to ground. If the circuit tests normal, replace the P16 instrument panel cluster.
- Connect a 3 A fused jumper wire between the MIL control circuit terminal X1 46 and ground. The MIL should illuminate.
- If the MIL illuminates, replace the K20 Engine Control Module.
- If the MIL does not illuminate, test the MIL control circuit terminal X1 46 for a short to voltage or an open/high resistance. If the MIL control circuit tests normal, test the instrument cluster ignition voltage circuit for a short to ground or open/high resistance. If the circuit tests normal, replace the P16 instrument panel cluster/bulb.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Instrument Cluster Replacement
- Control Module References for replacement, programming, and setup.

Fuel Injector Solenoid Coil Test (Article 11382)

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Circuit/System Description

The engine control module (ECM) supplies a separate high voltage supply circuit and a high voltage control circuit for each fuel injector . The fuel injector high voltage supply circuit and the high voltage control circuit are both controlled by the ECM. The ECM energizes each fuel injector by grounding the control circuit.

The ECM controls each fuel injector with 65 V. This is controlled by a boost capacitor in the ECM. During the 65 V boost phase, the capacitor is discharged through a fuel injector, allowing for initial injector opening. The fuel injector is then held open with 12 V. A fuel injector coil winding resistance that is too high or too low will affect the engine driveability. The fuel injector coil windings are affected by temperature. The resistance of the fuel injector coil windings will increase as the temperature of the fuel injector increases.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

Master Electrical Component List

Electrical Information Reference

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

Component Testing

- The resistance test must be performed at the fuel injector or mis-diagnosis will occur.
- The DMM and test leads must be calibrated to 0 Ω in order to prevent mis-diagnosis.
- Ignition OFF, all vehicle system OFF, Disconnect the harness connector at the appropriate Q17 Fuel Injector. It may take up to 2 m for all vehicle systems to power down.
- Test for 1–3 Ω at 18-23°C (65-75°F) between the high voltage supply circuit terminal 2 and the high voltage control circuit terminal 1 at the Q17 fuel injector.
- If not within the specified range Replace the Q17 Fuel Injector.
- If within the specified range
- Test for infinite resistance between each terminal at the Q17 Fuel Injector and the Q17 Fuel Injector housing/case.
- If less than infinite resistance Replace the Q17 Fuel Injector.
- If infinite resistance
- All OK, perform the Fuel Injector Balance Test .

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Fuel Injector Replacement

Fuel Injector Balance Test (Article 11378)

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Circuit/System Description

Two methods of testing fuel injector balance are available, the Active Fuel Injector Tester (AFIT) or a scan tool. The Active Fuel Injector Tester and SIDI adaptor connects to the engine control module harness connectors to test the high pressure fuel pump performance, fuel injector wiring, and fuel injector operation. The AFIT displays step by step instructions to precisely determine pressure drop of each fuel injector. The scan tool fuel injector balance test is performed while the engine is running at idle. The scan tool pressurizes the fuel rail to a predetermined pressure before each fuel injector is pulsed for a precise amount of time allowing a measured amount of the fuel to be injected. This causes a drop in the system fuel pressure that is recorded and used to compare each fuel injector.

Diagnostic Aids

- Monitoring the Current Misfire Counters may help to isolate the fuel injector that is causing the condition.
- Operating the vehicle over a wide temperature range may help isolate the fuel injector that is causing the condition.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Fuel System Description

Scan Tool Reference

Control Module References for scan tool information

Special Tools
- CH-47976 - Active Fuel Injector Tester
- CH-47976-500A - Active Fuel Injection Tester (AFIT) SIDI Adapter Kit
For equivalent regional tools, refer to Special Tools

Circuit/System Verification
- Ignition ON.
- Verify the scan tool Fuel Remaining parameter is greater than 10%.
- If the Fuel Remaining parameter is less than 10% , add fuel to the fuel tank .
- If the Fuel Remaining parameter is 10% or greater
- Verify the scan tool ECT Sensor parameter is less than 60°C (140°F).
- If the ECT Sensor parameter is greater than 60°C (140°F) , allow the engine temperature to cool.
- If the ECT Sensor parameter is 60°C (140°F) or less
- Verify the battery is fully charged and all accessories are Off.
- If the battery is not fully charged , charge or repair battery as necessary.
- If the battery is fully charged
- Preform the appropriate Fuel Injector Balance Test in Circuit System Testing.

Circuit System Testing
Fuel Injector Balance Test with Active Fuel Injector Tester
- Ignition OFF, all vehicle systems OFF. Install the CH-47976 - Active Fuel Injector Tester and the CH-47976-500A - Active Fuel Injection Tester (AFIT) SIDI Adapter Kit , refer to the Active Fuel Injector Tester User Guide. It may take up to 2 minutes for all vehicle systems to power down.
- Turn ON the Active Fuel Injector Tester and select the vehicle.
- Ignition ON, perform the Injector Test with the Active Fuel Injector Tester.
- If the Active Fuel Injector Tester aborts testing due to fuel pressure or fuel leak down Refer to Fuel System Diagnosis .
- If the Active Fuel Injector Tester does not abort testing
- Compare the test results with the appropriate recommended tolerance.
- If any fuel injector exceeds the recommended tolerance Replace the appropriate Q17 Fuel Injector(s).
- If all fuel injectors are within the recommended tolerance
- Perform Fuel Injector Circuit Diagnosis .

Fuel Injector Balance Test with Scan Tool
- Command the Fuel Pump Enable ON with a scan tool.
- Verify the fuel pressure is between 345–690 kPa (50–100 PSI) with the fuel pump running.
- If not within 345–690 kPa (50–100 PSI) Refer to Fuel System Diagnosis .
- If within 345–690 kPa (50–100 PSI)
- Verify the fuel pressure does not decrease greater than 34 kPa (5 PSI) within 1 minute.
- If greater than the specified value Refer to Fuel System Diagnosis .
- If less than the specified value
- Engine idling.
- Verify the scan tool Fuel Rail Pressure Sensor 1 parameter is between 1.9–5.0 MPa (276–725 PSI).
- If not between 1.9–5.0 MPa (276–725 PSI) Refer to Fuel System Diagnosis .
- If between 1.9–5.0 MPa (276–725 PSI)
- Select the Fuel Injector Balance function within the Control Functions menu of a scan tool.
- Select and test a Q17 Fuel Injector. Repeat for each Q17 Fuel Injector.
- Obtain and record a pressure drop value for each Q17 Fuel Injector.
- Add all of the individual pressure drop values except for the fuel injector suspected of being faulty. This is the total pressure drop.
- Divide the total pressure drop by the number of fuel injectors that were added together. This is the average pressure drop.
- Multiply the average pressure drop by 0.20. This is the acceptable variance from the average pressure drop, 20%.
- Verify the difference between any individual pressure drop and the average pressure drop is not greater than the acceptable variance.
- If greater than the acceptable variance Replace the Q17 Fuel Injector.
- If within the acceptable variance

Repair Instructions
Perform the Diagnostic Repair Verification after completing the repair.
- Fuel Injection Fuel Rail Assembly Replacement - Bank 1
- Fuel Injection Fuel Rail Assembly Replacement - Bank 2

Fuel Injector Circuit Diagnosis (Article 11380)

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit Short to Ground Open/High Resistance Short to Voltage Signal Performance
Fuel Injector 1 Control + P2147 P0201 P2148 P1248
Fuel Injector 1 Control – P0261 P0201 P0262 P1248
Fuel Injector 2 Control + P2150 P0202 P2151 P1249
Fuel Injector 2 Control – P0264 P0202 P0265 P1249
Fuel Injector 3 Control + P2153 P0203 P2154 P124A
Fuel Injector 3 Control – P0267 P0203 P0268 P124A
Fuel Injector 4 Control + P2156 P0204 P2157 P124B
Fuel Injector 4 Control – P0270 P0204 P0271 P124B
Fuel Injector 5 Control + P216B P0205 P216C P124C
Fuel Injector 5 Control – P0273 P0205 P0274 P124C
Fuel Injector 6 Control + P216E P0206 P216F P124D
Fuel Injector 6 Control – P0276 P0206 P0277 P124D

Circuit/System Description

The engine control module (ECM) supplies voltage to each fuel injector on the injector high voltage supply circuits. The ECM energizes each fuel injector by grounding the high voltage control circuit of the fuel injector. The ECM monitors the status of the injector high voltage supply circuits and the injector high voltage control circuits. When a fuel injector circuit condition is detected by the ECM, the affected fuel injector(s) is disabled.

Diagnostic Aids

- Performing the fuel injector coil test may help isolate an intermittent condition. Refer to Fuel Injector Solenoid Coil Test .
- If the condition is intermittent, move the related harnesses and connectors, with the engine operating, while monitoring the scan tool Injector Control Circuit Status parameters. An Injector Control Circuit Status parameter will change from OK or Not Run to Malfunction if there is a condition with the circuit or a connection.

Reference Information

Schematic Reference
Engine Controls Schematics
Connector End View Reference
Component Connector End Views
Description and Operation
Fuel System Description
Scan Tool Reference
Control Module References for scan tool information

Circuit/System Verification

- Engine idling.
- Verify the scan tool Cylinder 1–6 Current Misfire Counter parameters do not increment.
- If the Cylinder 1–6 Current Misfire Counters increment Refer to Circuit/System Testing.
- If the Cylinder 1–6 Current Misfire Counters do not increment
- Verify the scan tool Cylinder 1–6 Injector Control Circuit Status parameters display OK.
- If the Cylinder 1–6 Injector Control Circuit Status parameters do not display OK Refer to Circuit/System Testing.
- If the Cylinder 1–6 Injector Control Circuit Status parameters display OK
- All OK.

Circuit/System Testing

- Ignition OFF, all vehicle systems OFF. Disconnect the X3 harness connector at the K20 Engine Control Module . It may take up to 2 min for all vehicle systems to power down.
- Test for infinite resistance between the appropriate Q17 Fuel Injector control + circuit and ground.
- If less than infinite resistance
- Disconnect the harness connector of the Q17 Fuel Injector.
- Test for infinite resistance between the Q17 Fuel Injector control + circuit and ground.
- If infinite resistance

- Test for infinite resistance between the Q17 Fuel Injector control – circuit and ground.
- If less than infinite, repair the short to ground in the circuit.
- If infinite, replace the Q17 Fuel Injector.
- Ignition ON.
- Test for less than 1 V between the Q17 Fuel Injector control + circuit and ground.
- If 1 V or greater
- Disconnect the harness connector of the Q17 Fuel Injector, ignition ON.
- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V, repair the short to voltage on the control – circuit.
- If less than 1 V
- Ignition OFF.
- Test for less than 3 Ω between the Q17 Fuel Injector control + circuit and control – circuit.
- If 3 Ω or greater
- Test for less than 2 Ω on the control + circuit end to end.
- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω
- Test for less than 2 Ω on the control – circuit end to end.
- If less than 2 Ω, replace the Q17 Fuel Injector.
- If less than 3 Ω
- Replace the K20 Engine Control Module.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.
- Fuel Injector Replacement
- Control Module References for K20 Engine Control Module replacement, programming, and setup

Fuel Rail Pressure Sensor Test (Article 11384)

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

Circuit/System Description

For an overview of the component/system, refer to: Fuel System Description

Circuit/System Testing
- Perform the following procedure/test: Fuel Pressure Relief
- Install any previously removed components.
- Install » EN-37287 Fuel Line Shut-Off Adapter @ Fuel Feed Pipe
- Open the valve on the tool: EN-37287 Fuel Line Shut-Off Adapter
- Ignition » On / Vehicle » In Service Mode
- Perform the scan tool control function: Fuel Pump Enable » On — Command the function On several times.
- Verify the following parameters are within 68.9 kPa (10 PSI) of each other: Fuel Pressure Sensor & Fuel Rail Pressure Sensor
- If not within 68.9 kPa (10 PSI) of each other
- Ignition/Vehicle » Off
- Close the valve on the tool: EN-37287 Fuel Line Shut-Off Adapter
- Start and idle the engine until it stalls due to lack of fuel. » Repeat — 2 times
- Remove the component: B47B Fuel Rail Pressure Sensor » Refer to: Fuel Pressure Sensor Replacement - Fuel Injection Fuel Rail
- Connect the electrical connector: @ B47B Fuel Rail Pressure Sensor
- Verify the scan tool parameter: Fuel Rail Pressure Sensor = –20.7 to 20.7 kPa (–3 to 3 PSI)
- If not between –20.7 and 20.7 kPa (–3 and 3 PSI) » Replace the component: B47B Fuel Rail Pressure Sensor
- If between –20.7 and 20.7 kPa (–3 and 3 PSI) » Replace the component: B47 Fuel Pressure Sensor
- If within 68.9 kPa (10 PSI) of each other
- All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: Diagnostic Repair Verification
- Fuel Pressure Sensor Replacement - Fuel Injection Fuel Rail
- Fuel Pressure Sensor Replacement - Fuel Feed Pipe

Alcohol/Contaminants-in-Fuel Diagnosis (Article 11091)

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Circuit/System Description

Water contamination in the fuel system may cause driveability conditions such as hesitation, stalling, no start, or misfires in one or more cylinders. Water may collect near a single fuel injector at the lowest point in the fuel injection system and cause a misfire in that cylinder. If the fuel system is contaminated with water, inspect the fuel system components for rust or deterioration.

Ethanol concentrations of greater than 10% in non-blended gasoline or greater than 85% with E85 blended gasoline for flexible fuel applications can cause driveability conditions such as hesitation, lack of power, stalling, or no start. Excessive concentrations of ethanol used in vehicles not designed for it may cause fuel system corrosion, deterioration of rubber components, and fuel filter restriction.

Reference Information

Special Tools

CH 44175–A - Alcohol Tester Kit , if available

For equivalent regional tools, refer to Special Tools .

Circuit/System Verification

- Remove a sample of fuel from the bottom of the fuel tank and place in a clean, clear container.
- Place the sample on a level surface for 2 minutes.
- Verify the sample is clear and bright in color.
- If the sample appears cloudy, or contaminated with water, as indicated by a water layer at the bottom of the sample Refer to Circuit/System Testing — Particulate Contaminants in Fuel.
- If alcohol contamination is suspected Refer to Circuit/System Testing — Alcohol in Fuel Testing.
- If the sample remains clear and bright
- All OK.

