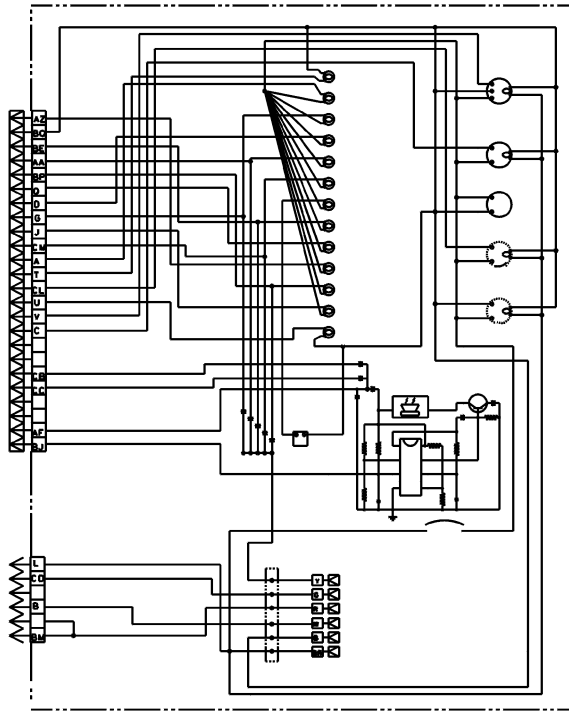


# DIAGRAMS

S3.50-5.50XM (S70-120XM) [E004, F004]



HM210070

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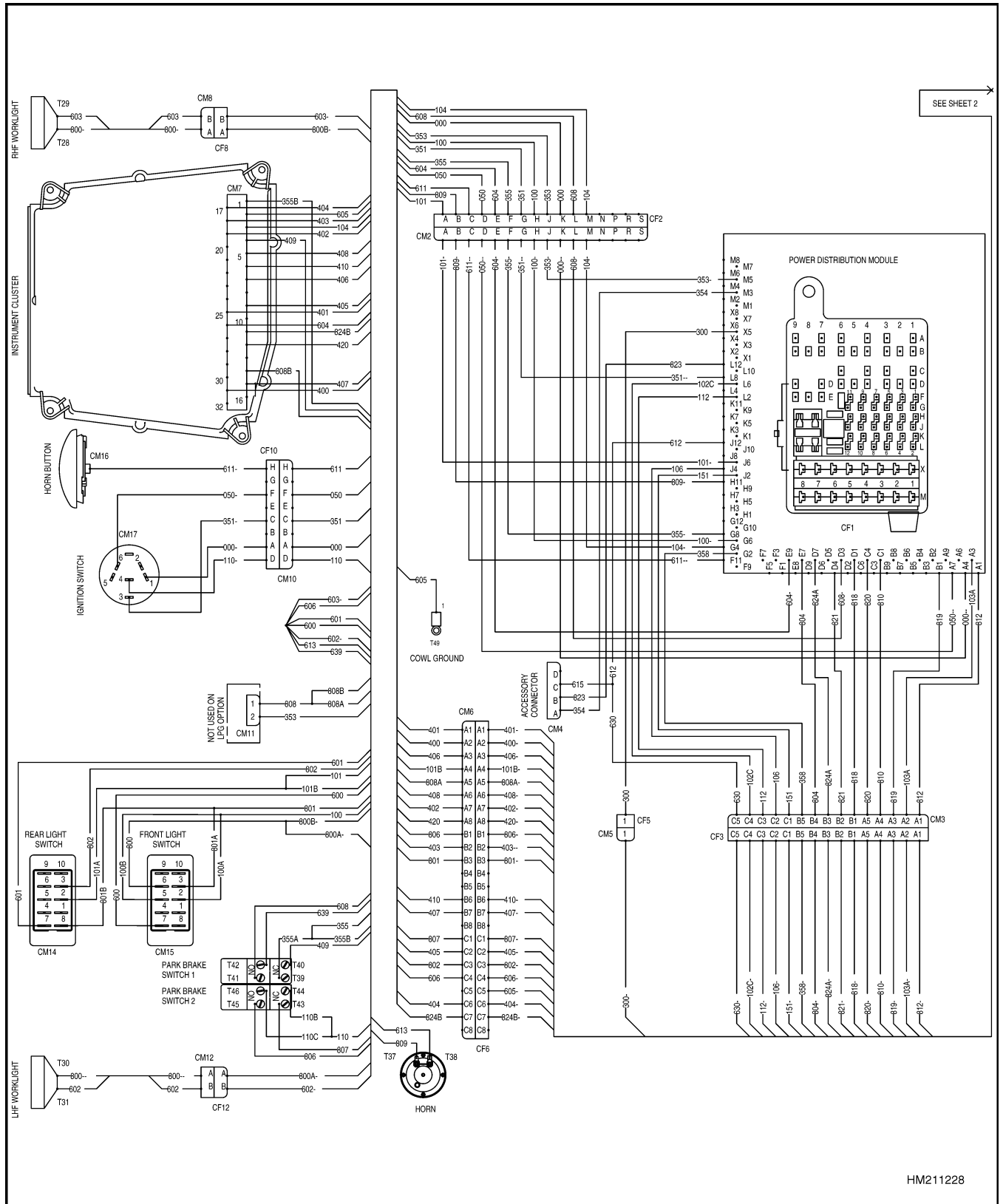


