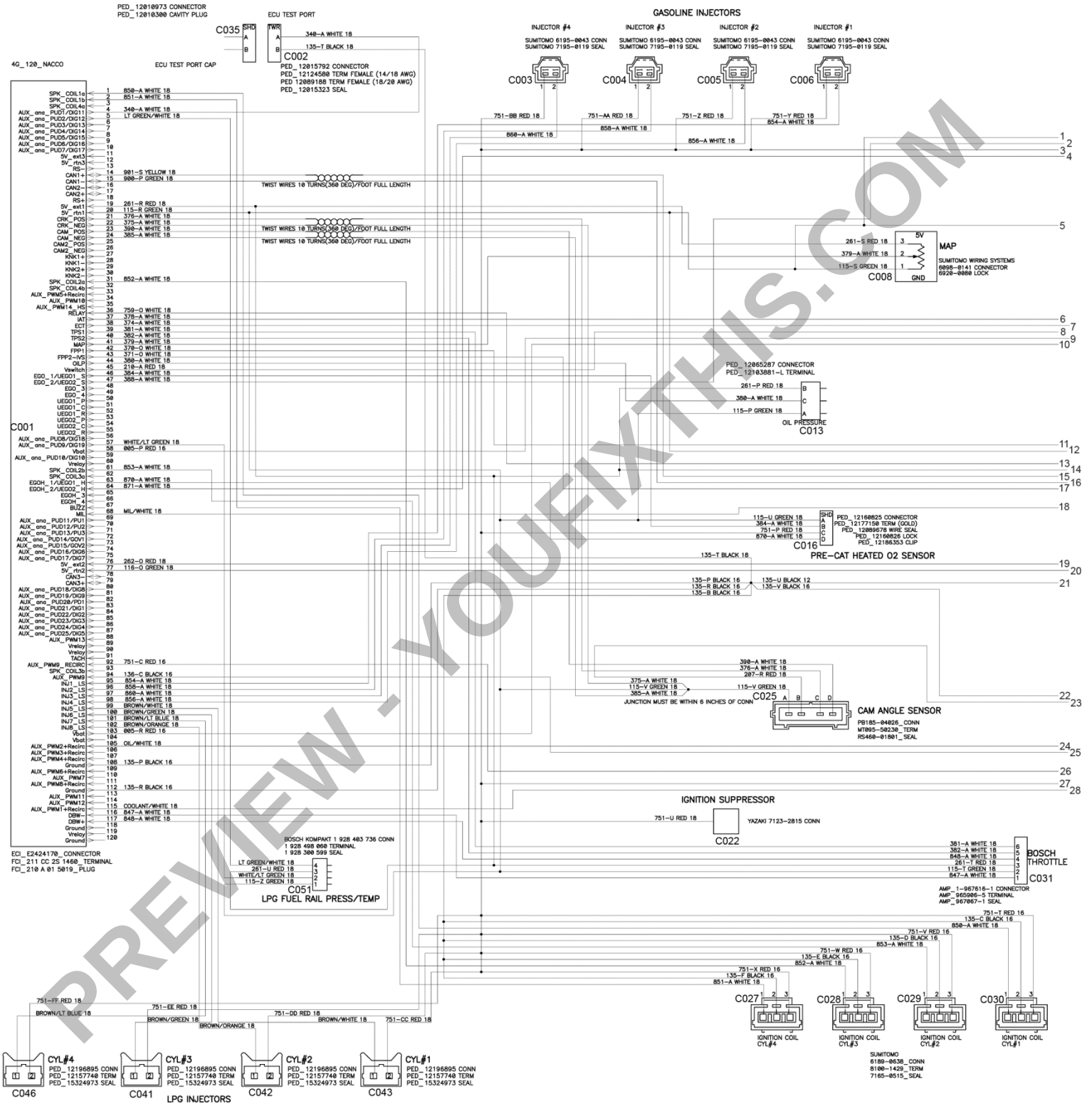
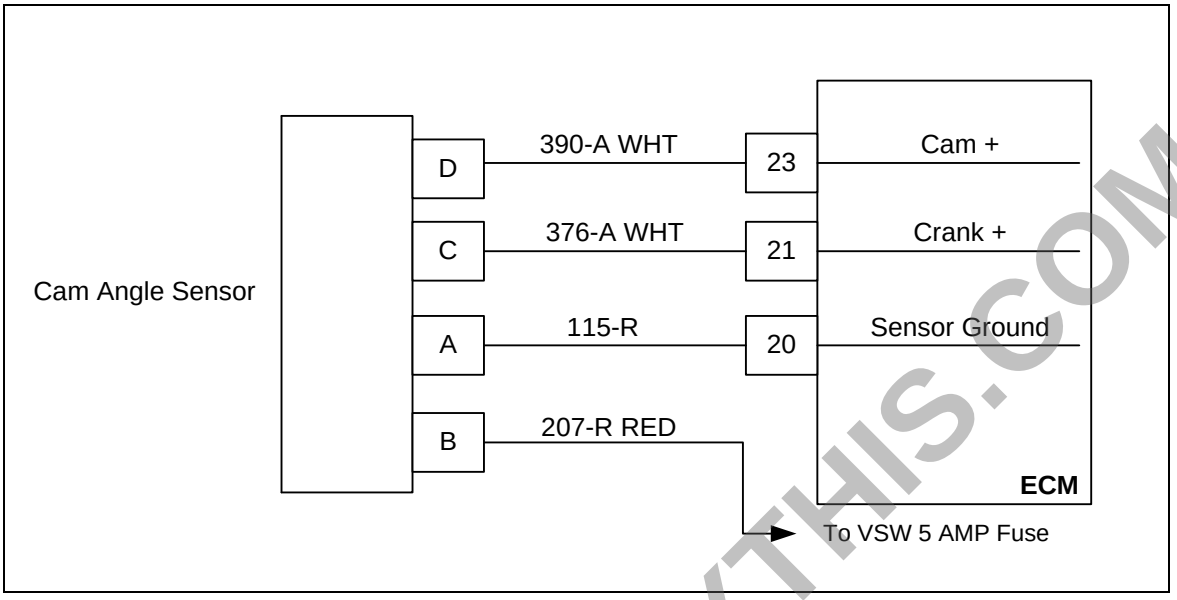
Engine Wiring Schematic (Bi-Fuel System)