Circuit/System Testing

Alcohol in Fuel Testing with Special Tool, If Available

- Test the fuel composition using CH 44175–A - Alcohol Tester Kit and Instruction Manual.
- Verify no water appears in the fuel sample.
- If water appears in the fuel sample Clean the fuel system.
- If no water appears in the fuel sample
- Subtract 50 from the reading on the DMM in order to obtain the percentage of alcohol in the fuel sample.
- Verify the non-blended gasoline fuel sample does not measure greater than 15% or an E85 blended gasoline fuel sample measures greater than 91% ethanol.
- If greater than the specified value
- Add fresh regular gasoline to the vehicle's fuel tank.
- Remove a new sample of fuel from the tank.
- If additional testing indicates that the ethanol percentage is still above 15% for a non-blended gasoline sample, drain and replace the vehicle's fuel. Refer to Fuel Tank Draining .
- If additional testing indicates that the E85 blended gasoline sample still measures above 91%, continue adding fresh, regular gasoline until the ethanol content is 85% or less.
- If the specified value or less

Alcohol in Fuel Testing without Special Tool

- Using a 100 ml (3.38 oz) specified cylinder with 1 ml (0.034 oz) graduation marks, fill the cylinder with fuel to the 90 ml (3.04 oz) mark.
- Add 10 ml (0.34 oz) of water in order to bring the total fluid volume to 100 ml (3.38 oz) and install a stopper.
- Shake the cylinder vigorously for 10–15 seconds.
- Carefully loosen the stopper in order to release the pressure.
- Re-install the stopper and shake the cylinder vigorously again for 10–15 seconds.
- Put the cylinder on a level surface for approximately 5 minutes in order to allow adequate liquid separation. If alcohol is present in the fuel, the volume of the lower layer, which would now contain both alcohol and water, will be more than 10 ml (0.34 oz). For example, if the volume of the lower layer is increased to 15 ml (0.51 oz), this indicates at least 5% alcohol in the fuel. The actual amount of alcohol may be somewhat more because this procedure does not extract all of the alcohol from the fuel.
- Verify the non-blended gasoline fuel sample does not measure greater than 15%.
- Test the fuel composition of the new sample.

- Verify the non-blended gasoline fuel sample does not measure greater than 15% .
- If greater than the specified value, drain and replace the vehicle's fuel. Refer to Fuel Tank Draining .
- If the specified value or less, all OK.

Particulate Contaminants in Fuel

- Using an approved fuel container, draw approximately 0.5 liter (0.53 qt) of fuel from the bottom of the fuel tank.
- Place the container on a level surface for approximately 5 minutes in order to allow settling of the particulate contamination. Particulate contamination will show up in various shapes and colors. Sand will typically be identified by a white or light brown crystals. Rubber will appear as black and irregular particles.
- Verify there are no physical contaminants or water present in the fuel sample.
- If any physical contaminants or water are present Clean the fuel system.
- If no physical contaminants or water are present

Repair Instructions

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Fuel System Cleaning
- Fuel Tank Draining

Evaporative Emission System Diagnosis (Article 11376)

Special Tools

- CH-44284-2 Fuel Flapper Door Holder
- EN-41413-VLV EVAP Service Port Vent Fitting
- GE-41415-60 Engine Induction System Leak Test Adapter/Capless Fuel Fill Adapter

Operating Instructions for the Evaporative Emission System Tester

Vehicle Setup

- Engine OFF, open the hood. Position a large fan to blow air under the vehicle onto the fuel tank area.
- Connect the red battery clip from the tester to the positive battery terminal.
- Connect the black battery clip from the tester to chassis ground.

Flow Meter Test – Leak Detection

- Open the Nitrogen tank valve and turn the NITROGEN / SMOKE valve on the front control panel to NITROGEN.
- Connect the hose to the correct test orifice on the bottom front of the tester. For orifice size, refer to the vehicle specific information found in service procedures for DTCs that relate to EVAP system leaks.
- Press and release the remote switch to activate the tester.
- Position the sliding red flag on the flow meter to align with the floating indicator. When the red flag is set, press and release the remote switch to deactivate the tester.
- Remove the hose from the test orifice and install the hose onto the vehicle. For proper connection location, and the special tool numbers for any adapters that may be required, refer to the service procedures for DTCs that relate to EVAP system leaks.
- Ignition ON, seal the EVAP system per instructions in the service procedures for DTCs that relate to EVAP system leaks. Most systems can be sealed using a scan tool output control for the EVAP Vent Solenoid Valve , other systems require that the vent system be plugged.
- Larger volume fuel tanks, and/or those with lower fuel levels, may require several minutes to fill with nitrogen.
- Static buildup may cause the float indicator to stick. It may be necessary to tap on the flow meter to free up the float.
- If fuel level is 90% or greater it will take longer to fill the system with smoke because the fuel fill tube check valve will be closed and force any smoke to pass through the on-board refueling vapor recovery pipe and orifice.
- Press and release the remote switch to activate the nitrogen flow and fill the system.
- Verify the stable floating indicator position to the red flag.
- Above the red flag, result is unacceptable – fail Go to the Smoke Procedure
- Below the red flag – pass. Test complete
- Press and release the remote switch to deactivate the tester.

Smoke Procedure – Locate the Leak

- Turn OFF any fans that may cause air movement around or near the vehicle.
- Connect the nitrogen/smoke hose to the vehicle as directed in the service procedures. Some vehicles require that the nitrogen/smoke hose be connected at the front of the EVAP system at the EVAP service port. An adapter may be necessary. Other vehicles require the connection be made at the rear of the system using an adapter at the fuel fill cap or capless fuel fill. Consult the service procedures for DTCs that relate to EVAP system leaks for vehicle specific instructions regarding connection location and adapters.

- Open the Nitrogen tank valve and turn the nitrogen/smoke valve on the control panel to smoke.
- Press and release the remote switch to activate the tester and inject smoke into the EVAP system.
- Verify smoke has filled the EVAP system by opening the system opposite the end where smoke is injected.
- When injecting smoke at the service port:
- Vehicles with gas cap — remove fill cap
- Vehicles with capless fuel fill — open flappers with CH-44284-2 or GE-41415-60 Until smoke is observed, then close the system and continue testing.
- If using a special tool fuel fill cap / capless fuel fill adapter at the filler neck, vent the system at the service port, with special tool EN-41413-VLV until smoke is observed then remove the vent fitting tool and close the system to continue with the test.
- Inject smoke in less than 2 min cycles for optimum tester performance.
- Introduce smoke into the system for an additional 60 s. Continue introducing smoke at 15 s intervals, as necessary until leak source is identified.
- Using a high-intensity white light, inspect the entire EVAP system path, and look for the source of the leak indicated by the exiting smoke.
- Smoke seen leaking Repair or replace the affected component.
- No smoke seen leaking
- All OK

Temperature Variation Instructions

The Concern

Ideal circumstances for conducting the EVAP flow meter test require equal temperatures between the Nitrogen gas and the vehicle EVAP system. Significant differences in temperature between them can result in a flow or pressure change during testing, causing misleading results. Typically, the evaporative emission system tester is stored indoors, approximately 21°C (70°F). Vehicles brought in for diagnosis may have an EVAP system at significantly different temperatures.

For Example

When the EVAP flow meter tests are performed with significant differences in temperature between the Nitrogen gas and the vehicle EVAP system, the following results can occur:

- An increase in flow during the flow meter test can be caused by a vehicle’s warm EVAP system cooling down.
- A decrease in flow during the flow meter test can be caused by a vehicle’s cool EVAP system warming up.

The Solution

When working on a vehicle with significant temperature differences between the vehicle EVAP system and the Nitrogen gas, allow the vehicle EVAP system temperature to stabilize as close as possible to the temperature of the Nitrogen gas before conducting the flow meter test.

Electronic Ignition (EI) System Diagnosis) (Article 11373)

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Circuit/System Description

This ignition system uses an individual ignition coil for each cylinder. The Engine Control Module (ECM) controls the spark events by transmitting the timing pulses on the ignition control circuits to the individual ignition coil in firing order sequence.

Diagnostic Aids

- This engine application may use 2 fuses, one for each bank, to supply ignition voltage to the ignition module/coil assemblies. A good indication that a fuse is open is that all misfire counters are incrementing on one side of the engine.
- An open/high resistance on the low reference circuit to the ignition coil may cause a misfire.
- An erratic or weak spark is considered a no spark condition.

Reference Information

Schematic Reference

Engine Controls Schematics

Connector End View Reference

Master Electrical Component List

Description and Operation

Electronic Ignition System Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs
Scan Tool Reference
Control Module References
Special Tools
EL 26792 - HEI Spark Tester
For equivalent regional tools, refer to Special Tools .
Circuit/System Testing
- Ignition OFF and all vehicle systems OFF. Disconnect the harness connector at the appropriate T8 Ignition Coil. It may take up to 2 min for all vehicle systems to power down.
- Test for less than 5 Ω between the ground circuit terminal 1/A and ground.
- If 5 Ω or greater
- Ignition OFF.
- Test for less than 2 Ω in the ground circuit end to end.
- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω, repair the open/high resistance in the ground connection.
- If less than 5 Ω
- Test for less than 5 Ω between the low reference circuit terminal 2/B and ground.
- Ignition OFF, disconnect the X3 harness connector at the K20 Engine Control Module .
- Test for less than 2 Ω in the low reference circuit end to end.
- If less than 2 Ω, replace the K20 Engine Control Module.
- Ignition ON.
- Verify a test lamp illuminates between the ignition circuit terminal 4/D and ground.
- If the test lamp does not illuminate
- Test for less than 2 Ω in the ignition circuit end to end.
- If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
- If the test lamp illuminates
- Ignition OFF, exchange the suspect T8 Ignition Coil with the T8 Ignition Coil of a known functioning cylinder.
- Engine Running.
- Verify the scan tool Cylinder 1–6 Current Misfire Counter does not increment for the same cylinder that the suspect T8 Ignition Coil was removed from.
- If increments Replace the K20 Engine Control Module.
- If does not increment
- Test or replace the T8 Ignition Coil.
Component Testing
- Ignition OFF, connect the EL 26792 to the appropriate T8 Ignition Coil.
- Verify the spark output of the T8 Ignition Coil.
- If no output or the output is weak Replace the T8 Ignition Coil
- If the output is good
- All OK.
Repair Instructions
Perform the Diagnostic Repair Verification after completing the repair.
- Ignition Coil Replacement - Bank 1
- Ignition Coil Replacement - Bank 2
- Control Module References for engine control module replacement, programming, and setup.

Inspection/Maintenance System Check (Article 11389)

Diagnostic Instructions
- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.
Description
Several states require that a vehicle pass on-board diagnostic (OBD) system tests and inspection/maintenance (I/M) emission inspections in order to renew license plates. This is accomplished by viewing the Inspection/Maintenance System Status or Data display on a scan tool. Using a scan tool, the technician can observe the I/M status in order to verify that the vehicle meets the criteria that complies with the local area requirements.
While testing in the I/M System Status mode, some DTCs may occur that are called I/M Test DTCs. An I/M Test DTC is defined as a fault code that is currently commanding the malfunction indicator lamp (MIL) ON, and is

stored in non-volatile memory. The intended use of this data is to prevent vehicles from passing I/M inspection without proper repair to the vehicle. These fault codes are not erasable from any scan tool command or by disconnecting power to the controller. I/M Test DTCs are supported by all emissions related electronic control unit s, such as engine control module s (ECMs), transmission control module s (TCMs), fuel pump control module s, etc . An I/M Test DTC will not be stored or erased from the electronic control unit except at the end of trip processing which occurs 5 s after ignition OFF.

Conditions for Updating the I/M System Status

Each system requires at least one, and sometimes several, diagnostic tests. The results of these tests are reported by a DTC. A system monitor is complete when either all of the DTCs comprising the monitor have Run and Passed, or any one of the DTCs comprising the monitor have illuminated the MIL. Once all of the tests are completed, the Inspection/Maintenance System Status or Data will indicate YES in the Completed or Value column.

For example, when the HO2S Heater Status indicates YES, either all of the oxygen sensor heater tests have passed or one of the tests has illuminated the MIL. If the vehicle has four heated oxygen sensors, either all four heater circuit tests have passed or one of the heater circuit tests has illuminated the MIL. The Inspection/Maintenance System Status or Data will indicate NO under the Completed or Value column when any of the required tests for that system have not run. The following is a list of conditions that would set the Inspection/Maintenance System or Data indicator to NO:

- The vehicle is new from the factory and has not yet been driven through the necessary drive conditions to complete the tests.
- The battery has been disconnected or discharged below operating voltage.
- The control module power or ground has been interrupted.
- The control module has been reprogrammed.
- The control module DTCs have been cleared as part of a service procedure.

Conditions for Clearing I/M Test DTCs

- Only the OBD II System can erase I/M Test DTCs. The OBD II system must determine that the malfunction that caused the I/M Test DTC to be stored is no longer present and is not commanding the MIL. Each of the following represents ways to clear an I/M Test DTC:
- If the MIL goes off due to 3 passing drive cycles, and the scan tool code clear is not used, the I/M Test DTC is erased at power down of the last drive cycle.
- If a scan tool code clear is used to turn OFF the MIL, the I/M Test DTC is not erased, therefore the DTC must PASS and not FAIL during the drive cycle. The I/M Test DTC is erased at power down of the drive cycle.
- If the controller is reflashed/reprogrammed, all I/M Test DTCs are erased.
- For the OBD II System to run a single drive cycle for clearing an I/M Test DTC, all of the following conditions must occur:
- Cumulative time of engine run time greater than 600 s.
- Cumulative vehicle operation above 41 km/h (25 mph) over 300 s.
- Continuous vehicle idle greater than 30 s.
- Ignition OFF for 5 s to allow the code to clear.

Monitored Emission Control Systems

The OBD II system monitors all emission control systems that are on-board, but not all vehicles need every possible emission control system. For example, a vehicle may not be equipped with secondary air injection or exhaust gas recirculation (EGR). The OBD II regulations require monitoring of the following; if equipped:

- The air conditioning system
- The catalytic converter efficiency
- Comprehensive component monitoring—Emission related inputs and outputs
- The evaporative emission (EVAP) system
- The fuel delivery system
- Heated catalyst monitoring
- Misfire monitoring
- The oxygen sensor system (O2S or HO2S)
- The oxygen sensor heater system (HO2S heater)

For the specific DTCs required for each system, refer to Inspection/Maintenance (I/M) System DTC Table . Systems such as misfire and comprehensive components may not be listed in a system status list. These tests run continuously and do not require an I/M System Status indicator.