Figure 3. Wiring Diagram LPG (REV 1) (E004) (Sheet 1 of 4)

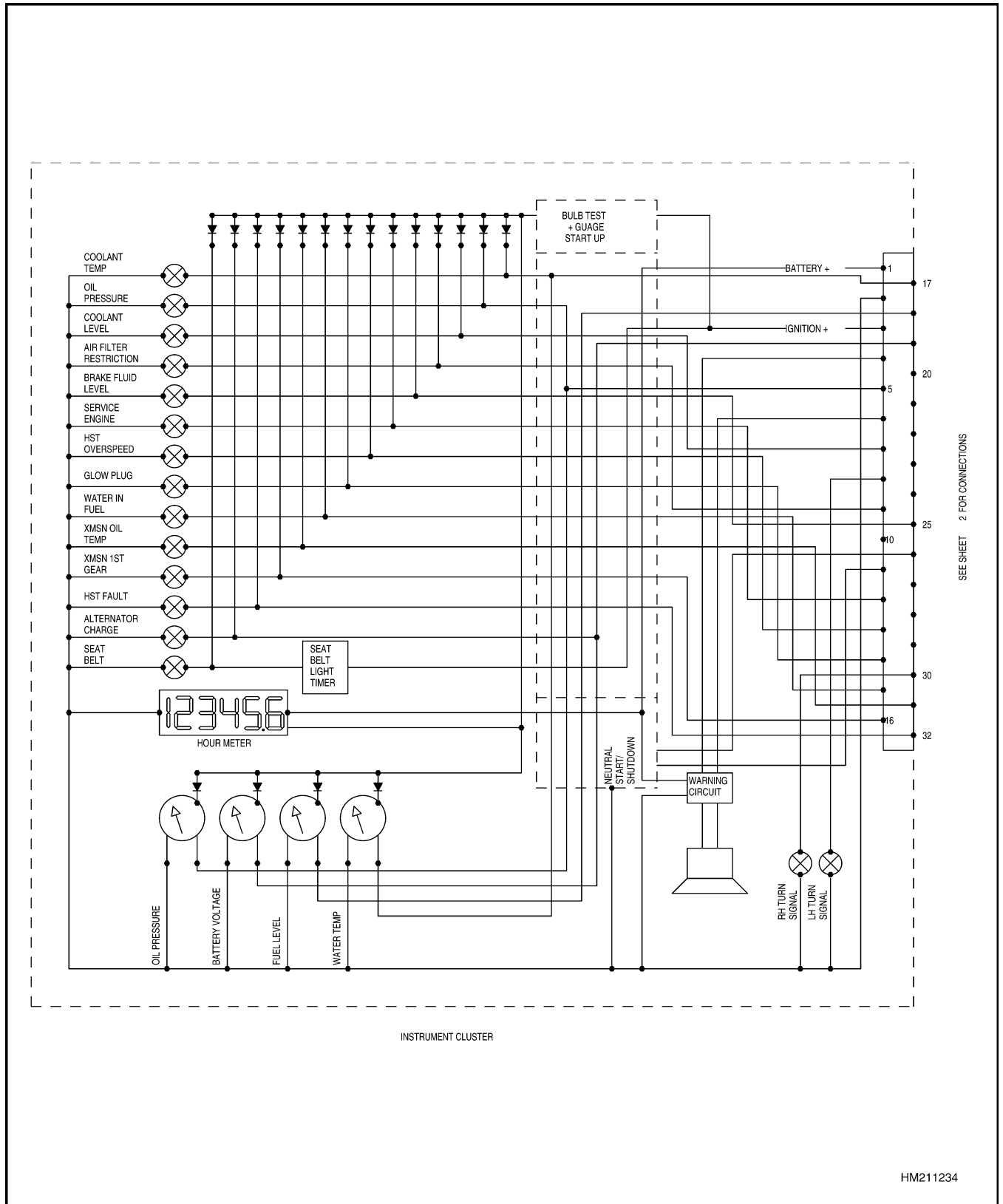


Figure 5. Electrical Schematic Gas (REV 1) (E004) (Sheet 3 of 3)

HM211234

CONNECTOR ID CF8 (SHOWN)	DELPHI PACKARD P/N 12047663	CONNECTOR ID CF36 (SHOWN)	DEUTSCH P/N DT06-2S-CE06	CONNECTOR ID CM55 (SHOWN)	DELPHI PACKARD P/N 12162193	CONNECTOR ID CF101 (SHOWN)	DELPHI PACKARD P/N 15422562
CONNECTOR ID CF12 (NOT SHOWN)	DELPHI PACKARD P/N 12047663	CONNECTOR ID CM63 (NOT SHOWN)	DELPHI PACKARD P/N 12162194				
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Figure 8. Wiring Diagram Gas (REV 2) (E004) (Sheet 4 of 4)