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DTC 16-Never Crank Synced at Start



Conditions for Setting the DTC

- CKP (crankshaft position sensor)
- Check Condition-Engine Cranking or Running
- Fault Condition-Cranking Revolutions without synchronization
- Adaptive learn disabled
- MIL-On

Circuit Description

The cam angle sensor combines two sensors in one four pin package. It is a powered sensor that outputs a camshaft position (CMP) signal and a simulated crankshaft (CKP) sensor signal. The CMP is used to synchronize the fuel and ignition systems. The CKP sensor is used to measure engine RPM and its signal is also used to synchronize the ignition and fuel system. This fault will set if the ECM detects cranking revolutions without synchronization of the CMP and CKP sensors.

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I. ENGINE CONTROL MODULE

This procedure relates to removal and installation of the ECM--see Diagnostic Scan Tool for accessing ECM software.

REMOVAL PROCEDURE

1. Disconnect Negative battery cable.
2. Remove four screws mounting the controller to the mounting bracket.
3. Unplug the ECM and remove.
4. Push connector lock back to unlock connector.

INSTALLATION PROCEDURE

IMPORTANT
The ECM is calibrated for each engine. Verify you have the correct controller by noting the P/N on the ECM label. The calibration number can also be found by connecting the DST and finding the calibration number on the Gauge page.

1. Mount controller into mounting bracket with four screws. Torque to 7.5 N•m (5.5 ft. lbs.)
2. Plug connector into controller.
3. Push lock into place.
4. Reconnect the negative battery cable.
5. Install Diagnostic service tool.
6. Start engine.
7. Check for any DTC codes and clear.
8. Verify engine is in closed loop and no MIL light is present.

II. ENGINE WIRE HARNESS

1. Disconnect negative battery cable.
2. Lay out the new wire harness, noting the location, type of connectors, and identifying markings. Take special note of identical or similar connectors (such as the ignition coils or HEGO Sensors) to avoid crossing connections during installation. Note the routing of the existing wire harness in and around the engine and the vehicle. Refer the Electrical Schematic.

CAUTION

Ensure that all connections are made to the correct locations on the engine and its components. Crossing connections may cause poor engine performance, a MIL warning and/or permanent damage to the ECM.

3. Remove all wire harness connectors on the vehicle.
4. Remove all clips and brackets holding the wire harness and remove harness from vehicle.
5. Lay the new wire harness over the engine and route each end to its connection. Verify that all connectors match prior to installation.
6. Connect all connectors and ring terminals.
7. Install all clips and brackets to hold down the harness.
8. Reconnect negative battery cable.
9. Start the vehicle.
10. Check for MIL.

III. THROTTLE BODY

REMOVAL PROCEDURE

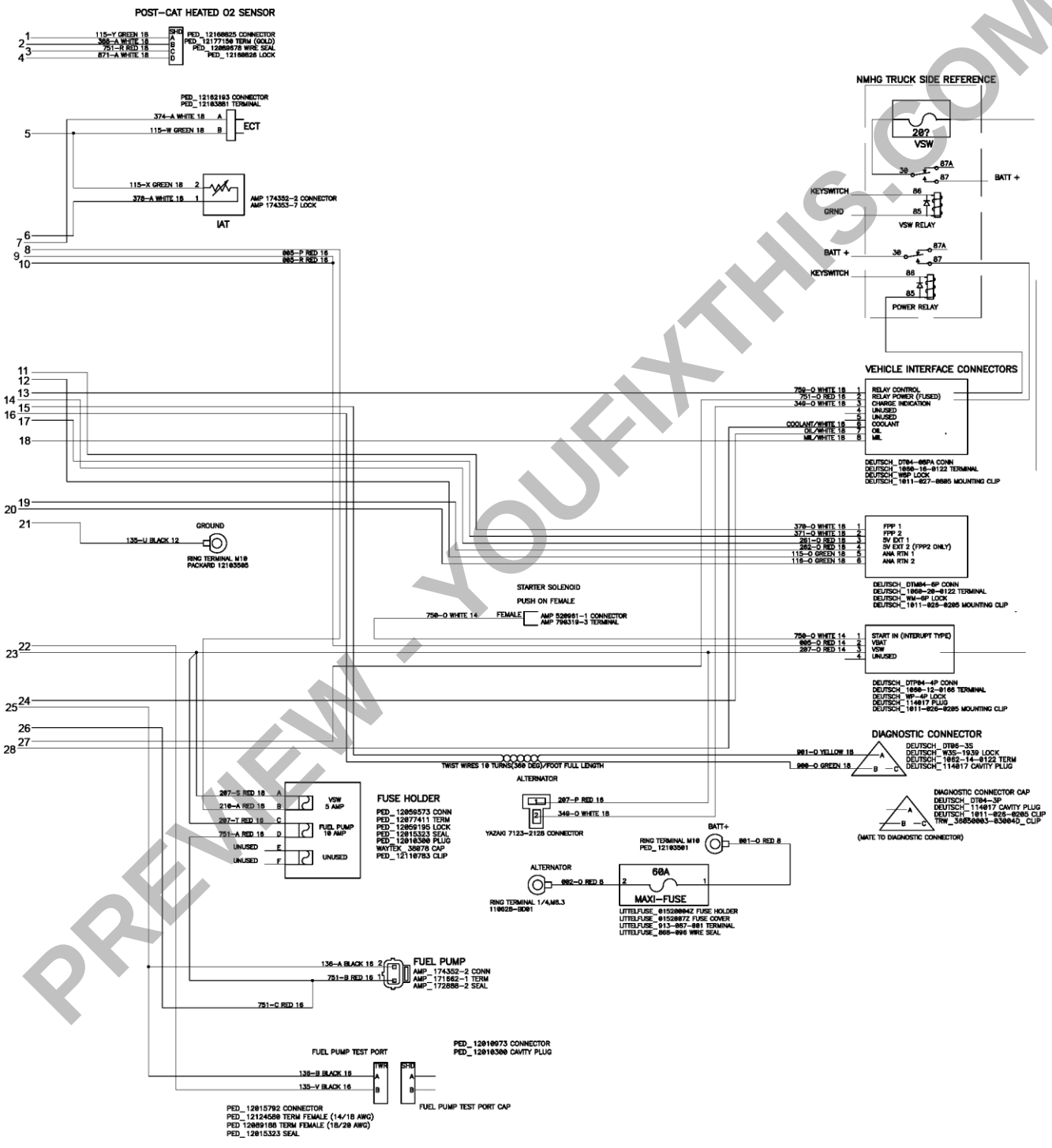
1. Disconnect the negative battery cable.
2. Relieve the LPG fuel system pressure. Refer to *XXI. LPG FUEL PRESSURE RELIEF.*
3. Remove air intake from throttle body.
4. Remove Throttle Body electrical connector.
5. Remove four screws securing the throttle body.
6. Remove throttle body and gasket.