Diagnostic Aids

The Inspection/Maintenance System Status or Data display provides an indication of when the control module has completed the required tests. This does not necessarily mean that the test has passed, only that a decision was made. If the diagnostic fails, a DTC will indicate the failure. If a failure indication is present for a DTC associated with one of the I/M regulated systems, it may prevent other required tests from running. For

example, a DTC for the control circuit of the EVAP purge solenoid may not be listed in the Inspection/Maintenance System DTC Table because it is a continuous test. If this DTC is set, the Active Tests for the EVAP system may not run.
The Inspection/Maintenance System Status or Data information may be useful for a technician to determine if diagnostics have run when verifying repairs.
Circuit/System Verification
- Verify that all Inspection/Maintenance System Status or Data indicators report YES, and that no I/M Test DTCs are present.
- If any I/M Test DTCs are set Refer to Diagnostic Trouble Code (DTC) List - Vehicle .
- If no I/M Test DTCs are set
- All OK.
Circuit/System Testing
- Verify no I/M DTCs are present.
- If an I/M DTC is set that would prevent the I/M System Status tests from completing, diagnose that DTC before continuing. Refer to Inspection/Maintenance (I/M) System DTC Table .
- If no I/M DTCs are set
- Review applicable service bulletins for software updates that would prevent the I/M System Status tests from completing.
- If a control module re-program or other repair is required, Perform the Inspection/Maintenance Complete System Set Procedure after repair.
- If no repair is required
- Observe the Inspection/Maintenance System Status or Data indicators.
- If any Inspection/Maintenance System Status or Data indicators report NO Perform the Inspection/Maintenance Complete System Set Procedure .
- If no Inspection/Maintenance System Status or Data indicators report NO

Inspection/Maintenance Complete System Set Procedure (Article 11388)

Diagnostic Instructions
- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.
Description
The purpose of the Inspection/Maintenance (I/M) complete system set procedure is to satisfy the enable criteria necessary to execute all of the I/M readiness diagnostics and complete the trips for those particular diagnostics. When all I/M monitored diagnostic tests are completed, the I/M System Status indicators are set to YES. Perform the Inspection/Maintenance (I/M) Complete System Set Procedure if any I/M System Status indicators are set to NO.
Conditions for Meeting a Cold Start
- The ignition voltage between 10 and 15 V.
- The barometric pressure (BARO) is more than 75 kPa (10.9 PSI).
- The engine coolant temperature (ECT) at start-up is less than 42°C (108°F).
- The intake air temperature (IAT) is between 2–32°C (36-90°F).
- The engine is OFF for greater than 6 hours or the following conditions must be met:
- The start-up IAT minus start-up ECT are within 12°C (22°F).
- The start-up ECT minus start-up IAT are within 50°C (90°F).
- Fuel level is between 25 and 75%.
Circuit/System Verification
- Verify that all I/M System Status indicators report YES, and that no I/M Test DTCs are present.
- If any I/M Test DTCs are set Refer to Diagnostic Trouble Code (DTC) List - Vehicle .
- If no I/M Test DTCs are set
- All OK.
Inspection/Maintenance (I/M) System Set Procedure
- Ensure that the vehicle meets the conditions for a cold start listed above.
- If the EVAP I/M System Status indicator displays NO, perform the EVAP Service bay test if applicable.
- Turn OFF all accessories; HVAC system, other electrical loads, including aftermarket/add-on equipment, etc ., and open the hood.
- Set the vehicle parking brake and ensure the vehicle is in park for automatic transmission or neutral for manual transmission.
- Start and idle the engine for 2 min.
- Close the hood, release the parking brake and Accelerate at part throttle to 72–80 km/h (45–50 MPH) with

this speed maintained until the engine reaches operating temperature, 8–10 min .
- Continue operation under these conditions for an additional 6 min.
- Accelerate at part throttle to 90 km/h (55 MPH) with this speed maintained for 2 min.
- Release the accelerator pedal for at least 10 s. This will allow the vehicle to enter the decel fuel cut off.
- Safely stop the vehicle, with the engine in drive for automatic or neutral with the clutch pedal depressed and parking brake applied for manual. Allow the vehicle to idle for 2 min.
- Shift the vehicle to park for automatic and neutral for manual. Turn OFF the ignition and exit the vehicle. Do NOT disturb the vehicle for 45 min.
- Observe the Inspection/Maintenance (I/M) System Status with a scan tool. All of the I/M System Status indicators should display YES.
- If the EVAP I/M System Status indicator displays NO, turn OFF the ignition, ensure that the vehicle meets the conditions for a cold start, and repeat steps 6–11 three more times, or until the EVAP I/M System Status indicator transitions to YES. If the indicator continues to display NO, refer to the Inspection/Maintenance (I/M) System DTC Table to identify the DTCs that did not run.
- If any of the I/M System Status indicators display NO, refer to the Inspection/Maintenance (I/M) System DTC Table for the indicator which did not display YES. The I/M System DTC Table identifies the DTCs associated with each I/M System Status Indicator.
- Observe the I/M Test DTC information with a scan tool. Verify there are no I/M Test DTCs present.
- If an I/M Test DTC is set, diagnose the DTC using the Diagnostic Trouble Code (DTC) List - Vehicle and refer to Inspection/Maintenance System Check .
- Observe the engine DTC information with a scan tool. Verify no DTCs are present.
- If a DTC is set, diagnose using the Diagnostic Trouble Code (DTC) List - Vehicle . After repairs, perform the Inspection/Maintenance Complete System Set Procedure to verify no further DTCs are set.

Inspection/Maintenance (I/M) System DTC Table) (Article 11387)

System DTCs Required to Set System Status to YES
If an I/M System Status indicator did NOT update to YES during the Inspection/Maintenance Complete System Set Procedure , review each indicator and reference this table to determine each DTC associated with the I/M System Status Indicator. Each DTC listed below has specific conditions that must be met for the diagnostic to run. Included within the conditions are additional DTCs, which if set, may inhibit the DTCs listed below from running. Reviewing and operating the vehicle within the Conditions for Running for each DTC listed below will allow the I/M System Status Indicators to transition to YES.
Catalyst DTC P0420 or P0430
EVAP DTC P0442 DTC P0446 DTC P0455
- DTC P0442
- DTC P0446
- DTC P0455
Fuel System DTC P219A or P219B
Oxygen Sensor DTC P0131, P0132, P0134, P0137, P0138, P0140, P0151, P0152, P0154, P0157, P0158, or P0160 DTC P0133, P013A-P013F, P014A, P014B, P0153, P015A-P015D, or P2270-P2273
- DTC P0131, P0132, P0134, P0137, P0138, P0140, P0151, P0152, P0154, P0157, P0158, or P0160
- DTC P0133, P013A-P013F, P014A, P014B, P0153, P015A-P015D, or P2270-P2273
Oxygen Sensor Heater DTC P0030-P0032, P0036-P0038, P0050-P0054, P0056-P0060, P0135, P0141, P0155, or P0161
Camshaft System DTC P0011, P0014, P0021, or P0024

Service Programming System (SPS) (Article 10756)

For step-by-step control module programming instructions, please refer to the techline information system (TIS) terminal.
Review the information below to ensure proper programming protocol.
- DO NOT program a control module unless you are directed by a service procedure or you are directed by a General Motors service bulletin. Programming a control module at any other time will not permanently correct a customers concern.
- It is essential that the TIS terminal, MDI/MDI2, and/or Scan Tool, is equipped with the latest software before performing service programming.
- Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required, install a battery maintainer or power supply that provides a steady and stable voltage. Do not use a battery charger, as charging voltage will often fluctuate when connected to the vehicle. This may interrupt programing. If a battery maintainer is not available, connect a

fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.
- Some modules will require additional programming/setup events to be performed before or after programming.
- Some vehicles may require the use of a CANDi or MDI/MDI2 module for programming.
- Review the appropriate service information for these procedures.
- DTCs may set during programming. Clear DTCs after programming is complete.
- Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.
Ensure the following conditions are met before programming a control module:
- Vehicle system voltage:
- There is not a charging system concern. All charging system concerns must be repaired before programming a control module.
- Battery voltage is greater than 12 volts but less than 16 volts. The battery must be fully charged before programming the control module.
- Turn OFF or disable any system that may put a load on the vehicles battery, such as the following components:
- Interior lights
- Exterior lights including daytime running lights (DRL)—Applying the parking brake, on most vehicles, disables the DRL system
- Heating, ventilation, and air conditioning (HVAC) systems
- Engine cooling fans
- Radio, etc .
- The ignition switch must be in the proper position. SPS prompts you to turn ON the ignition, with the engine OFF. DO NOT change the position of the ignition sw itch during the programming procedure, unless instructed to do so.
- Make certain all tool connections are secure, including the following components and circuits:
- Scan Tool
- The RS-232 communication cable port
- The connection at the data link connector (DLC)
- The voltage supply circuits
- MDI/MDI2
- The USB, Ethernet or Wireless communication port
- DO NOT disturb the tool harnesses while programming. If an interruption occurs during the programming procedure, programming failure or control module damage may occur.
In the event of an interrupted or unsuccessful programming event, perform the following steps:
- DO NOT turn the ignition OFF. Ensure that all control module and DLC connections are secure and the TIS terminal operating software is up to date.
- Attempt to reprogram the control module.
- If the control module can still not be programmed, turn the ignition OFF for at least one minute.
- Turn the ignition ON and attempt to reprogram the control module. The control module should program.
- If the control module still cannot be programmed, replace the control module.
After successfully programming the control module, ensure that all post programming procedures are performed; refer to Control Module References for the appropriate control module Programming and Setup document for any required procedures.

Throttle or Idle Learn (Article 11461)

Description
The engine control module (ECM) learns the airflow through the throttle body to ensure the correct idle. The learned airflow values are stored within the ECM. These values are learned to adjust for production variation and will continuously learn during the life of the vehicle to compensate for reduced airflow due to throttle body coking. Anytime the throttle body airflow rate changes, for example due to cleaning or replacing, the values must be relearned.
An engine that had a heavily coked throttle body that has been cleaned or replaced may take several drive cycles to unlearn the coking. To accelerate the process, the scan tool has the ability to reset all learned values back to zero. A new ECM will also have values set to zero.
The idle may be unstable or a DTC may set if the learned values do not match the actual airflow.
Conditions for Running the Throttle Learn Procedure
Scan tool Idle Learn or Idle Learn Reset Procedure
- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0116, P0117, P0118, P0120, P0122, P0123, P0128, P0171, P0172, P0174, P0175, P0201-P0208, P0220, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0279, P0280, P0282, P0283, P0300-P0308, P0351-P0358, P0496, P0601, P0604, P0606, P060D, P0641, P0651, P0697, P06A3, P06D2, P1248, P1249, P124A, P124B, P1516, P16A0-P16A2, P2101, P2119,

P2120, P2122, P2123, P2125, P2127, P2128, P2135, P2138, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216B, P216C, P216E, P216F, P217B, P217C, P217E, P217F, P2176, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, P2316, P2318, P2319, P2321, or P2322 are not set.
- Ignition ON, engine OFF.
- The vehicle speed sensor (VSS) is 0 km/h (0 MPH).
Service Bay/On Road Learn Procedure
- The engine speed is between 450–4,000 RPM.
- The manifold absolute pressure (MAP) is greater than 5 kPa.
- The mass air flow (MAF) is greater than 2 g/s.
- The ignition voltage is greater than 10 volts.
Diagnostic Aids
A un-metered air leak in the induction system or a small vacuum leak may not set a DTC. If the condition goes undetected, the ECM may learn an incorrect Throttle Body Idle Airflow Compensation value over time. The incorrectly learned value may cause various symptoms to occur such as rough or unstable idle speeds, and/or engine stall. If this condition is detected and repaired it will be necessary perform the Idle Learn procedure to ensure any symptoms are corrected.
Throttle Learn
Scan Tool Idle Learn or Idle Learn Reset Procedure – Performed after the throttle body is cleaned or replaced
- Ignition ON, engine OFF, perform the Idle Learn or Idle Learn Reset in Configuration/Reset or Module Setup.
- Engine idling, verify the scan tool Throttle Body Idle Airflow Compensation value is equal 0% and the engine is idling at a normal idle speed.
- Clear the DTCs and return to the diagnostic that referred you here.
Service Bay/On Road Idle Learn Procedure – Performed after the ECM is programmed or replaced
- Engine idling for 3 min.
- The ECM will start to learn the new idle cells and the scan tool Desired Idle Speed should start to decrease.
- Ignition OFF for 60 s.
- Start and idle the engine for 3 min.
- Verify the engine is idling normally.
- If the engine idle is not correct
- Operate the vehicle at speeds above 70 km/h (44 mph) with several decelerations and extended idles.
- If the engine idle is not correct. Ignition OFF for 60 s, repeat step 5.1.
- If the engine idle is correct.
- Clear any DTCs and return to the diagnostic that referred you here.
- If the engine idle is correct

Fuel Pump Flow Control Module Scan Tool Information (Article 10779)

Parameter System State Expected Value Description
Operating Conditions: Ignition ON/Engine Idling at Normal Operating Temperature / Vehicle is in Park or Neutral
Desired Fuel Pressure — 306.8 kPa (44.5 psi) This displays kPa (psi). This is the desired fuel pressure.
Fuel Pump Command — On The scan tool displays On or Off. This is the current state of the fuel pump command.
Fuel Pump Signal Command — Varies This displays %. This is the commanded fuel pump signal measured in percentage.
Fuel Pressure Sensor — 296.4–310.3 kPa (43–45 psi) This displays kPa (psi). This is the current pressure at the fuel pressure sensor .
Fuel Pressure Sensor — 2.00–3.00 Volts This voltage can vary depending on the engine application, engine load, operating conditions and other factors. This display is in Volts. This is the fuel pressure sensor voltage.
Ignition 1 Signal — Varies This displays Volts. This is the current ignition 1 signal.
LT Fuel Pump Trim — Varies This displays a numeric value. This is the long term (LT) fuel pump trim.
ST Fuel Pump Trim — Varies This displays a numeric value. This is the short term (ST) fuel pump trim.
Output Control Description
Fuel Pressure Control This output control is used to control the fuel pressure.
Fuel Pump This output control is used to command the fuel pump ON and OFF.
Fuel Pump Trim Reset This output control is used to reset the fuel pump trim.
Active Grille Air Shutter Position Command — Varies This displays %. This is the commanded active grille air shutter position.
Active Grille Air Shutter Position — Varies This displays %. This is the actual active grille air shutter position.
Cold Temperature Mode — On / Off The scan tool displays On or Off. This is the current state of the Cold

Temperature Mode.
Ambient Air Temperature — Varies The scan tool displays °C (°F). This is the current ambient air temperature.
Active Grille Air Shutter Actuator This output control is used to perform the Active Grille Air Shutter Actuator test. It is used to cycle the active grille air shutter open and closed. The test result will display pass or fail based on the ability of the louvers to cycle open and closed.
Exhaust Flow Control Valve Command — Open/Closed Exhaust Flow Valve Commanded State
Exhaust Flow Control Valve Command — % Exhaust Flow Valve Commanded Duty Cycle (0%-100%)
Exhaust Flow Control Valve Performance Mode — Active/Inactive Exhaust Flow Valve Control Status
Exhaust Flow Control Valve Rumble Mode — Active/Inactive Exhaust Flow Valve Control Status
Exhaust Flow Control Valve — Active/Inactive Exhaust Flow Valve Control Status
Exhaust Flow Control Valve Command This output control is used to cycle the exhaust flow control valve open and closed.