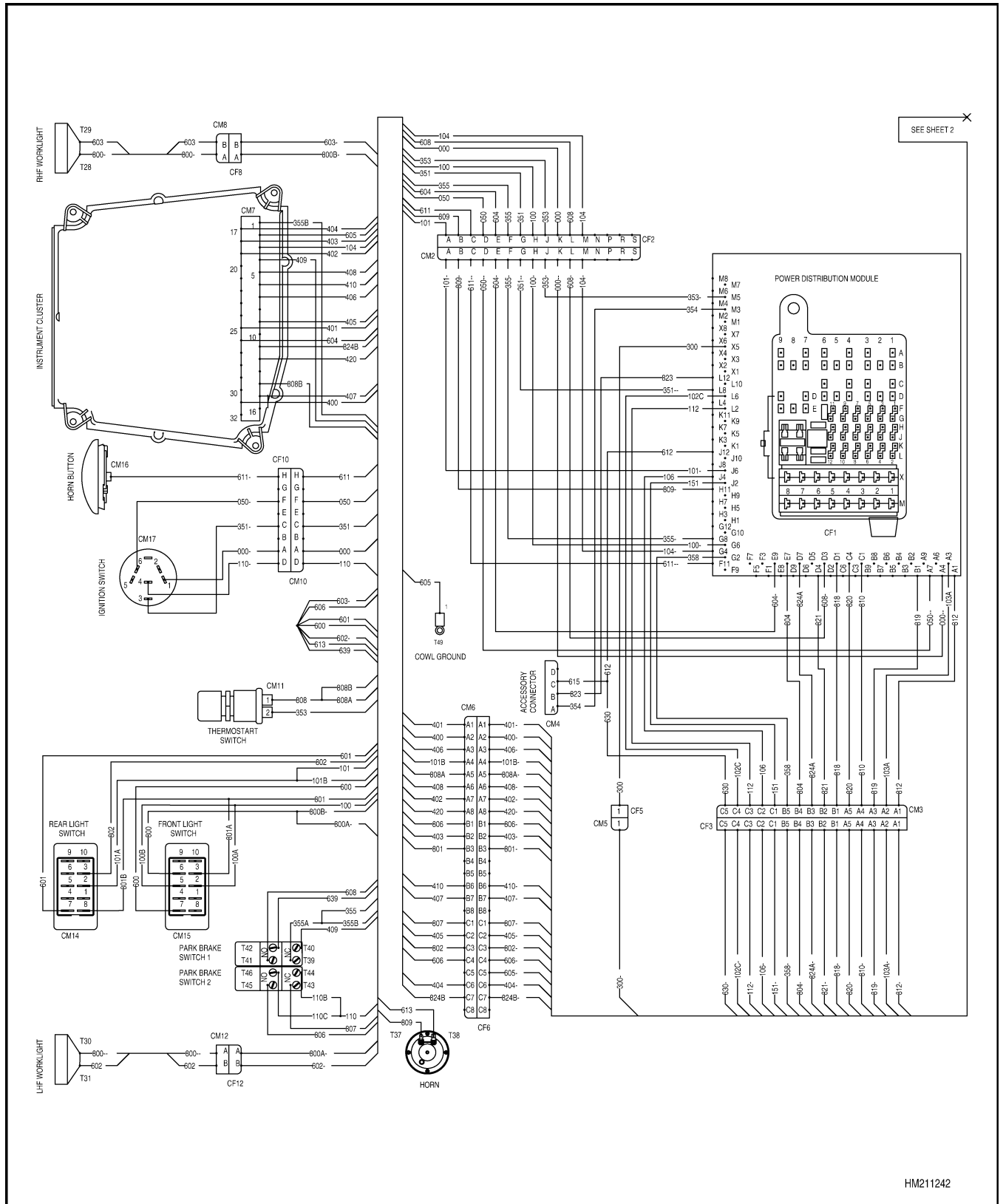
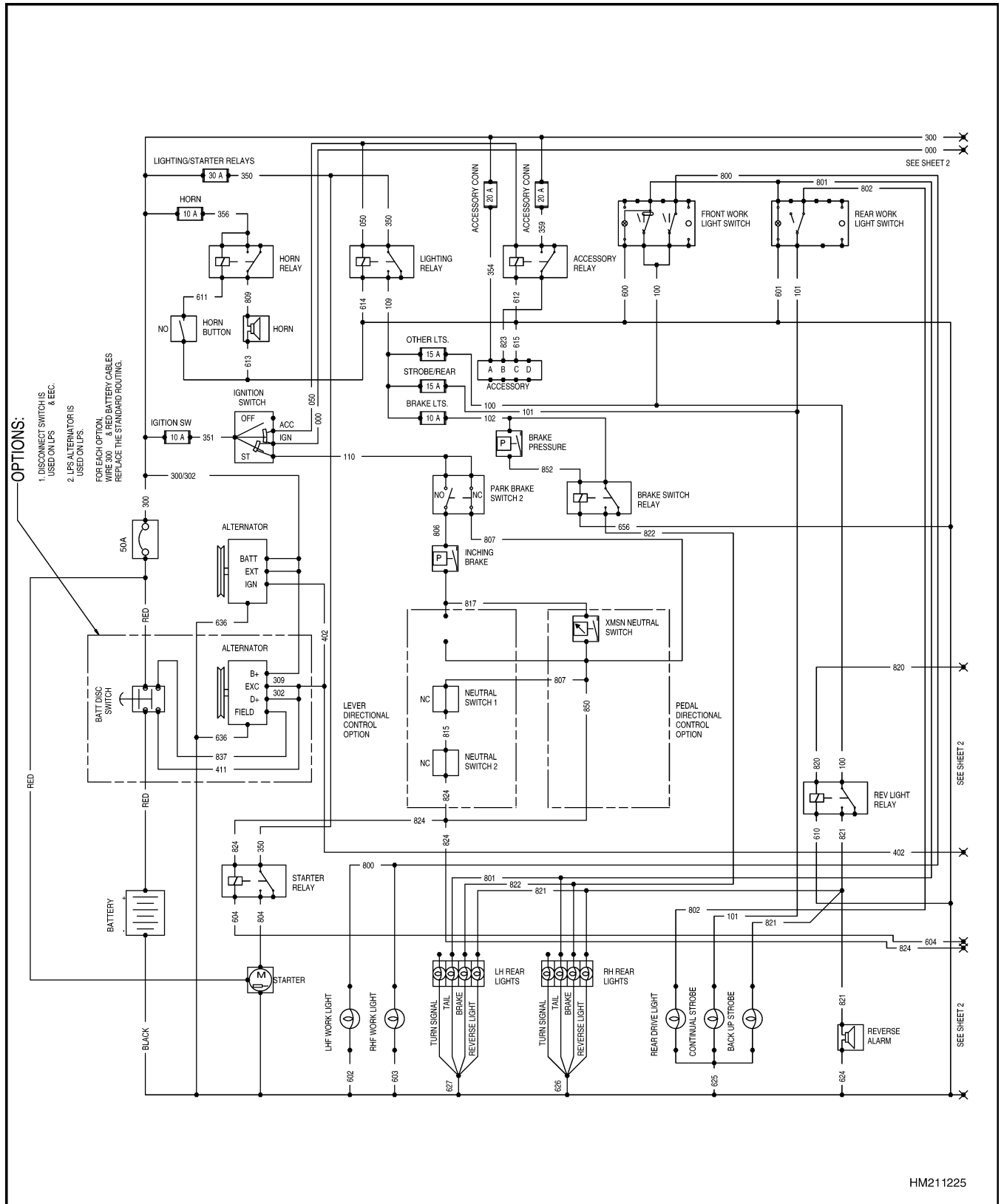