INSTALLATION PROCEDURE

1. Inspect Throttle Body gasket. Replace if necessary.
2. Insert screws through Throttle Body.
3. Hang Gasket on Screws.
4. Place Throttle Body and Gasket on Intake Manifold and secure with four Screws. Torque to 12 N•m (106 in. lbs.).
5. Reconnect negative battery cable.
6. Open manual shut-off valve on the LPG tank.
7. Start Engine and verify normal operation in all throttle ranges.

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DTC-16 Never Crank Synced at Start

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	• Check that the ECM ground terminal C014 is clean and tight Are the ground connections clean tight and in the proper location?		Go to Step (3)	Repair the circuit as necessary. Refer to Wiring Repairs in Engine Electrical.
3	• Disconnect the ECM connector C001 • Using a DVOM check for continuity between cam angle sensor connector pin A and the ECM connector pin 20 Do you have continuity?		Go To Step (4)	Repair the open circuit as required. See wire harness repair section.
4	• Using a DVOM check for continuity between cam angle sensor connector pin C and ECM connector pin 21 Do you have continuity?		Go To Step (5)	Repair the open circuit as required. See wire harness repair section.
5	• Using a DVOM check for continuity between cam angle sensor connector pin D and ECM connector pin 23 Do you have continuity?		Go To Step (6)	Repair the cam signal shorted to ground
6	• Inspect ECM connector pins 20, 21 and 23 for damage corrosion or contamination. Did you find a problem?		Correct the problem as required	Go To Step (7)
7	• Run the diagnostic chart for DTC 342 Did that correct the problem?		Go to Step (9)	Go To Step (8)
8	• Run the diagnostic chart for DTC 337 Did that correct the problem?		Go To Step (9)	–
9	• Remove all test equipment except the DST. • Connect any disconnected components, fuses, etc. • Using the DST clear DTC information from the ECM. • Turn the ignition OFF and wait 30 seconds. • Start the engine and operate the vehicle to full operating temperature • Observe the MIL • Observe engine performance and driveability • After operating the engine within the test parameters of DTC-16 check for any stored codes. Does the engine operate normally with no stored codes?		System OK	Go to OBD system check

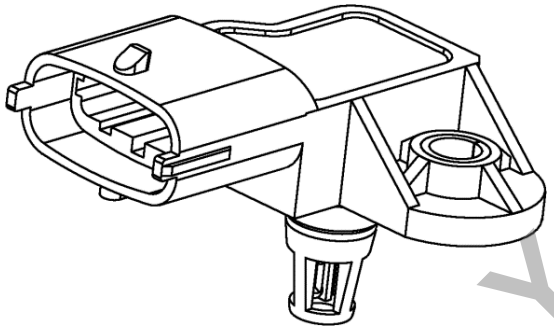
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IV. FUEL TEMPERATURE AND PRESSURE SENSOR

REMOVAL PROCEDURE

1. Disconnect the negative battery cable.
2. Relieve the LPG fuel system pressure. Refer to *XXI. LPG FUEL PRESSURE RELIEF.*
3. Locate the Fuel Temperature and Pressure Sensor under the LP fuel rail**. NOTE**: Do not confuse the Temperature and Pressure Sensor with the MAP Sensor located on the Intake Manifold.
4. Leave harness connected to sensor before removal.
5. Remove retaining screw and carefully remove the sensor from the Fuel Rail port.
6. Disconnect harness plug.
7. Inspect port for debris or "heavy ends" and remove with a Safety Solvent if necessary.



Fuel Temperature and Pressure Sensor

WARNING

Only use a Safety Solvent to clean any part of the fuel system. Harsh cleaners such as carb or brake cleaners may damage gaskets, O-rings, seals and other non-metallic components in the fuel system.