Engine Does Not Crank (Article 10767)

Refer to the appropriate diagnostic procedure below for the symptom observed.
- Starter Solenoid Does Not Click
- Starter Solenoid Clicks, Engine Does Not Crank
- Engine Cranks Slowly

Symptoms - Data Communications (Article 12850)

- Perform the Diagnostic System Check - Vehicle before using the symptom tables in order to verify that all of the following are true:
- There are no Diagnostic Trouble Codes (DTC) set.
- The devices can communicate via the serial data links.
- Review the system operation in order to familiarize yourself with the system functions. Refer to Data Link Communications Description and Operation .

Visual/Physical Inspection
- Inspect for aftermarket devices which could affect the operation of the systems.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent
Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to Testing for Intermittent Conditions and Poor Connections .

Symptom List
Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:
- Scan Tool Does Not Power Up
- Scan Tool Does Not Communicate with High Speed GMLAN Device
- Scan Tool Does Not Communicate with Low Speed GMLAN Device

Scan Tool Does Not Power Up (Article 12849)

Diagnostic Instructions
- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Diagnostic Fault Information
Circuit Short to Ground Open/High Resistance Short to Voltage Signal Performance
Data Link Connector B+ 1 1 — —
Data Link Connector Ground — 1 — —
1. Scan Tool Does Not Power Up

Circuit/System Description
The data link connector (DLC) is a standardized 16 cavity connector. Connector design and location is dictated by an industry wide standard, and is required to provide the following:
- Scan tool B+ voltage at terminal 16
- Scan tool ground at terminal 4
- Common ground at terminal 5

Diagnostic Aids
- The scan tool will power up with the ignition OFF. Some devices however, will not communicate unless the ignition is ON and the power mode master device sends the appropriate power mode message.
- If the B+ circuit, ground circuits, and connections of the data link connector are functioning properly, the

malfunction must be due to the scan tool.
Reference Information
Schematic Reference
- Data Communication Schematics
- Control Module References
Connector End View Reference
Master Electrical Component List
Description and Operation
Data Link Communications Description and Operation
Electrical Information Reference
- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs
Scan Tool Reference
Control Module References for scan tool information
Circuit/System Testing
- Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 10 minutes for all vehicle systems to power down.
- Test for less than 2 Ω between each of the X84 Data Link Connector ground circuit terminals listed below and ground.
- Ground circuit terminal 4
- Ground circuit terminal 5
- If 2 Ω or greater
- Ignition/Vehicle OFF.
- Test for less than 2 Ω in the ground circuit end to end.
- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω, repair the open/high resistance in the ground connection.
- If less than 2 Ω
- Ignition ON/Vehicle In Service Mode.
- Verify a test lamp illuminates between the B+ circuit terminal 16 at the X84 Data Link Connector and ground.
- If the test lamp does not illuminate and the circuit fuse is good
- Test for less than 2 Ω in the B+ circuit end to end.
- If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
- If the test lamp does not illuminate and the circuit fuse is open
- Test for infinite resistance between the B+ circuit and ground.
- If less than infinite resistance, repair the short to ground on the circuit.
- If the test lamp illuminates
- Refer to the scan tool user guide.

Scan Tool Does Not Communicate w/ Chassis High Speed GMLAN Device (Article 12846)

Diagnostic Instructions
- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.
Diagnostic Fault Information
Circuit Short to Ground Open/High Resistance Short to Voltage Signal Performance
Chassis High Speed GMLAN Serial Data (+) 1 U0100–U02FF* 1 —
Chassis High Speed GMLAN Serial Data (–) 1 U0100–U02FF* 1 —
Ground (X84 Data Link Connector terminal 5) — 1 — —
* No communications with one or more chassis high speed GMLAN devices. An open in only one chassis high speed GMLAN serial data circuit may allow degraded communication between the devices. An open between the X84 Data Link Connector (DLC) and the first splice/device will only affect the communication with the scan tool. The devices will still communicate. 1. No communication with any chassis high speed GMLAN device.
Circuit/System Description
The devices connected to the chassis high speed GMLAN serial data circuits monitor for serial data communications during normal vehicle operation. The serial data is transmitted on two twisted wires that allow speeds up to 500 kbit/s. The twisted pair is terminated with two 120 Ω resistors, one is internal to the K17 Electronic Brake Control Module (EBCM) and the other can be a separate resistor in a connector assembly or in another device. The resistors are used as the load for the chassis high speed GMLAN bus during normal vehicle

operation. The chassis high speed GMLAN is a differential bus. The chassis high speed GMLAN serial data bus (+) and chassis high speed GMLAN serial data (–) are driven to opposite extremes from a rest or idle level of approximately 2.5 V. Driving the lines to their extremes, adds 1 V to the chassis high speed GMLAN serial data bus (+) circuit and subtracts 1 V from the chassis high speed GMLAN serial data bus (–) circuit.
The chassis high speed GMLAN bus functions the same as the primary high speed GMLAN bus, and the two buses operate in parallel. The chassis high speed GMLAN bus is added to reduce message congestion on the primary high speed GMLAN bus. Since the chassis high speed GMLAN bus and primary high speed GMLAN bus operate in the same manner, the diagnostics for each are the same.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated “current” or “active” status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
- A device on the data communication circuit was disconnected while the communication circuit is awake.
- Power to one or more devices was interrupted during diagnosis.
- A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
- Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
- If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between some devices and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to those devices using multiple serial data communication system s.
- An open in the X84 Data Link Connector ground circuit terminal 5 will allow the scan tool to operate but not communicate with the vehicle.
- Technicians may find various Local Area Network (LAN) communication Diagnostic Trouble Codes (DTC).
- Some devices may not have internal protection for specific voltage outputs and may open a battery positive voltage or ignition voltage source fuse. If a voltage input fuse is open and no short is found in that circuit, ensure that no device output voltage circuit is shorted to ground before replacing the device.

Reference Information

Schematic Reference
- Data Communication Schematics
- Control Module References

Connector End View Reference

Master Electrical Component List

Description and Operation

Data Link Communications Description and Operation

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

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Perform Circuit/System Verification using one of the following two methods:

Verifying the Serial Data Circuits using Data Bus Diagnostic Tool
- Using schematics and vehicle build information, identify all chassis high speed GMLAN devices the tested vehicle is equipped with, terminating resistors, and each device location on the chassis high speed GMLAN bus.
- Ignition ON.
- From Data Circuit input selection, select Terminal 12, 13 to test the chassis high speed GMLAN serial data bus.
- Start the test and verify the Detected State parameter is displayed as OK.
- If the Detected State parameter is displayed as Control Module Not Awake Refer to Circuit/System Testing – Testing the Device Circuits.

- If the Detected State parameter is displayed as Control Module Ground Connection Malfunction Refer to Circuit/System Testing – Testing the Device Circuits.
- If the Detected State parameter is displayed as CAN Bus [+] (pin 12) Circuit Shorted to High Voltage or CAN Bus [-] (pin 13) Circuit Shorted to High Voltage Refer to Circuit/System Testing – Testing the Serial Data Circuits for a Short to Voltage.
- If the Detected State parameter is displayed as CAN Bus [+] (pin 12) Circuit Shorted to Low Voltage or CAN Bus [-] (pin 13) Circuit Shorted to Low Voltage Refer to Circuit/System Testing – Testing the Serial Data Circuits for a Short to Ground.
- If the Detected State parameter is displayed as CAN Bus [-] Shorted to Bus [+] Refer to Circuit/System Testing – Testing the Serial Data Circuits for a Short between the Circuits.
- If the Detected State parameter is displayed as CAN Bus Open with one or more non responding chassis high speed GMLAN devices Refer to Circuit/System Testing – Testing the Serial Data Circuits for an Open/High Resistance (Data Bus Diagnostic Tool).
- If the Detected State parameter is displayed as CAN Bus Open and all chassis high speed GMLAN devices are responding Repair the open/high resistance in the circuit between the external terminating resistor and the closet responding device.
- If the Detected State parameter is displayed as OK and none of the chassis high speed GMLAN devices are responding Repair the open/high resistance in the circuit between the X84 Data Link Connector and the first splice/device in the serial data circuit. If the circuit tests normal, check the MDI cable and the connection at X84 Data Link Connector prior to replacing the first device or splice pack.
- If the Detected State parameter is displayed as OK and one or more chassis high speed GMLAN devices are not responding Refer to Circuit/System Testing – Testing the Device Circuits to test the non responding device closest to a responding device.
- If the Detected State parameter is displayed as OK and all chassis high speed GMLAN devices are responding
- All OK.

Verifying the Serial Data Circuits using Digital Multimeter

- Verify two or more devices are not communicating on the chassis high speed GMLAN serial data circuit. Refer to Data Link References to determine how many devices should be communicating on the chassis high speed GMLAN bus.
- If only one device is not communicating Refer to Circuit/System Testing – Testing the Device Circuits.
- If two or more devices are not communicating
- Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the scan tool from the X84 Data Link Connector. The following tests will be done at the X84 Data Link Connector.
- Test for less than 10 Ω between the ground circuit terminal 5 and ground.
- If 10 Ω or greater
- Ignition OFF.
- Test for less than 2 Ω in the ground circuit end to end.
- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω, repair the open/high resistance in the ground connection.
- If less than 10 Ω
- Test for less than 4.5 V between the serial data circuits listed below and ground.
- Terminal 12
- Terminal 13
- If 4.5 V or greater Refer to Circuit/System Testing – Testing the Serial Data Circuits for a Short to Voltage.
- If less than 4.5 V
- Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
- Test for greater than 100 Ω between the serial data circuits listed below and ground.
- If 100 Ω or less Refer to Circuit/System Testing – Testing the Serial Data Circuits for a Short to Ground.
- If greater than 100 Ω
- Test for 50–70 Ω between the serial data circuit terminals 12 and 13.
- If less than 35 Ω Refer to Circuit/System Testing – Testing the Serial Data Circuits for a Short between the Circuits.
- If between 35–50 Ω There may be a third terminating resistor between the serial data circuits. This can happen if the incorrect device is installed. Some devices are available with and without the terminating resistors installed to reduce the need of terminating resistors in the wiring harness. Refer to Circuit/System Testing – Testing the Serial Data Circuits for a Short between the Circuits.
- If greater than 70 Ω but less than infinite Refer to Circuit/System Testing – Testing the Serial Data

Circuits for an Open/High Resistance.
- If infinite resistance Repair the open/high resistance in the circuit between the X84 Data Link Connector and the first splice/device in the serial data circuit.
- If between 50–70 Ω
- Refer to Circuit/System Testing – Testing the Device Circuits.

Circuit/System Testing
- All chassis high speed GMLAN devices and terminating resistors the vehicle is equipped with
- Chassis high speed GMLAN device locations on the chassis high speed GMLAN serial data circuits
- Each device's ground, B+, ignition, and chassis high speed GMLAN serial data circuit terminals

Testing the Serial Data Circuits for a Short to Voltage
- Ignition OFF, disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at an easily accessible device, ignition ON.
- Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
- If each serial data circuit is 4.5 V or less
- Test for less than 10 Ω between each of the device's ground circuit terminals and ground.
- If 10 Ω or greater, repair the open/high resistance in the circuit.
- If less than 10 Ω, replace the device that was disconnected.
- If any serial data circuit is greater than 4.5 V
- Ignition OFF, disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to voltage, ignition ON.
- Repeat step 3 until one of the following conditions are isolated:
- A short to voltage on the serial data circuit between two devices or splice packs, if equipped.
- A short to voltage on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short to Ground
- Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at an easily accessible device.
- Test for greater than 100 Ω between each serial data circuit at the device connector that was just disconnected and ground.
- If each serial data circuit is 100 Ω or greater Replace the device that was disconnected.
- If any serial data circuit is less than 100 Ω
- Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to ground.
- If both serial data circuits are 100 Ω or greater Replace the device that was disconnected.
- Repeat step 4 until one of the following conditions are isolated:
- A short to ground on the serial data circuit between two devices or splice packs, if equipped.
- A short to ground on the serial data circuit between a device and a terminating resistor.
- A short to ground on the serial data circuit between the X84 Data Link Connector and the first device or splice pack.

Testing the Serial Data Circuits for a Short between the Circuits
- Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
- Test for greater than 110 Ω between each pair of serial data circuits at the device connector that was just disconnected.
- If each pair of serial data circuits is 110 Ω or greater Replace the device that was disconnected.
- If any pair of serial data circuits is less than 110 Ω
- Connect the harness connectors at the device that was disconnected.
- Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted together.
- Serial data circuits shorted together between two devices or splice packs, if equipped.
- Serial data circuits shorted together between a device and a terminating resistor.
- Serial data circuits shorted together between the X84 Data Link Connector and the first device or splice pack.
- A shorted terminating resistor.