Figure 12. Wiring Diagram Diesel (REV 1) (E004, F004) (Sheet 1 of 4)





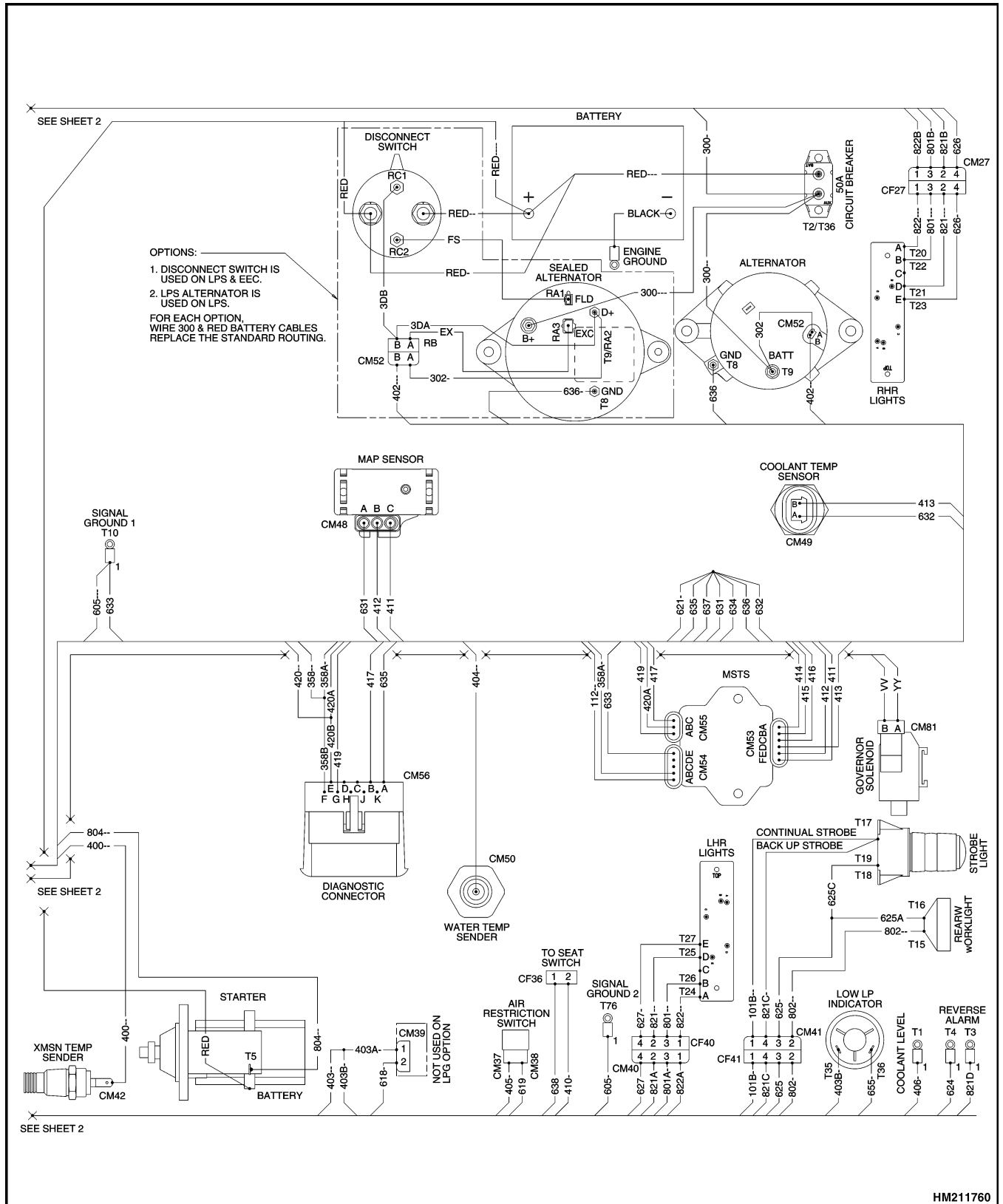


Figure 5. Wiring Diagram LPG (REV 2 and 3) (E004) (Sheet 3 of 4)