INSTALLATION

1. Lubricate O-rings on the sensor with petroleum jelly or Vaseline.

CAUTION

The HEGO is sensitive to silicone based products an can become contaminated. Avoid using silicone sealers/lubricants.

2. Plug in harness connector.
3. Install the sensor into the Fuel Rail port. Secure with retaining screw and torque to 10Nm+/-1.0Nm (**7-9 ft.lbs)**.
4. Reconnect the negative battery cable.
5. Using the DST, clear DTC information from the ECM.
6. Turn the ignition OFF and wait 30 seconds.
7. Start the vehicle and let run until it reaches normal operating temperature.
8. If a DTC code is found, refer to the Electrical Section for further diagnosis.

V. OIL PRESSURE SENDER

REMOVAL PROCEDURE

1. Disconnect the negative battery cable.
2. Locate the Oil Pressure Sender on the side of the engine block.
3. Remove electrical connection from sender. Remove the Sender (do not remove the brass adapter from the engine block).

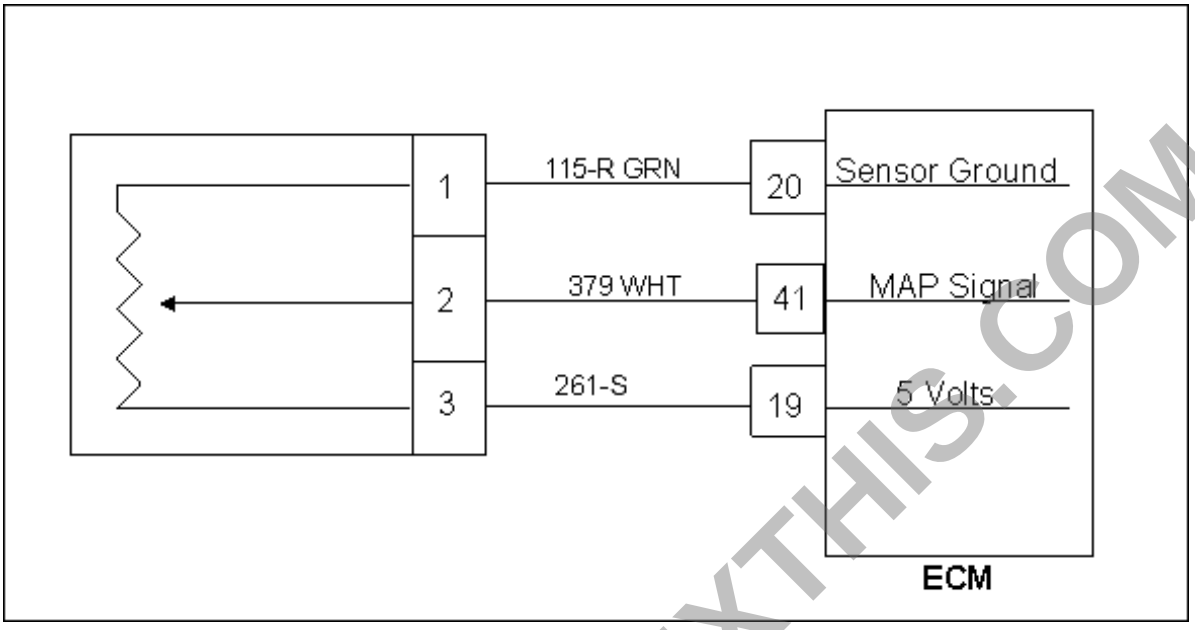
INSTALLATION PROCEDURE

1. Apply Loctite 567 (or equivalent high-temp thread locker/sealer) to the threads on the Oil Pressure Sender.
2. Install Oil Pressure Sender. Torque until tight.
3. Plug in electrical connector.
4. Reconnect negative battery cable.
5. Using the DST, clear DTC information from the ECM.
6. Turn the ignition OFF and wait 30 seconds.
7. Start the vehicle and let run until it reaches normal operating temperature.
8. If a DTC code is found, refer to the Electrical Section for further diagnosis.

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DTC 107-MAP Low Voltage



Conditions for Setting the DTC

- Manifold Absolute Pressure Sensor
- Check Condition-Engine cranking or running
- Fault Condition-MAP voltage less than 0.200 with throttle position greater than 3.5% and engine RPM less than 3000
- MIL-ON
- Adaptive-Disabled
- Fueling is based on RPM and TPS Limp-Home Condition during this fault.

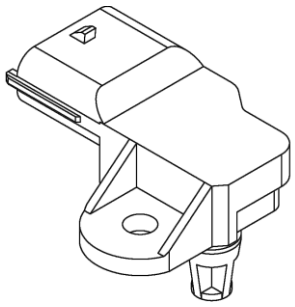
Circuit Description

The Manifold Absolute Pressure sensor is a pressure transducer connected to the intake manifold. It is used to measure the pressure of air in the intake manifold. This reading is used in conjunction with other inputs to estimate the airflow rate to the engine, which determines the fuel flow rate. This fault will set if the MAP voltage is less than 0.200 with TPS greater than 3.5% and engine RPM less than 3000. The adaptive Learn will be disabled for the remainder of the key on cycle and the MIL command is on.

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VI. MANIFOLD PRESSURE (MAP) SENSOR



MAP Sensor

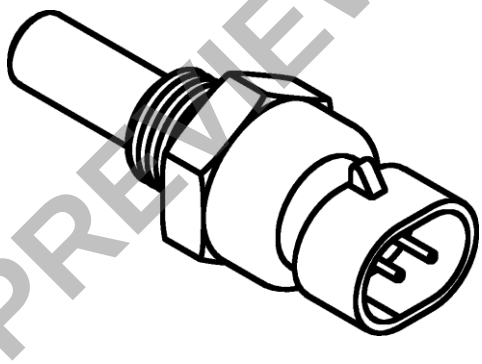
REMOVAL PROCEDURE

1. Disconnect the negative battery cable.
2. Locate the MAP Sensor at the top of the intake manifold and disconnect the MAP electrical connector.
3. Remove the two retaining bolts.