Testing the Serial Data Circuits for an Open/High Resistance (Data Bus Diagnostic Tool)
- Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at the non responding device closest to the responding device.
- Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at the responding device closest to the non responding device.
- Test for less than 2 Ω in each of the chassis high speed GMLAN serial data circuits end to end between the

two devices that was just disconnected.
- If 2 Ω or greater Repair the open/high resistance in the serial data circuit.
- If less than 2 Ω
- Replace the non responding device that was disconnected.
Testing the Serial Data Circuits for an Open/High Resistance (Digital Multimeter)
- Test for less than 130 Ω between each pair of serial data circuits at the device connector that was just disconnected.
- If each pair of serial data circuit is 130 Ω or less Replace the device that was disconnected.
- If any pair of serial data circuits is greater than 130 Ω
- Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at another device, in the direction of the circuit with the open/high resistance.
- If each pair of serial data circuits is 130 Ω or less Replace the device that was disconnected.
- An open/high resistance on the serial data circuit between two devices or splice packs, if equipped.
- An open/high resistance on the serial data circuit between a device and a terminating resistor.
- An open/high resistance terminating resistor.
Testing the Device Circuits
- Disconnect the harness connectors at the chassis high speed GMLAN device that is not communicating.
- Test for less than 10 Ω between each ground circuit terminal and ground.
- If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
- If the test lamp does not illuminate and the circuit fuse is good
- Ignition OFF, remove the test lamp.
- Test for less than 2 Ω in the B+ circuit end to end.
- If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
- If the test lamp does not illuminate and the circuit fuse is open
- Test for infinite resistance between the B+ circuit and ground.
- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the disconnected device.
- If the test lamp illuminates
- If equipped, verify a test lamp illuminates between each ignition circuit terminal, which has a fuse in the circuit, and ground.
- Test for less than 2 Ω in the ignition circuit end to end.
- If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
- Test for infinite resistance between the ignition circuit and ground.
- If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.
- If the test lamp does not illuminate
- Ignition OFF, remove the test lamp, disconnect the harness connectors at the control module that controls the ignition circuit.
- If infinite resistance
- If less than 2 Ω, replace the control module that controls the ignition circuit.
- Test for less than 2 Ω in each of the chassis high speed GMLAN serial data circuits end to end between the device harness connector and the appropriate X84 Data Link Connector terminals listed below.
- Replace the device that was disconnected.
Repair Instructions
Perform the Diagnostic Repair Verification after completing the repair.
Control Module References for device replacement, programming and setup

Scan Tool Does Not Communicate w/ High Speed GMLAN Device (Article 12847)

Diagnostic Instructions
- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.
Diagnostic Fault Information
Circuit Short to Ground Open/High Resistance Short to Voltage Signal Performance
High Speed GMLAN Serial Data (+) 1 U0100–U02FF* 1 —
High Speed GMLAN Serial Data (–) 1 U0100–U02FF* 1 —
Ground (X84 Data Link Connector terminal 5) — 1 — —
* No communications with one or more high speed GMLAN devices. An open in only one high speed GMLAN serial data circuit may allow degraded communication between the devices. An open between the X84 Data Link Connector (DLC) and the first splice/device will only affect the communication with the scan tool. The devices will

still communicate. 1. No communication with any high speed GMLAN device

Circuit/System Description

The devices connected to the high speed GMLAN serial data circuits monitor for serial data communications during normal vehicle operation. The serial data is transmitted on two twisted wires that allow speeds up to 500 kbit/s. The twisted pair is terminated with two 120 Ω resistors, one is internal to the K20 Engine Control Module (ECM) and the other can be a separate resistor in a connector assembly or in another device. The resistors are used as the load for the High Speed GMLAN bus during normal vehicle operation. The high speed GMLAN is a differential bus. The high speed GMLAN serial data bus (+) and high speed GMLAN serial data (–) are driven to opposite extremes from a rest or idle level of approximately 2.5 V. Driving the lines to their extremes, adds 1 V to the high speed GMLAN serial data bus (+) circuit and subtracts 1 V from the high speed GMLAN serial data bus (–) circuit. If serial data is lost, devices will set a no communication code against the non-communicating device. Note that a loss of serial data DTC does not represent a failure of the device that set it.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated “current” or “active” status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
- A device on the data communication circuit was disconnected while the communication circuit is awake.
- Power to one or more devices was interrupted during diagnosis.
- A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
- Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
- If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between some devices and the scan tool with the high speed GMLAN serial data system inoperative. This condition is due to those devices using multiple serial data communication system s.
- An open in the X84 Data Link Connector ground circuit terminal 5 will allow the scan tool to operate but not communicate with the vehicle.
- The engine will not start when there is a total malfunction of the high speed GMLAN serial data bus.
- Technicians may find various Local Area Network (LAN) communication Diagnostic Trouble Codes (DTC) and no high speed GMLAN communications with the scan tool.
- These conditions may be caused by the installation of an aftermarket navigation radio module (see bulletins). Some customers may comment of one or more of the following concerns:
- Vehicle will not crank
- Vehicle cranks but will not start
- Vehicle stability enhancement system warning lights and messages
- PRNDL gear indicator position errors
- Some devices may not have internal protection for specific voltage outputs and may open a battery positive voltage or ignition voltage source fuse. If a voltage input fuse is open and no short is found in that circuit, ensure that no device output voltage circuit is shorted to ground before replacing the device.

Reference Information

Schematic Reference

- Data Communication Schematics
- Control Module References

Connector End View Reference

Master Electrical Component List

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

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

Scan Tool Reference
Control Module References for scan tool information
Circuit/System Verification
Perform Circuit/System Verification using one of the following two methods:
Verifying the Serial Data Circuits using Data Bus Diagnostic Tool
- Using schematics and vehicle build information, identify all high speed GMLAN devices the tested vehicle is equipped with, terminating resistors, and each device location on the high speed GMLAN bus.
- Ignition ON/Vehicle In Service Mode.
- From Data Circuit input selection, select Terminal 6, 14 to test the high speed GMLAN serial data bus.
- Start the test and verify the Detected State parameter is displayed as OK.
- If the Detected State parameter is displayed as Control Module Not Awake Refer to Circuit/System Testing – Testing the Device Circuits.
- If the Detected State parameter is displayed as Control Module Ground Connection Malfunction Refer to Circuit/System Testing – Testing the Device Circuits.
- If the Detected State parameter is displayed as CAN Bus [+] (pin 6) Circuit Shorted to High Voltage or CAN Bus [-] (pin 14) Circuit Shorted to High Voltage Refer to Circuit/System Testing – Testing the Serial Data Circuits for a Short to Voltage.
- If the Detected State parameter is displayed as CAN Bus [+] (pin 6) Circuit Shorted to Low Voltage or CAN Bus [-] (pin 14) Circuit Shorted to Low Voltage Refer to Circuit/System Testing – Testing the Serial Data Circuits for a Short to Ground.
- If the Detected State parameter is displayed as CAN Bus [-] Shorted to Bus [+] Refer to Circuit/System Testing – Testing the Serial Data Circuits for a Short between the Circuits.
- If the Detected State parameter is displayed as CAN Bus Open with one or more non responding high speed GMLAN devices Refer to Circuit/System Testing – Testing the Serial Data Circuits for an Open/High Resistance (Data Bus Diagnostic Tool).
- If the Detected State parameter is displayed as CAN Bus Open and all high speed GMLAN devices are responding Repair the open/high resistance in the circuit between the external terminating resistor and the closet responding device.
- If the Detected State parameter is displayed as OK and none of the high speed GMLAN devices are responding Repair the open/high resistance in the circuit between the X84 Data Link Connector and the first splice/device in the serial data circuit. If the circuit tests normal, check the MDI cable and the connection at X84 Data Link Connector prior to replacing the first device or splice pack.
- If the Detected State parameter is displayed as OK and one or more high speed GMLAN devices are not responding Refer to Circuit/System Testing – Testing the Device Circuits to test the non responding device closest to a responding device.
- If the Detected State parameter is displayed as OK and all high speed GMLAN devices are responding
- All OK.
Verifying the Serial Data Circuits using Digital Multimeter
- Verify two or more devices are not communicating on the high speed GMLAN serial data circuit. Refer to Data Link References to determine how many devices should be communicating on the high speed GMLAN bus.
- If only one device is not communicating Refer to Circuit/System Testing – Testing the Device Circuits.
- If two or more devices are not communicating
- Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 10 min for all vehicle systems to power down. Disconnect the scan tool from the X84 Data Link Connector. The following tests will be done at the X84 Data Link Connector.
- Test for less than 10 Ω between the ground circuit terminal 5 and ground.
- If 10 Ω or greater
- Ignition/Vehicle OFF.
- Test for less than 2 Ω in the ground circuit end to end.
- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω, repair the open/high resistance in the ground connection.
- If less than 10 Ω
- Test for less than 4.5 V between the serial data circuits listed below and ground.
- Terminal 6
- Terminal 14
- If 4.5 V or greater Refer to Circuit/System Testing – Testing the Serial Data Circuits for a Short to Voltage.
- If less than 4.5 V
- Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 10 min for all vehicle systems to power down.

- Test for greater than 100 Ω between the serial data circuits listed below and ground.
- If 100 Ω or less Refer to Circuit/System Testing – Testing the Serial Data Circuits for a Short to Ground.
- If greater than 100 Ω
- Test for 50–70 Ω between the serial data circuit terminals 6 and 14.
- If less than 35 Ω Refer to Circuit/System Testing – Testing the Serial Data Circuits for a Short between the Circuits.
- If between 35–50 Ω There may be a third terminating resistor between the serial data circuits. This can happen if the incorrect device is installed. Some devices are available with and without the terminating resistors installed to reduce the need of terminating resistors in the wiring harness. Refer to Circuit/System Testing – Testing the Serial Data Circuits for a Short between the Circuits.
- If greater than 70 Ω but less than infinite Refer to Circuit/System Testing – Testing the Serial Data Circuits for an Open/High Resistance (Digital Multimeter).
- If infinite resistance Repair the open/high resistance in the circuit between the X84 Data Link Connector and the first splice/device in the serial data circuit.
- If between 50–70 Ω
- Refer to Circuit/System Testing – Testing the Device Circuits.

Circuit/System Testing

- High speed GMLAN devices and terminating resistors the vehicle is equipped with
- Device locations on the high speed GMLAN serial data circuits
- Each device's ground, B+, ignition, and high speed GMLAN serial data circuit terminals

Testing the Serial Data Circuits for a Short to Voltage

- Ignition/Vehicle OFF, disconnect the harness connectors with the high speed GMLAN serial data circuits at an easily accessible device, ignition ON/Vehicle In Service Mode.
- Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
- If each serial data circuit is 4.5 V or less
- Test for less than 10 Ω between each of the device's ground circuit terminals and ground.
- If 10 Ω or greater, repair the open/high resistance in the circuit.
- If less than 10 Ω, replace the device that was disconnected.
- If any serial data circuit is greater than 4.5 V
- Ignition/Vehicle OFF, disconnect the harness connectors with the high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to voltage, ignition ON/Vehicle In Service Mode.
- Repeat step 3 until one of the following conditions are isolated:
- A short to voltage on the serial data circuit between two devices or splice packs, if equipped.
- A short to voltage on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short to Ground

- Disconnect the harness connectors with the high speed GMLAN serial data circuits at an easily accessible device.
- Test for greater than 100 Ω between each serial data circuit at the device connector that was just disconnected and ground.
- If each serial data circuit is 100 Ω or greater Replace the device that was disconnected.
- If any serial data circuit is less than 100 Ω
- Disconnect the harness connectors with the high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to ground.
- If both serial data circuits are 100 Ω or greater Replace the device that was disconnected.
- Repeat step 4 until one of the following conditions are isolated:
- A short to ground on the serial data circuit between two devices or splice packs, if equipped.
- A short to ground on the serial data circuit between a device and a terminating resistor.
- A short to ground on the serial data circuit between the X84 Data Link Connector and the first device or splice pack.

Testing the Serial Data Circuits for a Short between the Circuits

- Disconnect the harness connectors with the high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
- Test for greater than 110 Ω between each pair of serial data circuits at the device connector that was just disconnected.
- If each pair of serial data circuits is 110 Ω or greater Replace the device that was disconnected.
- If any pair of serial data circuits is less than 110 Ω
- Connect the harness connectors at the device that was disconnected.
- Disconnect the harness connectors with the high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted together.

- Serial data circuits shorted together between two devices or splice packs, if equipped.
- Serial data circuits shorted together between a device and a terminating resistor.
- Serial data circuits shorted together between the X84 Data Link Connector and the first device or splice pack.
- A shorted terminating resistor.
Testing the Serial Data Circuits for an Open/High Resistance (Data Bus Diagnostic Tool)
- Disconnect the harness connectors with the high speed GMLAN serial data circuits at the non responding device closest to the responding device.
- Disconnect the harness connectors with the high speed GMLAN serial data circuits at the responding device closest to the non responding device.
- Test for less than 2 Ω in each of the high speed GMLAN serial data circuits end to end between the two devices that was just disconnected.
- If 2 Ω or greater Repair the open/high resistance in the serial data circuit.
- If less than 2 Ω
- Replace the non responding device that was disconnected.
Testing the Serial Data Circuits for an Open/High Resistance (Digital Multimeter)
- Test for less than 130 Ω between each pair of serial data circuits at the device connector that was just disconnected.
- If each pair of serial data circuits is 130 Ω or less Replace the device that was disconnected.
- If any pair of serial data circuits is greater than 130 Ω
- Disconnect the harness connectors with the high speed GMLAN serial data circuits at another device, in the direction of the circuit with the open/high resistance.
- An open/high resistance on the serial data circuit between two devices or splice packs, if equipped.
- An open/high resistance on the serial data circuit between a device and a terminating resistor.
- An open/high resistance terminating resistor.
Testing the Device Circuits
- Disconnect the harness connectors at a high speed GMLAN device that is not communicating.
- Test for less than 10 Ω between each ground circuit terminal and ground.
- If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
- If the test lamp does not illuminate and the circuit fuse is good
- Ignition/Vehicle OFF, remove the test lamp.
- Test for less than 2 Ω in the B+ circuit end to end.
- If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
- If the test lamp does not illuminate and the circuit fuse is open
- Test for infinite resistance between the B+ circuit and ground.
- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the disconnected device.
- If the test lamp illuminates
- If equipped, verify a test lamp illuminates between each ignition circuit terminal, which has a fuse in the circuit, and ground.
- Test for less than 2 Ω in the ignition circuit end to end.
- If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
- Test for infinite resistance between the ignition circuit and ground.
- If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.
- If the test lamp does not illuminate
- Ignition/Vehicle OFF, remove the test lamp, disconnect the harness connectors at the control module that controls the ignition circuit.
- If infinite resistance
- If less than 2 Ω, replace the control module that controls the ignition circuit.
- Test for less than 2 Ω in each of the high speed GMLAN serial data circuits end to end between the device harness connector and the appropriate X84 Data Link Connector terminals listed below:
- Replace the device that was disconnected.
Repair Instructions
Perform the Diagnostic Repair Verification after completing the repair.
Control Module References for device replacement, programming and setup

Scan Tool Does Not Communicate w/ Low Speed GMLAN Device (Article 12848)

Diagnostic Instructions
- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit Short to Ground Open/High Resistance Short to Voltage Signal Performance
Low Speed GMLAN Serial Data 1 U0100-U02FF* 1 —
Ground (X84 Data Link Connector terminal 5) — 1* — —
* An open between the X84 Data Link Connector (DLC) and the first splice pack/device will only affect the communication with the scan tool. 1. No communication with any low speed GMLAN device

Circuit/System Description

The devices connected to the low speed GMLAN serial data circuits monitor for serial data communications during normal vehicle operation. The serial data is transmitted over a single wire to the appropriate devices. The transmission speed for GMLAN low speed is up to 83.33 kbit/s. Under normal vehicle operating conditions, the speed of the bus is 33.33 kbit/s. The devices toggle the serial data circuit between 0–5 V during normal communications. To wake the devices connected to the low speed GMLAN serial data circuit, a voltage wake up pulse of 10 V is sent out. If serial data is lost, devices will set a no communication code against the non-communicating device. A loss of serial data communications DTC does not represent a failure of the device that set it.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated “current” or “active” status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
- A device on the data communication circuit was disconnected while the communication circuit is awake.
- Power to one or more devices was interrupted during diagnosis
- A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
- Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
- If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with the low speed GMLAN serial data system inoperative. This condition is due to the device using both the high and low speed GMLAN systems.
- An open in the low speed GMLAN serial data circuit between the splice pack and a device will only affect that specific device. This type of failure will set a loss of communication DTC for each device affected, and the other devices will still communicate.
- An open in the X84 Data Link Connector ground circuit terminal 5 will allow the scan tool to operate but not communicate with the vehicle.
- The engine may not start when there is a total malfunction of the low speed GMLAN serial data circuit.
- Technicians may find various Local Area Network (LAN) communication Diagnostic Trouble Codes (DTC) and no low speed LAN communications with the scan tool.
- These conditions may be caused by the installation of an aftermarket navigation radio device (see bulletins). Some customers may comment of one or more of the following concerns:
- Vehicle will not crank
- Vehicle cranks but will not start
- Vehicle stability enhancement system warning lights and messages
- PRNDL gear indicator position errors
- Some devices may not have internal protection for specific voltage outputs and may open a battery positive voltage or ignition voltage source fuse. If a voltage input fuse is open and no short is found in that circuit, ensure that no device output voltage circuit is shorted to ground before replacing the device.