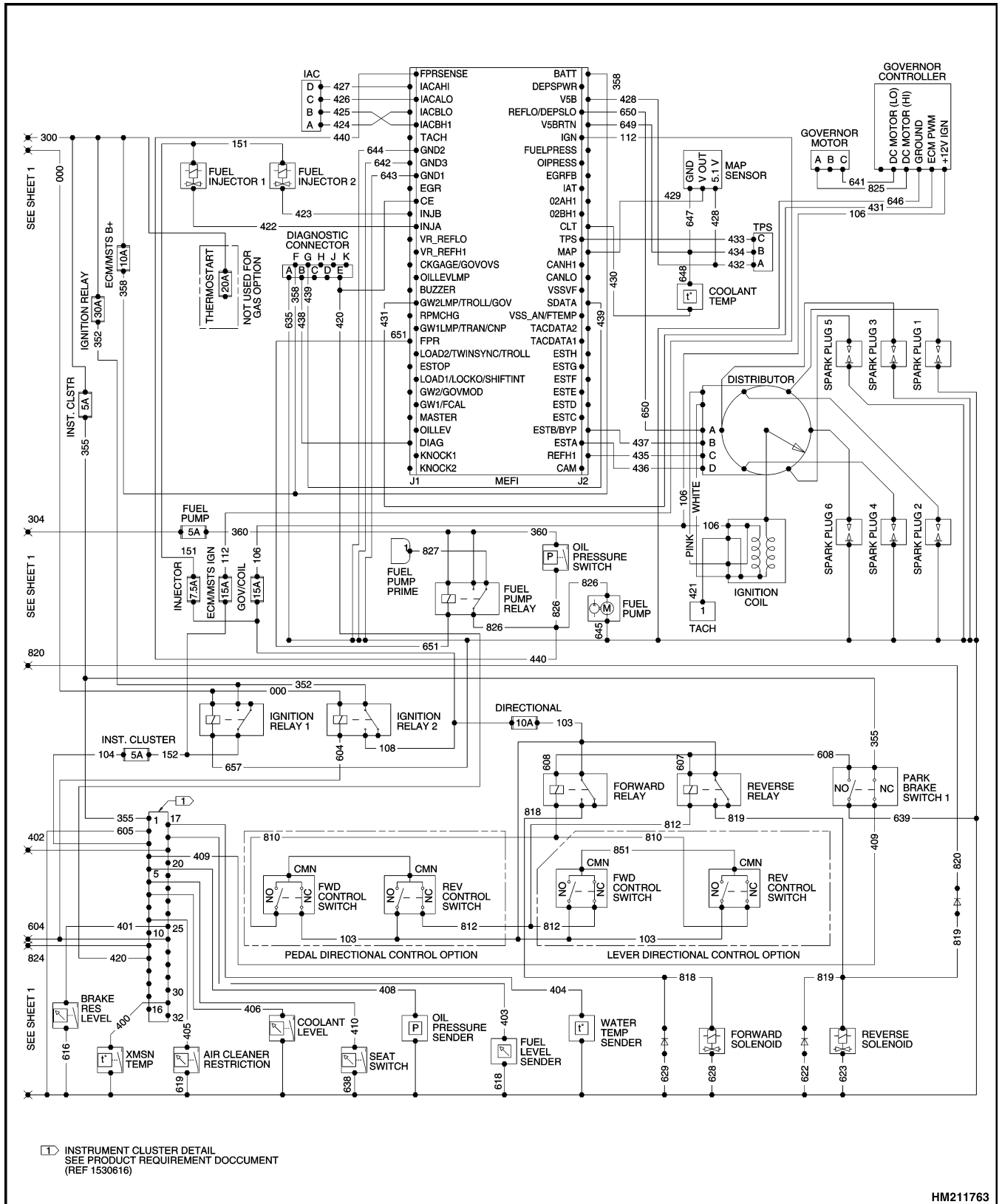
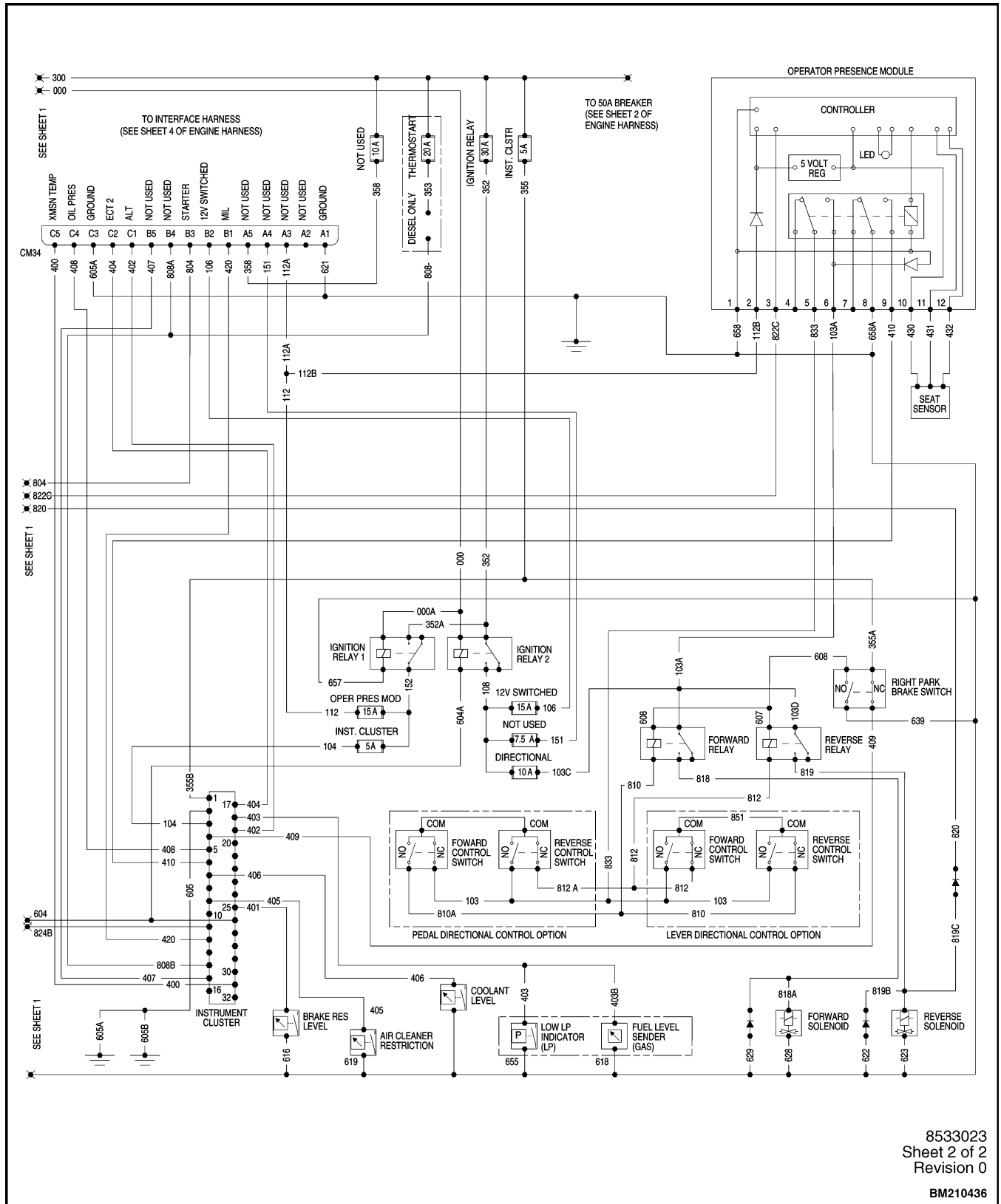


Figure 8. Electrical Schematic Gas (REV 2-4) (E004) (Sheet 2 of 2)

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Figure 11. Wiring Diagram Gas (REV 2) (E004) (Sheet 4 of 4)



8533023  
 Sheet 2 of 2  
 Revision 0  
 BM210436

Figure 14. GM V-6 Gas and LPG Engine Electrical Schematic/Wiring Diagram (F004), After November 2005 (Sheet 2 of 2)