INSTALLATION PROCEDURE

1. Install the MAP and torque the two retaining to 2.1 N•m (19 in. lbs.).
2. Reconnect the negative battery cable.
3. Using the DST, clear DTC information from the ECM.
4. Turn the ignition OFF and wait 30 seconds.
5. Start the vehicle and let run until it reaches normal operating temperature.
6. If a DTC code is found, refer to the Electrical Section for further diagnosis.

VII. AIR TEMPERATURE (IAT) SENSOR



Air Temperature Sensor or IAT.

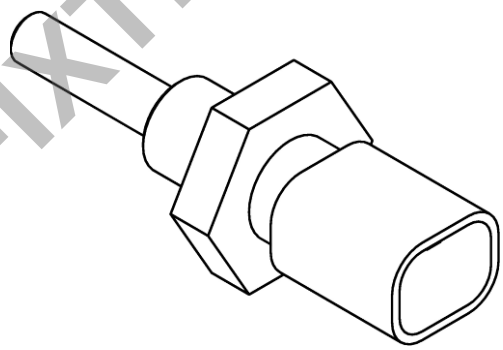
REMOVAL PROCEDURE

1. Disconnect the negative battery cable.
2. Locate the Air Temperature Sensor next to the MAP sensor on the side of the intake manifold
3. Remove electrical connector.
4. Remove the sensor.

INSTALLATION PROCEDURE

1. Inspect and replace seal if necessary.
2. Install IAT Sensor. Torque to 19 N•m (14 ft. lbs.).
3. Reconnect electrical connector.
4. Reconnect the negative battery cable.
5. Using the DST, clear DTC information from the ECM.
6. Turn the ignition OFF and wait 30 seconds.
7. Start the vehicle and let run until it reaches normal operating temperature.
8. If a DTC code is found, refer to the Electrical Section for further diagnosis.

VIII. ENGINE COOLANT TEMPERATURE SENSOR (ECT)



Engine Coolant Sensor or ECT.

REMOVAL PROCEDURE

1. Disconnect the negative battery cable.
2. Locate the Engine Coolant Temperature Sensor below the intake manifold next to the thermostat housing.
3. Remove electrical connector.
4. Drain the cooling system

CAUTION

The coolant may be hot. Use caution when removing hose(s) to prevent contact.

5. Remove the sensor.

INSTALLATION PROCEDURE

1. Apply a minimal amount of pipe thread seal-

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SPECTRUM by IMPCO

2012 Emission Certified Bi-Fuel (Multi-Point Injected LPG & Gasoline Fuel System)

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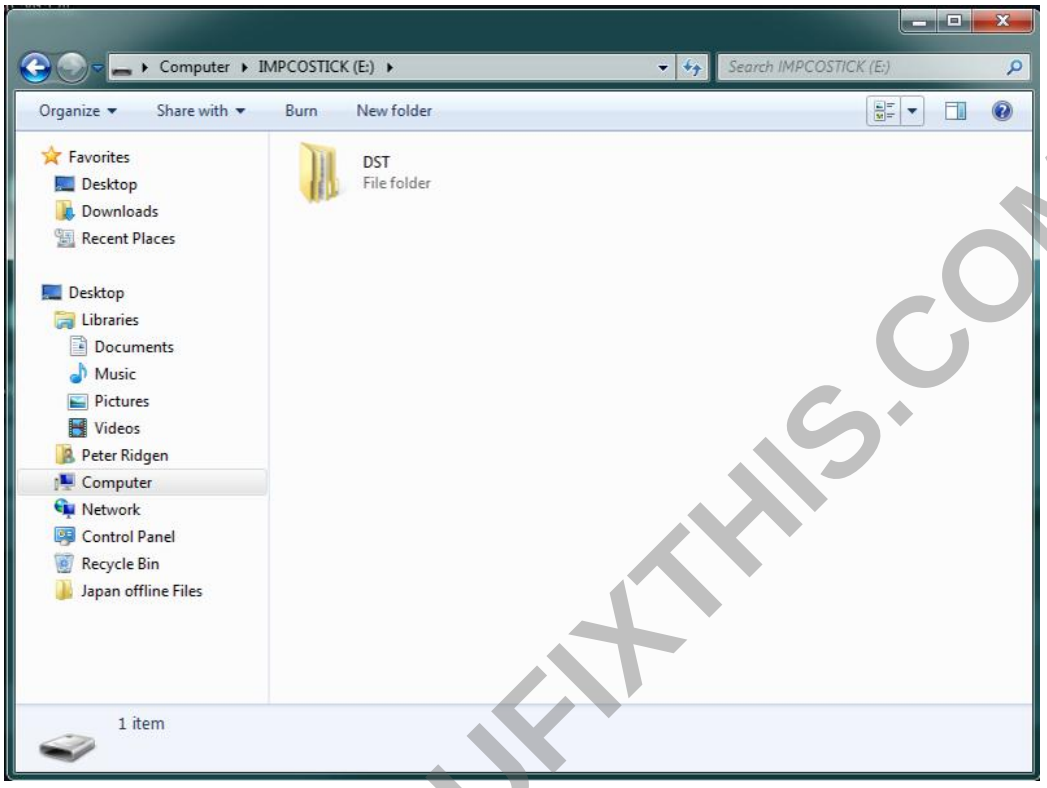
LACK OF POWER, SLUGGISHNESS, OR SPONGINESS