Reference Information

Schematic Reference
- Data Communication Schematics
- Control Module References
Connector End View Reference
Master Electrical Component List

Description and Operation
Data Link Communications Description and Operation
Electrical Information Reference
- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs
Scan Tool Reference
Control Module References for scan tool information
Circuit/System Verification
Perform Circuit/System Verification using one of the following two methods:
Verifying the Serial Data Circuits using Data Bus Diagnostic Tool
- Using schematics and vehicle build information, identify all low speed GMLAN devices the tested vehicle is equipped with, and each device location on the low speed GMLAN serial data bus.
- Ignition ON/Vehicle In Service Mode.
- From Data Circuit input selection, select Terminal 1 to test the low speed GMLAN serial data bus.
- Start the test and verify that all applicable low speed GMLAN devices are displayed under the Control Module column of the Detected State tab.
- If all low speed GMLAN devices are not responding Refer to step 3 of Circuit/System Verification – Verifying the Serial Data Circuits using Digital Multimeter to test for a short to voltage or short to ground on the low speed GMLAN serial data circuit, or an open/high resistance between the X84 Data Link Connector and the first low speed GMLAN device or splice pack.
- If one or more low speed GMLAN devices are not responding Refer to Circuit/System Testing – Testing the Device Circuits to test the non-communicating low speed GMLAN device closest to the X84 Data Link Connector.
- If all low speed GMLAN devices are responding
- All OK.
Verifying the Serial Data Circuits using Digital Multimeter
- Attempt to communicate with all devices on the low speed GMLAN serial data circuit. Refer to Data Link References to determine how many devices should be communicating on the low speed GMLAN bus.
- Verify which devices are communicating on the low speed GMLAN serial data circuit.
- If only one device is not communicating Diagnose that device only. Refer to DTC U0100-U02FF .
- If one or more devices are communicating but not all Refer to Circuit/System Testing – Testing the Serial Data Circuit for an Open/High Resistance.
- If none of the devices are communicating
- Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 10 min for all vehicle systems to power down. Disconnect the scan tool from the X84 Data Link Connector. The following tests will be done at the X84 Data Link Connector.
- Test for less than 10 Ω between the ground circuit terminal 5 and ground.
- If 10 Ω or greater
- Ignition/Vehicle OFF.
- Test for less than 2 Ω in the ground circuit end to end.
- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω, repair the open/high resistance in the ground connection.
- If less than 10 Ω
- Test for less than 4.5 V between the serial data circuit terminal 1 and ground.
- If 4.5 V or greater Refer to Circuit/System Testing – Testing the Serial Data Circuits for a Short to Voltage.
- If less than 4.5 V
- Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 10 min for all vehicle systems to power down.
- Test for greater than 100 Ω between the serial data circuit terminal 1 and ground.
- If 100 Ω or less Refer to Circuit/System Testing – Testing the Serial Data Circuits for a Short to Ground.
- If greater than 100 Ω
- Disconnect the appropriate harness connector at the first splice pack closest in the circuit to the X84 Data Link Connector.
- Test for less than 2 Ω between the X84 Data Link Connector's serial data circuit terminal 1 and the splice pack harness connector's serial data input terminal.
- If 2 Ω or greater Repair the open/high resistance in the serial data circuit.
- If less than 2 Ω
- Replace the splice pack.

Circuit/System Testing
- All low speed GMLAN devices the vehicle is equipped with
- Low speed GMLAN device and splice pack locations on the low speed GMLAN serial data circuit
- The low speed GMLAN serial data circuit terminals for each device or splice pack
Testing the Serial Data Circuits for a Short to Voltage (If equipped with a splice pack)
- Ignition/Vehicle OFF, disconnect the appropriate harness connectors at all low speed GMLAN serial data splice packs, ignition ON/Vehicle In Service Mode.
- Test for less than 4.5 V between the serial data circuit terminal 1 at the X84 Data Link Connector and ground.
- If 4.5 V or greater Repair the short to voltage on the serial data circuit.
- Test for less than 4.5 V between each low speed GMLAN serial data circuit at a splice pack and ground.
- If any serial data circuit is greater than 4.5 V
- Ignition/Vehicle OFF, disconnect all devices on the failed serial data circuit, ignition ON/Vehicle In Service Mode.
- Test for less than 1 V between each section of the failed serial data circuit and ground.
- If 1 V or greater, repair the short to voltage in the circuit.
- If less than 1 V
- Connect the splice pack and connect the first device on the failed serial data circuit, ignition ON/Vehicle In Service Mode.
- Verify the scan tool communicates or not with the low speed GMLAN serial data circuit.
- If the scan tool does not communicate, replace the device that was just connected.
- If the scan tool communicates and there are more devices to connect, connect the next device and repeat step 3.4.
- If the scan tool communicates and there are no more devices to connect
- If all serial data circuits are less than 4.5 V
Testing the Serial Data Circuits for a Short to Voltage (If NOT equipped with a splice pack)
- Ignition/Vehicle OFF, cut the appropriate harness at a low speed GMLAN serial data splice closest to the K56 Serial Data Gateway Module , at least 40 mm (1.57 in) from the splice. Do not cut the wires right at the splice because these wires need to be repaired after the test is done.
- Test for less than 4.5 V between each of the low speed GMLAN serial data circuits at the splice and ground.
- If any serial data circuit is 4.5 V or greater
- Ignition/Vehicle OFF, repair all serial data circuits at the tested splice except the faulted serial data circuit, ignition ON/Vehicle In Service Mode.
- Verify the low speed GMLAN devices that are still not communicating to identify the faulted serial data circuit.
- Ignition/Vehicle OFF, disconnect all devices on the faulted serial data circuit, ignition ON/Vehicle In Service Mode.
- Test for less than 1 V between each section of the faulted serial data circuit and ground.
- If 1 V or greater, repair the short to voltage in the serial data circuit.
- Ignition/Vehicle OFF, repair the faulted serial data circuit to the splice and connect the first device on the faulted serial data circuit, ignition ON/Vehicle In Service Mode.
- If the scan tool communicates and there are more devices to connect, connect the next device and repeat step 3.6.
- Inspect all low speed GMLAN splices for damage.
Testing the Serial Data Circuits for a Short to Ground (If equipped with a splice pack)
- Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 10 min for all vehicle systems to power down. Disconnect the appropriate harness connectors at all low speed GMLAN serial data splice packs.
- Test for infinite resistance between the serial data circuit terminal 1 at the X84 Data Link Connector and ground.
- If less than infinite resistance Repair the short to ground on the serial data circuit.
- If infinite resistance
- Test for greater than 100 Ω between each low speed GMLAN serial data circuit at a splice pack and ground.
- If any serial data circuit is 100 Ω or less
- Disconnect all devices on the failed serial data circuit.
- Test for infinite resistance between each section of the failed serial data circuit and ground.
- If less than infinite resistance, repair the short to ground in the circuit.
- If all serial data circuits are greater than 100 Ω
Testing the Serial Data Circuits for a Short to Ground (If NOT equipped with a splice pack)
- Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft)

away from vehicle. It may take up to 10 min for all vehicle systems to power down. Cut the appropriate harness at a low speed GMLAN serial data splice closest to the K56 Serial Data Gateway Module, at least 40 mm (1.57 in) from the splice. Do not cut the wires right at the splice because these wires need to be repaired after the test is done.
- Test for greater than 100 Ω between each of the low speed GMLAN serial data circuits at the splice and ground.
- Repair all serial data circuits at the tested splice except the faulted serial data circuit, ignition ON/Vehicle In Service Mode.
- Ignition/Vehicle OFF, disconnect all devices on the faulted serial data circuit.
- Test for infinite resistance between each section of the faulted serial data circuit and ground.
- Repair the faulted serial data circuit to the splice and connect the first device on the faulted serial data circuit, ignition ON/Vehicle In Service Mode.
- If the scan tool communicates and there are more devices to connect, connect the next device and repeat step 2.6.
- If each serial data circuit is greater than 100 Ω
Testing the Serial Data Circuit for an Open/High Resistance
- Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 10 min for all vehicle systems to power down. Disconnect the splice pack containing the devices that are not communicating on the low speed GMLAN serial data circuit.
- Test for less than 2 Ω between the X84 Data Link Connector terminal 1 and the disconnected splice pack.
- Test for less than 2 Ω between each section of the failed serial data circuit end to end.
- Connect the splice pack and connect the first device on the failed serial data circuit.
- Verify if the device communicates or not with the scan tool.
- If the device does not communicates Replace the device.
- If the device communicates and there are more devices to connect Connect the next device on the failed serial data circuit and repeat step 6.
- If all devices are connected and communicating
Testing the Device Circuits
- Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 10 min for all vehicle systems to power down.
- Disconnect the harness connectors at a low speed GMLAN device that is not communicating.
- Test for less than 10 Ω between each ground circuit terminal and ground.
- If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
- If the test lamp does not illuminate and the circuit fuse is good
- Ignition/Vehicle OFF, remove the test lamp.
- Test for less than 2 Ω in the B+ circuit end to end.
- If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
- If the test lamp does not illuminate and the circuit fuse is open
- Test for infinite resistance between the B+ circuit and ground.
- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the disconnected device.
- If the test lamp illuminates
- If equipped, verify a test lamp illuminates between each ignition circuit terminal, which has a fuse in the circuit, and ground.
- Test for less than 2 Ω in the ignition circuit end to end.
- If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
- Test for infinite resistance between the ignition circuit and ground.
- If equipped, verify a test lamp illuminates between the accessory wakeup serial data circuit terminal or the serial data communication enable circuit terminal and ground.
- If the test lamp does not illuminate
- Ignition/Vehicle OFF, remove the test lamp, disconnect the harness connectors at the K9 Body Control Module .
- Test for less than 2 Ω in the accessory wakeup serial data circuit or the serial data communication enable circuit end to end.
- If less than 2 Ω, replace the K9 Body Control Module.
- Test for less than 2 Ω in the low speed GMLAN serial data circuit end to end between the device harness connector and the X84 Data Link Connector terminal 1.
- Replace the device that was disconnected.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for device replacement, programming and setup

Symptoms - Engine Controls (Article 11393)

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Symptoms Description

Symptoms covers conditions that are not covered by DTCs. Certain conditions can cause multiple symptoms. These conditions are listed together under Symptoms Testing. Conditions that may only cause specific symptoms are listed separately under Additional Symptoms Testing. Perform the Symptoms Testing before using the Additional Symptoms Testing.

Symptoms Definition

The fuel ignites in the intake manifold or in the exhaust system, making a loud popping noise.
A steady pulsation or jerking that follows engine speed, which is usually more pronounced as the engine load increases. This condition is not normally felt above 1,500 RPM or 48 km/h (30 mph). The exhaust has a steady spitting sound at idle or at low speed.
A mild to severe ping which usually occurs worse while under acceleration. The engine makes sharp metallic knocks that change with throttle opening.
The engine continues to run after the key is turned OFF, but runs very rough.
The ECM illuminates the Reduced Engine Power lamp and will limit engine power under potential engine/vehicle damaging or emissions related conditions. A DTC may not be set.
A noticeable smell of unburned fuel.
The engine cranks OK, but does not start for a long time. The vehicle does eventually run, or may start but immediately stall.
A momentary lack of response as the accelerator is pushed down. This condition can occur at any vehicle speed. This condition is usually more pronounced when first trying to make the vehicle move, as from a stop. This condition may cause the engine to stall in severe conditions.
The engine delivers less than expected power. Little or no increase in vehicle speed when the accelerator pedal is pushed down part way.
Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, the fuel economy is noticeably lower than it was on this vehicle at one time, as previously shown by an actual road test.
The engine runs unevenly at idle. If severe, the engine or the vehicle may shake. Engine idle speed may vary. Either condition may be severe enough to stall the engine.
An engine power variation under steady throttle or cruise. Feels like the vehicle speeds up and slows down with no change in the accelerator pedal position .

Symptoms Verification

Before using the Symptom tables, perform the following verifications:

- Verify that the malfunction indicator lamp (MIL) is operating correctly. Use the scan tool to command the lamp ON and OFF.
- Verify there are no DTCs that are stored.
- Verify that the scan tool data is within a normal operating range. Refer to Control Module References for scan tool information.
- Verify the customer concern.
- Perform the Visual/Physical Inspection in this section. The visual/physical inspection is extremely important, and can lead to correcting a condition without additional testing. It may also help reveal the cause of an intermittent condition.

Identifying Intermittent Conditions

Many intermittent conditions occur with harness or connector movement due to engine torque, rough pavement, vibration or physical movements of a component. Refer to the following for a list of issues that may cause an intermittent condition:

- Moisture and water intrusion in connectors, terminals, and components
- Incomplete connector mating
- Poor terminal contact
- High circuit or component resistance—High resistance can include any resistance, regardless of the amount, which can interrupt the operation of the component.
- Wiring harness that is too short or tight
- Wire insulation that is chaffed or cut
- High or low ambient temperature
- High or low engine coolant temperature s

- High underhood temperatures
- Heat build up in component or circuit due to circuit resistance, poor terminal contact, or high electrical load
- High or low system voltage
- High vehicle load conditions
- Rough road surfaces
- Electro-magnetic interference (EMI)/circuit interference from relays, solenoids or other electrical surge
- Incorrect installation of aftermarket, add on accessories

Visual/Physical Check

- Verify that the control module grounds are clean, tight, and correctly located.
- Verify that the vacuum hoses are not split or kinked, and are properly connected.
- Verify that the air filter is clean and free from restrictions.
- Verify that there is no water intrusion in connectors terminals and components.
- Inspect the air intake duct s for the conditions listed below:
- Collapsed
- Damaged areas
- Looseness
- Incorrect installation
- Leaking If any condition listed above has allowed non-metered air to enter the air induction system, the Throttle or Idle Learn procedure must be performed after the repair is complete.
- Inspect for air leaks at the throttle body mounting area, the mass air flow (MAF) sensor and intake manifold sealing surfaces.
- Inspect the wiring harness for the following conditions:
- Poor connections
- Pinches
- Cuts
- Inspect for loose, damaged, unseated, or missing sensors/components.
- Inspect the terminals for corrosion and correct contact.

Symptoms Testing

Backfire, Cuts Out/Misses, Detonation/Spark Knock, Dieseling/Run-On, Engine Control Module (ECM) Commanded Reduced Engine Power, Fuel Odor, Hard Start, Hesitation/Sag/Stumble, Lack of Power/Sluggishness/Sponginess, Poor Fuel Economy, Rough, Unstable, or Incorrect Idle and Stalling, or Surges/Chuggles

- Test/inspect the fuel system for the conditions listed below:
- incorrect system operation or fuel pressure —Refer to Fuel System Diagnosis .
- Leaking or incorrectly operating fuel injectors —Refer to Fuel Injector Solenoid Coil Test .
- Contaminated or poor quality fuel—Refer to Alcohol/Contaminants-in-Fuel Diagnosis .
- Test/inspect the ignition system for the conditions listed below:
- Spark plugs with incorrect heat range or an abnormal condition—Refer to Gas Engine Ignition Spark Plug Inspection and Ignition System Specifications .
- Coolant or oil fouled spark plug s—Refer to Coolant in Combustion Chamber or Oil Consumption Diagnosis for diagnosis.
- Secondary ignition system susceptible to moisture. Wet down the secondary ignition system with water from a spray bottle to help locate damaged or deteriorated components. Engine running, look/listen for arcing or misfiring as the water is applied.
- Weak spark using the J 26792 - HEI Spark Tester —Refer to Electronic Ignition System Diagnosis .
- Test/inspect for the conditions listed below:
- Non-metered air flow into the air induction system. If a leak is found, repair as necessary. The Throttle or Idle Learn procedure must be performed when the repair is complete.
- Incorrectly operating transmission torque converter clutch (TCC) — The scan tool should indicate an engine speed drop when the TCC is commanded ON—Refer to Torque Converter Diagnosis .
- Incorrectly operating A/C compressor
- An engine that runs lean or rich—Observe the Fuel Trim parameters with a scan tool.
- Slow responding heated oxygen sensor s (HO2S)—The HO2S should respond quickly to different throttle positions.
- Water intrusion in the HO2S connector
- Incorrect mass air flow (MAF) sensor installation. A MAF sensor that is incorrectly installed may cause a hard start. Install the MAF in the correct direction. Refer to Mass Airflow Sensor with Intake Air Temperature Sensor Replacement .
- Incorrect MAF sensor connections.
- Engine oil contaminated by fuel

- Split or kinked vacuum hoses—Verify that the routing and connections are correct.
- Excessive knock sensor (KS) system spark retard activity—Observe the scan tool Knock Retard parameter for activity greater than 0°.
- Electromagnetic interference (EMI) on reference circuits, which can cause a misfire condition. You can usually detect EMI with a scan tool by monitoring the engine speed parameter. A sudden increase in the engine speed parameter with little change in actual engine speed indicates that EMI is present. Inspect the high voltage components near the ignition control circuit if a condition exists.
- Incorrectly operating crankcase ventilation valve—Refer to Crankcase Ventilation System Inspection/Diagnosis .
- A stuck open evaporative emission (EVAP) canister purge solenoid valve.
- A crankshaft position (CKP) sensor with an intermittent condition—Observe the scan tool Crankshaft Position Resync Counter parameter. The parameter should remain at 0 during all operating conditions, and when moving the related harnesses and connectors between the crankshaft position sensor and the ECM.
- Test/inspect the engine cooling system for the conditions listed below:
- A thermostat with an incorrect heat range—Refer to Thermostat Diagnosis .
- Incorrect engine coolant level—If the level is low, refer to Loss of Coolant . For additional information, refer to Symptoms - Engine Cooling .
- Test/inspect the exhaust system for the conditions listed below:
- Physical damage or possible internal failure
- Restricted three-way catalytic converter s For additional information, refer to Symptoms - Engine Exhaust .
- Test/inspect the engine for the mechanical conditions listed below:
- Excessive oil in the combustion chamber or leaking valve seals
- Oil consumption
- Incorrect cylinder compression
- Sticking or leaking valves
- Worn camshaft lobes
- Incorrect valve timing
- Worn rocker arms
- Broken valve springs
- Excessive carbon buildup in the combustion chambers—Clean the chambers with Top Engine Cleaner, if necessary. Follow the instructions on the can.
- Incorrect engine parts For additional information, refer to Symptoms - Engine Mechanical .
- If the above conditions do not address the symptom, refer to the additional symptoms tests.

Additional Symptoms Tests

Detonation/Spark Knock

- Test for an engine overheating condition. Refer to Engine Overheating .
- Verify that the engine coolant temperature (ECT) has not shifted in value. Allow the engine to run and reach operating temperature. Observe the ECT Sensor parameter with a scan tool and compare the reading to that parameter listed on the K20 Engine Control Module: Scan Tool Information list. If the reading is not in the range specified in the list, test the resistance of the ECT sensor. Refer to Temperature Versus Resistance - Engine Coolant Temperature Sensor for resistance specifications. Replace the ECT sensor if the resistance is not within specification. Refer to Engine Coolant Temperature Sensor Replacement . If the sensor is within the specification, test the ECT sensor circuits for high resistance.
- Inspect for excessive carbon buildup in the combustion chambers. Clean the chambers with Top Engine Cleaner, if necessary. Follow the instructions on the can.
- If there are no engine mechanical faults, fill the fuel tank with a known high quality fuel that meets the vehicle minimum octane requirements.

Engine Control Module (ECM) Commanded Reduced Engine Power

Under certain conditions the engine control module may limit engine power by reducing engine torque and, for some vehicles, fuel pressure as well. For most, but not all of the conditions, the engine control module will illuminate the reduced engine power lamp on the instrument cluster. If equipped with the driver information center feature, a reduced engine power message may be displayed as well. A DTC may not be set.

A repair may not be necessary. Observe the scan tool Reduced Engine Power History parameter or refer to K20 Engine Control Module: Scan Tool Information to determine the reason for the reduced engine power event.

Verify or inspect for the following:

- Vehicle being driven inappropriately. Towing heavy loads up an incline for an extended period of time or operating the vehicle at sustained, excessively high engine speeds may cause the engine oil or coolant to overheat. Inspect the airflow passageways in front of the engine for obstructions and clear away any debris or foreign material that is found. If no obstructions are found, review approved driving habits with the customer. The customer may need to operate the vehicle at a higher engine speed to improve cooling system

performance, or, at a slower engine speed to reduce engine load.
- Temporary reduced engine power. Under extremely cold ambient temperatures some SIDI equipped vehicles may experience ECM commanded reduced engine power for a few minutes during engine warm-up. This would be a normal condition, noticeable only at wide open throttle, and the reduced engine power lamp would not be illuminated.
- Reduced engine power may be due to OnStar® remote command. Verify the vehicle is not in the OnStar® initiated Stolen Vehicle Slowdown mode—Refer to Remote Vehicle Speed Limiting Description and Operation and OnStar Stolen Vehicle Slowdown Active .
- A cooling fan condition which may cause the engine coolant or oil to overheat. Refer to Cooling Fan Description and Operation and Cooling System Description and Operation to verify correct operation of the cooling fan.

Fuel Odor
- Inspect for leaking, damaged, or deteriorated fuel line s.
- Inspect for a saturated EVAP canister —Refer to Evaporative Emission Control System Description .
- Inspect for a condition with the internal components of the fuel tank assembly —Refer to Fuel System Description .

Hard Start
- Observe the scan tool Throttle Body Idle Airflow Compensation parameter. A value greater than 90% may indicate an excessive accumulation of deposits in the throttle bore. Inspect the throttle body and clean, if necessary. Refer to Throttle Body Inspection and Cleaning .
- Test the engine coolant temperature (ECT) sensor. Compare the ECT sensor value to the intake air temperature (IAT) sensor value on a cold engine. The ECT and IAT sensor values should be within ± 3°C (5°F). If the ECT sensor is out of range with the IAT sensor, test the resistance of the ECT sensor. Refer to Temperature Versus Resistance - Engine Coolant Temperature Sensor for resistance specifications. Replace the ECT sensor if the resistance is not within specification. Refer to Engine Coolant Temperature Sensor Replacement . If the sensor is within the specification, test the ECT sensor circuits for high resistance.
- Verify that the fuel system has adequate pressure for engine start-up. Observe the scan tool Chassis Control Module Fuel Pressure Sensor parameter and refer to Fuel System Diagnosis for correct pressure specifications.
- Inspect for excessive crankshaft endplay that will cause the crankshaft position (CKP) sensor reluctor wheel to move out of alignment with the CKP sensor . Refer to Crankshaft and Bearing Cleaning and Inspection and Engine Mechanical Specifications .

Hesitation, Sag, Stumble
- Test the fuel pressure. Refer to Fuel System Diagnosis .
- Inspect the mass air flow (MAF) sensor for obstruction, contamination, and damage. Refer to Mass Airflow Sensor with Intake Air Temperature Sensor Replacement .
- Test the generator. Refer to Symptoms - Engine Electrical . Repair the charging system if the generator output voltage is less than 9 volts or more than 16 volts.
- Inspect for excessive crankshaft endplay that will cause the crankshaft position (CKP) sensor reluctor wheel to move out of alignment with the CKP sensor. Refer to Crankshaft and Bearing Cleaning and Inspection and Engine Mechanical Specifications .
- Test the manifold absolute pressure (MAP) sensor. Refer to DTC P0106 .
- Engine warm and idling, verify the correct operation of the camshaft actuator system. Command the intake and exhaust camshaft actuator for each cylinder bank from 0 degrees to 20 degrees and back to zero while observing the appropriate scan tool Intake Camshaft Position Variance and exhaust Camshaft Position Variance parameters. Each parameter should be less than 2 degrees in each of the commanded states.
- If any of the parameters is greater than 2 degrees, inspect the suspect camshaft actuator and camshaft actuator solenoid valve and valve bore for contamination, obstruction, and damage. Refer to Camshaft Timing Drive Components Cleaning and Inspection and Camshaft Actuator System Description for additional information.

Lack of Power, Sluggishness, or Sponginess
- Inspect the engine electrical system for correct operation. Refer to Symptoms - Engine Electrical .
- Verify that each injector harness is connected to the correct injector.

Poor Fuel Economy
- Inspect for heavy loads being carried or towed
- Inspect for acceleration rate too much or too often
- Inspect for incorrect operation of the speedometer.
- Verify that the engine coolant temperature (ECT) has not shifted in value. Allow the engine to run and reach operating temperature. Observe the ECT Sensor parameter with a scan tool and compare the reading to the parameter listed in the K20 Engine Control Module: Scan Tool Information list. If the reading is not in the range specified in the list, test the resistance of the ECT sensor. Refer to Temperature Versus Resistance - Engine Coolant Temperature Sensor for resistance specifications. Replace the ECT sensor if the resistance is not within specification. Refer to Engine Coolant Temperature Sensor Replacement . If the sensor is within the

specification, test the ECT sensor circuits for high resistance.
- Inspect the brake system for brake drag.
Rough, Unstable, or Incorrect Idle and Stalling
- An excessively high idle may be due to the floor mat interfering with the accelerator pedal. With this condition present, it may not be possible to shift the transmission into gear. Inspect the accelerator pedal for binding and verify that the floor mat is not interfering with the accelerator pedal movement.
- Engine idle speed may be unstable or the engine may stall if the ECM has learned an incorrect idle/airflow compensation value. A DTC may also set. Observe the scan tool Throttle Body Idle Airflow Compensation parameter. A value greater than 90% may indicate an excessive accumulation of deposits in the throttle bore. If the throttle body needs cleaning, refer to Throttle Body Inspection and Cleaning . The actions listed below may also cause the ECM to learn an incorrect idle value.
- The engine control module has been replaced
- The throttle body has been replaced
- The throttle body has been cleaned but the idle learn procedure was not performed after completing the cleaning
- The air induction system was leaking, allowing non-metered air to enter the combustion chamber. The leak was repaired but the idle learn procedure was not performed after repairing the leak If any of the actions listed above have occurred, the Throttle or Idle Learn procedure must be performed.
- Inspect the engine mounts for looseness, wear, and damage. Refer to Engine Mount Inspection
- Inspect the intake and exhaust manifolds for casting flash.
- Inspect all bank 1 exhaust camshaft position sensor wiring for poor connections. Start the engine and observe for engine stalling while wiggling the bank 1 exhaust camshaft position sensor wiring harness. Refer to Inducing Intermittent Fault Conditions for further diagnosis.
Surges/Chuggles
- Inspect for slow responding heated oxygen sensor s (HO2S). The HO2S should respond quickly to a change in throttle position. If the HO2S do not respond to different throttle positions, inspect for contamination from fuel, silicon, or the incorrect use of RTV sealant. The sensors may have a white powdery coating and result in a high, but false, signal voltage, which gives a rich exhaust indication. The PCM reduces the amount of fuel delivered to the engine, causing a driveability condition.

Poor Fuel Fill Quality (Article 11392)

Problem Causes
DEFINITION: During the fueling process a continual, occasional, or no-fuel nozzle shut-off condition has occurred.
Difficult to fill Fill limit vent valve (FLVV) stuck closed – Located in and serviced by the fuel tank or fuel pump module . Evaporative emission (EVAP) canister restricted EVAP vent valve stuck closed Hose between canister and canister vent solenoid twisted or kinked if applicable High fuel temperature Fuel filler hose is kinked Faulty dispensing nozzle Ignition switch ON, vent valve closed
- Fill limit vent valve (FLVV) stuck closed – Located in and serviced by the fuel tank or fuel pump module .
- Evaporative emission (EVAP) canister restricted
- EVAP vent valve stuck closed
- Hose between canister and canister vent solenoid twisted or kinked if applicable
- High fuel temperature
- Fuel filler hose is kinked
- Faulty dispensing nozzle
- Ignition switch ON, vent valve closed
Over fill Fill limit vent valve (FLVV) stuck open or leaking – Located in and serviced by the fuel tank or fuel pump module. Fuel inlet check valve stuck open
- Fill limit vent valve (FLVV) stuck open or leaking – Located in and serviced by the fuel tank or fuel pump module.
- Fuel inlet check valve stuck open
Pre-mature shut-off of the fuel dispensing nozzle occurs immediately after engaging dispensing nozzle, tank empty Restricted vapor lines or fuel fill pipe High fuel temperature Inlet check valve at tank stuck closed, fill pipe full of fuel Fuel tank full, gauge not accurate
- Restricted vapor lines or fuel fill pipe
- Inlet check valve at tank stuck closed, fill pipe full of fuel
- Fuel tank full, gauge not accurate
Pre-mature shut-off of the fuel dispensing nozzle, more than 1/8 of tank capacity dispensed Kinked, pinched or plugged lines in fuel tank vent system EVAP vent valve stuck closed or restricted EVAP canister restricted Fill limit vent valve (FLVV) stuck closed or obstruction at top of fuel tank – Located in and serviced by the

fuel tank or fuel pump module.
- Kinked, pinched or plugged lines in fuel tank vent system
- EVAP vent valve stuck closed or restricted
- EVAP canister restricted
- Fill limit vent valve (FLVV) stuck closed or obstruction at top of fuel tank – Located in and serviced by the fuel tank or fuel pump module.
Fuel Spitback Restricted EVAP canister High fuel temperature Ignition sw itch ON, EVAP vent valve closed
- Restricted EVAP canister
- Ignition sw itch ON, EVAP vent valve closed

Engine Cranks But Does Not Run (Article 11375)

Diagnostic Instructions
- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Circuit/System Description
This Engine Cranks But Does Not Run diagnostic is an organized approach to identify a condition which causes the engine to crank but not start. This diagnostic directs the technician to the appropriate system diagnosis.