Checks	Action
DEFINITION: *The engine delivers less than expected power. There is little or no increase in speed when partially applying the accelerator pedal.*	
Preliminary Checks	• Refer to the *LPG Fuel system OBD System Check.* • Compare the customer's vehicle with a similar unit to verify customer has an actual problem. *Do not compare the power output of the vehicle operating on LPG to a vehicle operating on gasoline as the fuels do have different drive feel characteristics.* • Remove the air filter and check for dirt or restriction. • Check the vehicle transmission. • Refer to the OEM transmission diagnostics.
Fuel System Checks	• Check for a restricted fuel filter, contaminated fuel, or improper fuel pressure. Refer to *LPG Fuel System Diagnosis*. • Check for the proper ignition output voltage with the spark tester *J 26792* or the equivalent. • Check all air inlet ducts for condition and proper installation. • Check for fuel leaks around the regulator and lines leading to and from the regulator. • Verify that the LPG tank manual shut-off valve is fully open. • Verify that liquid fuel (not vapor) is being delivered to the Regulator.
Sensor Checks	• Check the Heated Exhaust Gas Oxygen Sensors (HEGO) for contamination and performance. Check for proper operation of the MAP sensor. • Check for proper operation of the TPS and FPP sensors.
Exhaust System Checks	Check the exhaust system for a possible restriction: • Inspect the exhaust system for damaged or collapsed pipes. • Inspect the muffler for signs of heat distress or for possible internal failure. • Check for possible plugged catalytic converter.
Engine Mechanical Check	Check the engine for the following: • Engine compression. • Valve timing. • Improper or worn camshaft. • Refer to *Engine Mechanical* in the Service Manual.
Additional Check	• Check the ECM grounds for being clean, tight, and in their proper locations. • Check the alternator output voltage. If all procedures have been completed and no malfunction has been found, review and inspect the following items: • Visually and physically, inspect all electrical connections within the suspected circuit and/or systems. • Check the DST data.

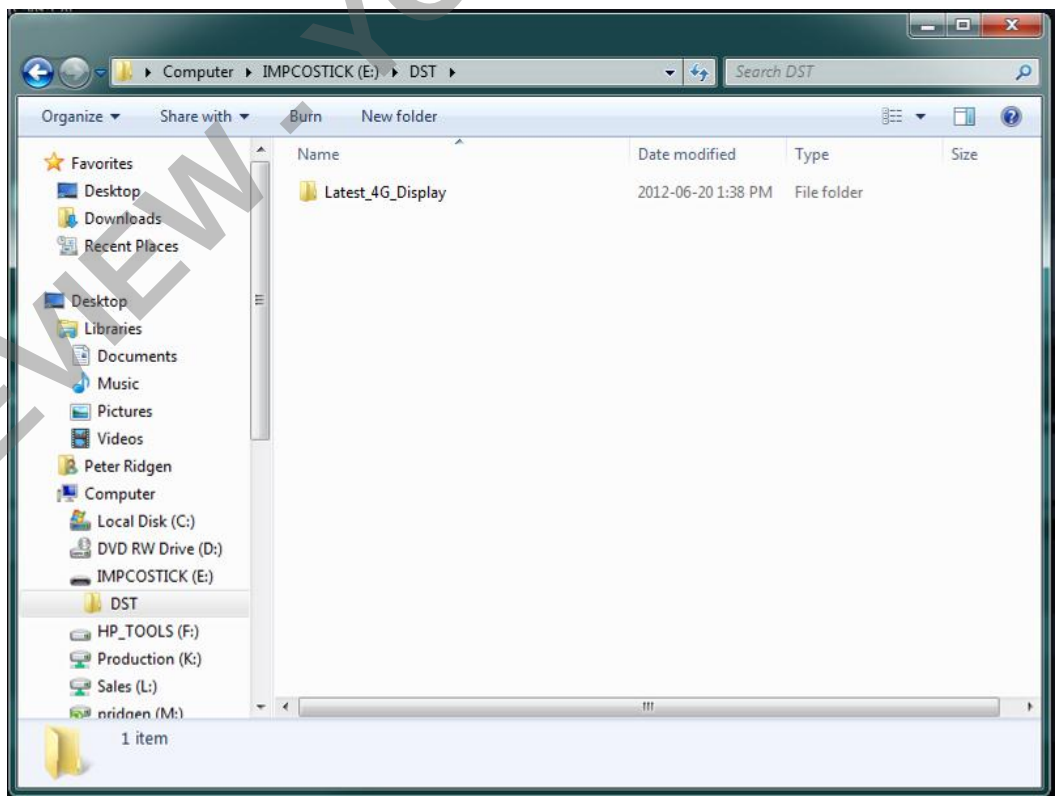
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Installation of DST Software