Diagnostic Aids
Inspect for any of the conditions listed below:
- If equipped with a key type ignition system , a partially retracted or folded over ignition key. When attempting to start the engine, the mechanical portion of the vehicle key must be locked in the fully extended position with the fob parallel to the key. Leaving the key partially retracted or folded over when starting may interrupt transponder authentication and result in an intermittent no-start condition. In such instances, DTC B3055 may also be set. If an intermittent no-start complaint is received, it may be necessary to discuss with the customer their starting habits and verify they are locking the key in the fully extended position, fob parallel to the key, before starting.
- A crankshaft position sensor condition. When this condition is present, the engine control module (ECM) uses the camshaft position sensor s to determine engine speed and position. If the condition exists in the signal circuit of the sensor, the engine will go into a limp home mode after a hard restart. The ECM then calculates engine speed from one of the camshaft position sensors. However, the engine will operate with a crankshaft position sensor condition only if the ECM has stored the learned reference position of the camshafts in memory.
- An in-tank fuel pump condition. The fuel pump flow control module controls and monitors the operation of the in-tank fuel pump. If the fuel pump flow control module detects a fault, a DTC sets in the fuel pump flow control module. The fuel pump flow control module will then send a serial data message to the engine control module (ECM) requesting the illumination of the malfunction indicator lamp (MIL).
- The fuel injectors are calibrated to begin operating when the fuel rail pressure reaches 2 MPa (290 psi) at 20–32°C (68–90°F). This specification will vary when the temperature is outside of this range.
- Insufficient fuel. Thoroughly inspect the fuel delivery system for sufficient fuel volume to the fuel injector s. Inspect the fuel supply components for partial blockage or restrictions.
- Fuel injectors with partially blocked and restricted nozzles, or a malfunctioning solenoid. Refer to Fuel Injector Solenoid Coil Test for diagnosis.
- Fuel injector ON time inadequate. When this condition is present, there may be fuel spray at the fuel injectors and the indicated fuel pressure may be correct, yet there may not be enough fuel to start the engine. If the engine control module (ECM) receives incorrect inputs from the various information sensors, the fuel delivered by the fuel injectors may be inadequate to start the engine. Check all the engine data parameters with a scan tool and compare the values indicated with the expected values or the values from a known good vehicle.
- Loose unsecured engine electrical grounds. Inspect the engine for good secure electrical grounds.
- Water or foreign material in the fuel, which can cause either a no start or a engine will not stay running condition. During freezing weather water can freeze inside the fuel system . The engine may start after 30 min in a heated repair shop. The malfunction may not recur until parked overnight in freezing temperatures. Extreme weather conditions can cause contaminated fuel to prevent the vehicle from starting.
- An ignition system that is susceptible to moisture. An engine that starts and runs after being brought into a warm, dry repair shop, may be susceptible to moisture. Spray water on the ignition system components and wiring while cranking the engine in order to check for an engine starting or will not stay running concern.

Reference Information
Schematic Reference
Engine Controls Schematics

Connector End View Reference
Component Connector End Views
Electrical Information Reference
- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs
DTC Type Reference
Powertrain Diagnostic Trouble Code (DTC) Type Definitions
Scan Tool Reference
Control Module References for scan tool information
Special Tools
- CH 48027 - Digital Pressure Gauge
- EL 26792 - HEI Spark Tester
For equivalent regional tools, refer to Special Tools .
Circuit/System Verification
- The battery is completely charged.
- The engine cranking speed is acceptable.
- There is adequate fuel in the fuel tank .
- Crank the engine for up to 15 s.
- Verify DTC P0116, P0118, P0201–P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0335, P0336, P0513, P0601, P0602, P0603-P0606, P062B, P0627, P0628, P0629, P0633, P069E, P1631, P1649, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216B, P216C, P216E, P216F, or U0109 is not set.
- If any of the DTCs are set Refer to Diagnostic Trouble Code (DTC) List - Vehicle .
- If none of the DTCs are set
- Ignition ON.
- Verify the Security Indicator on the instrument cluster illuminates momentarily.
- If the security indicator stays ON or is flashing Review the scan tool DTC information for Immobilizer system DTCs—Refer to Diagnostic Trouble Code (DTC) List - Vehicle . For additional information, refer to Immobilizer Description and Operation .
- If the security indicator illuminates momentarily
- Verify the scan tool Engine Speed parameter displays greater than 0 RPM while cranking the engine.
- If 0 RPM Refer to DTC P0335 or P0336 .
- If greater than 0 RPM
- Verify the scan tool Mass Airflow Sensor parameter displays greater than 0 Hz while cranking the engine.
- If 0 Hz Refer to DTC P0102 or P0103 .
- If greater than 0 Hz
- Ignition OFF, connect the EL 26792 - HEI Spark Tester between the spark plug boot of a T8 Ignition Coil and ground.
- Perform the spark test on at least 3 of the cylinders.
- An erratic or weak spark is considered a no spark condition.
- Verify the spark tester sparks while cranking the engine.
- If the spark tester does not spark Refer to Electronic Ignition System Diagnosis .
- If the spark tester sparks
- Ignition OFF, all accessories OFF, install the CH 48027 - Digital Pressure Gauge . Refer to Fuel Pressure Gauge Installation and Removal .
- Ignition ON, engine OFF.
- If the engine is too hot, high fuel pressure readings may result due to hot soak fuel boiling. Allow the engine coolant temperature to cool to less than 60° C (150° F) before attempting to verify fuel pressure.
- The Fuel Pump Enable may need to be commanded On a few times in order to obtain the highest possible fuel pressure.
- Additional DTCs may set when using the fuel pump output control.
- Command the Fuel Pump Enable On several times with a scan tool.
- Verify the fuel pressure is between 345–690 kPa (50–100 psi) with the fuel pump running.
- If not within the specified range Refer to Fuel System Diagnosis .
- If within the specified range
- Verify the fuel pressure, after the fuel pump has turned OFF, decreases to 500–599 kPa (72–87 psi), and does not decrease greater than 34 kPa (5 psi) in 1 minute.
- Verify the scan tool Fuel Rail Pressure Sensor parameter displays between 1.9–2.1 MPa (279–305 psi) while

cranking the engine.
- If not within the specified range Perform the Circuit/System Testing section of the Fuel Injector Circuit Diagnosis .
- Verify none of the conditions listed below exist:
- Collapsed air intake duct to the throttle body
- Restricted air filter element
- Gas or coolant fouled spark plugs
- A skewed engine coolant temperature (ECT) sensor—Refer to Temperature Versus Resistance - Engine Coolant Temperature Sensor .
- Restricted exhaust system—Refer to Restricted Exhaust .
- Contaminated fuel—Refer to Alcohol/Contaminants-in-Fuel Diagnosis .
- An engine mechanical condition, for example, worn timing chain and gears, low compression—Refer to Symptoms - Engine Mechanical .
- If a condition exists Repair as necessary.
- If no conditions exist
- All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Programming and Setup - Special Tools (Article 10759)

Illustration Tool Number/ Description
Click for full-size image EL 46079 Tire Pressure Monitor Diagnostic Tool
Click for full-size image EL 47955 Multi Diagnostic Interface (MDI)
Click for full-size image EL 50448 Tire Pressure Monitor Sensor Activation Tool
Click for full-size image EL 52100 Multi Diagnostic Interface 2 (MDI 2)
Click for full-size image EL 52545 Tire Pressure Monitor Sensor and RF Diagnostic Tool

Engine Controls and Fuel - Special Tools (Diagnostic Tools) (Article 11464)

Illustration Tool Number/Description
Click for full-size image CH-34730-2C J-34730-2C Injector Test Lamp
Click for full-size image CH-37287-1A Fuel Pressure Gauge Adapter 3/8”
Click for full-size image CH-38641-B J-38641-B Diesel Fuel Quality Tester
Click for full-size image CH-39021-301 J-39021-301 Fuel Injector Harness Adapter
Click for full-size image CH-39021-460 J-39021-460 Fuel Injector Test Adapter
Click for full-size image CH-41415-30 GE-41415-30 J-41415-30 Fuel Tank Cap Adapter
Click for full-size image CH-41769 J-41769 Fuel Line Quick Disconnect Tool
Click for full-size image CH-44284-2 J-44284-2 Fuel Flapper Door Holder
Click for full-size image CH-42982 J-42982 Fuel Pressure Gauge Adapter
Click for full-size image CH-44175-A J-44175-A Fuel Composition Tester
Click for full-size image CH-45004 J-45004 Fuel Tank Drain Hose
Click for full-size image CH-45722 J-45722 Fuel Sender Lock Ring Wrench
Click for full-size image CH-45873 J-45873 Fuel Return Volume Test Kit
Click for full-size image CH-47717 Lock Ring Wrench
Click for full-size image CH-47976 Active Fuel Injector Tester (AFIT)
Click for full-size image CH-47976-75 Fuel Injector Harness Adapter
Click for full-size image CH-47976-500A Active Fuel Injection Tester (AFIT) SIDI Adapter Kit
Click for full-size image CH-47976-502A AFIT SIDI E92 G2A Adapter Cable
Click for full-size image CH-47976-503 AFIT SIDI E80 G3 Adapter Cable
Click for full-size image CH-47976-504 E92/E39A G2B Start/Stop Adapter
Click for full-size image CH-47976-509 AFIT SIDI E81 G4 Adapter Cable
Click for full-size image CH-47976-511 AFIT SIDI E82 G5 Adapter Cable
Click for full-size image CH-47976-512 E80 G3B Stop/Start Adapter
Click for full-size image CH-47976-513 E92 G2C Stop/Start and SENT Adapter
Click for full-size image CH-48027 Fuel Pressure Gauge
Click for full-size image CH-48096 EVAP Service Access Port Tool
Click for full-size image CH–48482 Fuel Sender Lock Ring Wrench
Click for full-size image CH-50375 Diesel Injector Return Line Pressure Adapter
Click for full-size image CH-50377-A Injector Return Line Cap
Click for full-size image CH-50378 Injector Return Leakage Test Adapter

Click for full-size image CH-50933 Gauge Assembly, Liquid Propane Gas (LPG)
Click for full-size image EL-26792 J-26792 HEI Spark Tester
Click for full-size image EL-34730-405 J-34730-405 Injector Test Lamp
Click for full-size image EL-36169-HD Heavy Duty Fused Jumper
Click for full-size image EL-38522-A J-38522-A Variable Signal Generator
Click for full-size image EL-39021 J-39021 Fuel Injector Coil Balance Tester
Click for full-size image EL-39021-460 J-39021-460 Fuel Injector Test Adapter
Click for full-size image EL-43244 J-43244 Relay Puller Pliers
Click for full-size image EL-44603 J-44603 Injector Test Lamp
Click for full-size image EN-34730-91 J-34730-91 KM-J-34730-91 Pressure Tester
Click for full-size image EN-36012-A J-36012-A Ignition System Diagnosis Harness
Click for full-size image EN-37287 J-37287 Fuel Line Shut-off Adapters
Click for full-size image EN-37287–FF Fuel Line Shut-off Adapters
Click for full-size image EN-39021-210 J-39021-210 Injector Tester Adapter Box
Click for full-size image EN-41413-311 J-41413-311 EVAP Plug
Click for full-size image EN-41413-VLV J-41413-VLV EVAP Service Port Vent Fitting
Click for full-size image EN-44602 J-44602 Injector Test Adapter
Click for full-size image EN-45873-30 J-45873-30 Injector Flow Test Adapter
Click for full-size image EN-46091 J-46091 Charge Air Cooler Tester
Click for full-size image EN-46091-5 J-46091-5 Charge Air Cooler Tester Adapter
Click for full-size image EN-46091-10A Diesel Engine Pressure Test Adapter
Click for full-size image EN-46091-15 J-46091-15 Engine Pressure Test Adapter
Click for full-size image EN-46091-15A J-46091-15A Diesel Engine Pressure Test Adapter
Click for full-size image EN-46999 Displacement On Demand Tester
Click for full-size image EN-46999–15 Active Fuel Management Tester Harness – V6
Click for full-size image EN-46999–20 Active Fuel Management Tester Harness – Small Block V8
Click for full-size image EN-47603 Compression Gauge Adapter
Click for full-size image EN-47656–NA Pressure Test Plugs
Click for full-size image GE-23738-A J-23738-A Vacuum Pump
Click for full-size image GE-41413-300 EN-41413-300 J-41413-300 EVAP Cap and Plug Kit
Click for full-size image GE-41413-A EN-41413-A J-41413-A Evaporative Emissions System Tester (EEST)
Click for full-size image GE-41413-SPT J-41413-SPT High Intensity White Light
Click for full-size image GE-41415-50 J-41415-50 Fuel Tank Cap Adapter
Click for full-size image GE-41415-60 Engine Induction System Leak Test Adapter/Capless Fuel Fill Adapter
Click for full-size image J-25070 Heat Gun 260–399°C (500–750°F)
Click for full-size image J-34730-375 Injector Test Lamp
Click for full-size image J-44581 Fuel Line Disconnect Tool
Click for full-size image J-28428–E J 42220 CH 42220 Universal 12-Volt Leak Detection Lamp
Click for full-size image J-45878 Combustible Gas Detector

Driveability (itype_131)

Tsbs
- Stalling - Hesitation - Lack Of Performance P018B And/Or P2635 Setting In High Ambient Temperatures (PIP5507B, 2017/07/18)

New / Updated Parts (itype_117)

Tsbs
- Engine - THIS BULLETIN HAS BEEN CANCELED (04-06-04-054E, 2012/08/06)

OEM Policies and Procedures (itype_120)

Tsbs
- Do Not Swap Modules in Vehicles with Global Electrical Systems (25-NA-256, 2025/08/25)
- Identifying Non-GM (Aftermarket) Engine Calibrations for Gasoline Engines Using Tech 2® or GDS 2 (25-NA-122, 2025/12/23)
- Information on Module Harvesting (22-NA-205, 2022/10/19)

Warranty Information (itype_119)

Tsbs
- Warranty Administration - Warranty SPS Control Module Reprogramming (06-08-47-001O, 2019/06/11)