- Open the DST_folder



- Open the Latest_4G Display folder

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Step	Action	Value(s)	Yes	No
9	• Key OFF • Disconnect ECM connector • Check for continuity between MAP sensor connector pin 3 and ECM 5 volt reference pin 19. Do you have continuity between them?		Go To Step (10)	Repair the circuit as necessary. Refer to Wiring Repairs in Engine Electrical.
10	• Check for continuity between MAP sensor connector 5 volt reference pin 3 and engine ground Do you have continuity?		Repair the circuit as necessary. Refer to Wiring Repairs in Engine Electrical.	Go to Step (11)
11	• Inspect ECM and MAP wire harness connector and terminals for corrosion, contamination or mechanical damage Any problems found?		Repair the circuit as necessary. Refer to Wiring Repairs in Engine Electrical.	Go to Step (16)
12	• Replace ECM. Refer to ECM replacement in the Engine Controls Section. Is the replacement complete?		Go To Step (17)	-
13	• Disconnect ECM connector • Check for continuity between MAP sensor connector signal circuit pin 2 and ECM signal pin 41 Do you have continuity between them?		Go to Step (14)	Repair the circuit as necessary. Refer to Wiring Repairs in Engine Electrical.
14	• Check for continuity between MAP sensor connector signal pin 2 and engine ground Do you have continuity?		Repair the circuit as necessary. Refer to Wiring Repairs in Engine Electrical.	Go To Step (15)
16	• Replace ECM. Refer to ECM replacement in the Engine Controls Section. Is the replacement complete?		Go to Step (18)	-
17	• Replace MAP sensor Is the replacement complete?		Go To Step (18)	-
18	• Remove all test equipment except the DST. • Connect any disconnected components, fuses, etc. • Using the DST clear DTC information from the ECM. • Turn the ignition OFF and wait 30 seconds. • Start the engine and operate the vehicle to full operating temperature and observe the MIL • Observe engine performance and driveability • After operating the engine within the test parameters of DTC-107 check for any stored codes. Does the engine operate normally with no stored codes?		System OK	Go to OBD System Check

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DTC 221-TPS 1 Higher Than TPS 2

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	• Key ON, Engine OFF • DST (Diagnostic Scan Tool) connected in System Data Mode Does the DST display more than a 20% difference between TPS 1 and TPS 2?		Go to Step (3)	Intermittent problem Go to Intermittent section
3	• Key OFF • Disconnect electronic throttle connector C031 • Key ON • Change DST mode to DBW (drive by wire) test mode Is the voltage for TPS 1 less than 0.1 volts?		Go to Step (5)	Go to Step (4)
4	• Key OFF • Disconnect ECM wiring harness connector C001 • Key ON • Using a DVOM check for voltage between ECM connector TPS 1 signal pin 5 and engine ground Do you have voltage?		Repair the TPS 1 circuit shorted to voltage as necessary. Refer to Wiring Repairs in Engine Electrical.	Go to Step (9)
5	• Jump TPS 1 signal pin 6 to the 5 volt reference pin 3 at connector C028 Does DST display TPS 1 voltage over 4.95 volts		Go to Step (6)	Go to Step (8)
6	• Inspect wire terminals at throttle connector for damage corrosion or contamination Any problems found?		Repair the circuit as necessary. Refer to Wiring Repairs in Engine Electrical.	Go to Step (7)
7	• Replace the electronic Throttle Is the replacement complete?		Go to Step (12)	-
8	• Key OFF • Disconnect ECM wire harness connector C001 • Using a DVOM check for continuity between throttle connector TPS 1 signal pin 6 and ECM connector TPS 1 signal pin39 Do you have continuity between them?		Go to Step (9)	Repair the open circuit as necessary. Refer to Wiring Repairs in Engine Electrical.
9	• Using a DVOM check for continuity between throttle connector signal ground pin 2 and ECM connector signal ground pin 20 Do you have continuity between them?		Go to Step (10)	Repair the open circuit as necessary. Refer to Wiring Repairs in Engine Electrical.
10	• Inspect ECM connector terminals for damage corrosion or contamination. Any problems found?		Repair the circuit as necessary. Refer to Wiring Repairs in Engine Electrical	Go to Step (11)
11	• Replace ECM Is the replacement complete?		Go to Step (12)	-

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DTC 277-Injector Driver 6 Shorted

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	_	Go to Step (2)	Go to OBD System Check Section
2	• Key On, Engine Running • DST (Diagnostic Scan Tool) connected in System Data Mode • Clear System DTC 277 Does DTC 265 reset with the engine idling?		Go To Step (3)	Intermittent problem Go to Intermittent section
3	• Key Off • Disconnect the injector connector C041 • Using a high impedance DVOM, measure the resistance between the (2) pins of the injector Does the DVOM display a resistance value of 5 ohms or more?		Go To Step (5)	Go To Step (4)
4	• Replace the Fuel Injector Is the replacement complete?		Go to Step (8)	_
5	• Disconnect the ECM wire harness connector C001 • Key ON • Using a DVOM check for voltage between the ECM connector pin 100 and engine ground Does the DVOM display voltage?		Repair the shorted to voltage injector driver circuit as necessary. Refer to Wiring Repairs in Engine Electrical.	Go to Step (6)
6	• Replace Fuel Injector Is the replacement complete?		Go to Step (8)	-
7	• Replace ECM. Refer to ECM replacement in the Engine Controls Section. Is the replacement complete?	_	Go To Step (9)	_
8	• Remove all test equipment except the DST. • Connect any disconnected components, fuses, etc. • Using the DST clear DTC information from the ECM. • Turn the ignition OFF and wait 30 seconds. • Start the engine and operate the vehicle to full operating temperature • Observe the MIL • Observe engine performance and driveability • After operating the engine within the test parameters of DTC 277 check for any stored codes. Does the vehicle engine normally with no stored codes?		System OK	Go to Step (7)

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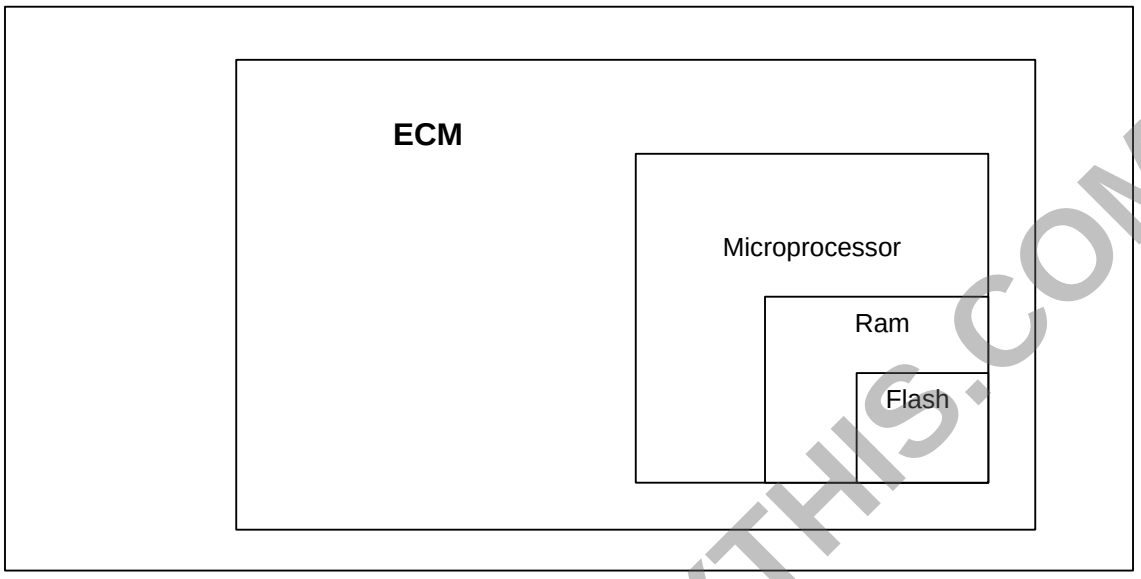
DTC 642-External 5V Reference Low

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	• Key ON, Engine Running • DST (Diagnostic Scan Tool) connected in System Fault Mode Does DST display DTC 642?		Go to Step (3)	Intermittent problem Go to Intermittent section
3	• Key OFF • Disconnect ECM connector C001 • Using DVOM check for continuity between ECM 5 volt reference pin 19 and engine ground Do you have continuity?		Go to Step (5)	Go to Step (4)
4	• Replace ECM Is the replacement complete?		Go to Step (7)	-
5	• While monitoring DVOM for continuity between ECM 5 volt reference and engine ground disconnect each sensor (below) one at a time to find the shorted 5 volt reference. When continuity to ground is lost the last sensor disconnected is the area of suspicion. Inspect the 5 volt reference supply wire leads for shorts before replacing the sensor. • IAT • ECT • Electronic throttle • Gasoline or LPG temperature sensor • FPP sensors • Crankshaft / camshaft sensor • Oil pressure transducer While disconnecting each sensor one at a time did you lose continuity?		Go to Step (6)	Repair shorted wire harness
6	• Replace the last disconnected sensor Is the replacement complete?		Go To Step (7)	-
7	• Remove all test equipment except the DST. • Connect any disconnected components, fuses, etc. • Using the DST clear DTC information from the ECM. • Turn the ignition OFF and wait 30 seconds. • Start the engine and operate the vehicle to full operating temperature • Observe the MIL • Observe engine performance and drivability • After operating the engine within the test parameters of DTC-642 check for any stored codes. Does the engine operate normally with no stored codes?		System OK	Go to OBD System Check

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DTC 1616-Invalid Interrupt



Conditions for Setting the DTC

- Engine Control Module
- Check Condition-Key on
- Fault Condition-Internal microprocessor error
- MIL-On
- Adaptive-Disabled for the remainder of the key-ON cycle
- Power Derate level 2

Circuit Description

The ECM has several internal checks that must be satisfied each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will attempt to reset itself in the event this fault is set. The MIL command is on and will remain on until the code is cleared using the DST. Power Derate level 2 will be enforced limiting maximum power.

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DTC 2128-FPP 2 Voltage High

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	• Key ON, Engine OFF • DST (Diagnostic Scan Tool) connected in System Data Mode Does the DST display FPP voltage of 4.80 volts or greater with the foot pedal in the idle position?	Greater than 4.80 volts	Go to Step (3)	Go to Step (3)
3	• Slowly increase FPP while observing FPP 2 voltage Does DST FPP voltage ever exceed 4.80 volts?		Go To Step (4)	Intermittent problem Go to Intermittent section
4	• Disconnect FPP sensor connector C018 Does the DST now show FPP 2 voltage below 0.200 volts?	Below 0.200 volts	Go To Step (5)	Go To Step (6)
5	• Replace FPP sensor Is the replacement complete?		Go To Step (10)	-
6	• Key OFF • Disconnect ECM connector C001. Using a DVOM check continuity between connector C018 pin 6 and ECM sensor ground pin 77 Do you have continuity?		Go To Step (7)	Repair the open ground circuit as required
7	• Key ON. Using a DVOM check for voltage between the FPP connector pin 2 and engine ground Do you have voltage?	No voltage	Repair the signal shorted to voltage circuit	Go To Step (8)
8	• Inspect ECM and FPP connectors and pins for damage corrosion or contamination Did you find a problem		Repair the circuit as required. See wire harness repair section	Go To Step (9)
9	• Replace ECM Is the replacement complete?		Go To Step (10)	-
10	• Remove all test equipment except the DST. • Connect any disconnected components, fuses, etc. • Using the DST clear DTC information from the ECM. • Turn the ignition OFF and wait 30 seconds. • Start the engine and operate the vehicle to full operating temperature • Observe the MIL • Observe engine performance and driveability • After operating the engine within the test parameters of DTC-2128 check for any stored codes. Does the engine operate normally with no stored codes?		System OK	Go to OBD System Check

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