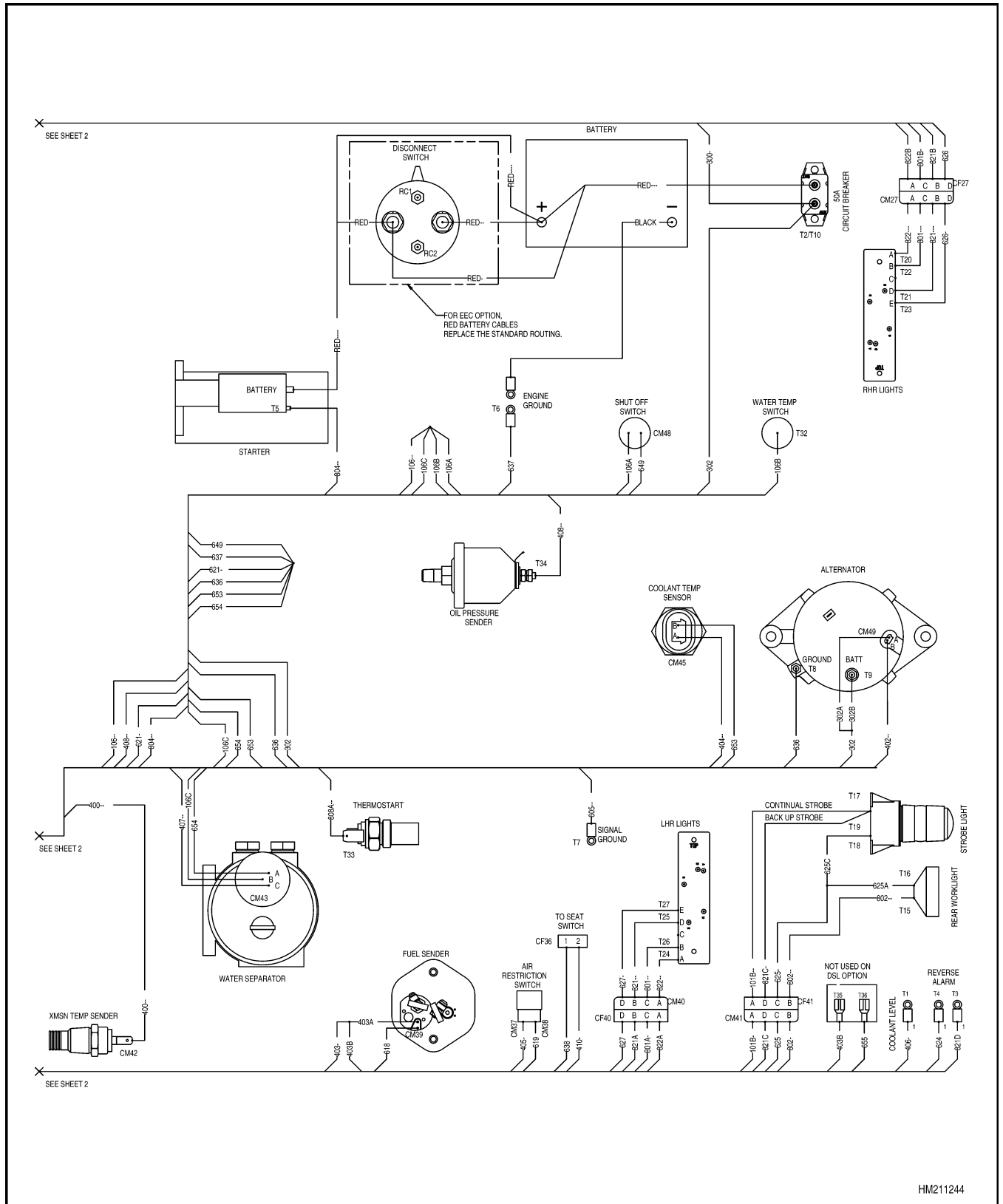
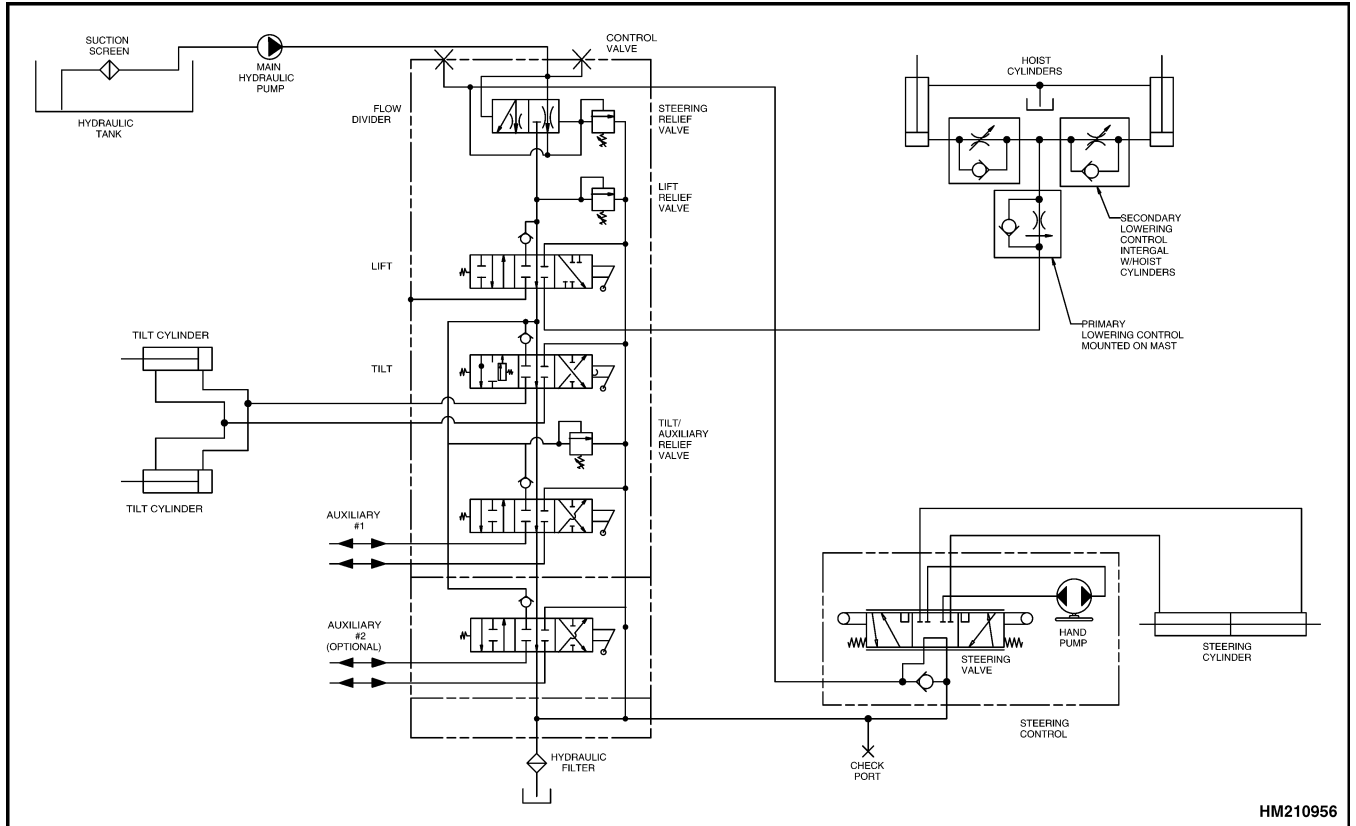
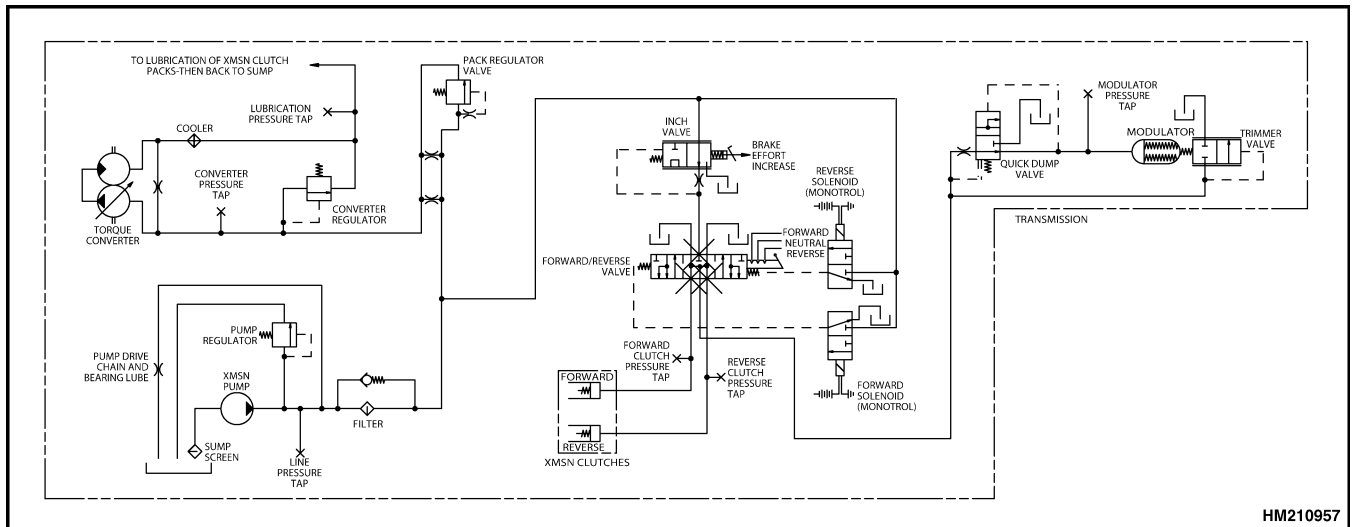


Figure 18. Wiring Diagram Diesel (REV 1) (E004, F004), Before November 2005 (Sheet 3 of 4)



HM210956

Figure 21. Hydraulic System Schematic (REV 1) (E004, F004)



HM210957

Figure 22. Single-Speed Powershift Transmission Schematic (REV 1) (E004, F004)

## General

This section has the description, operation, and repair procedures for the parts of the LPG and gasoline fuel systems used on the GM 3.0L and 4.3L engines.

Special service tools shown in this service manual that have tool product numbers beginning with “J” or “BT” are available for world wide distribution from Kent-Moore Tools.

### FUEL SYSTEM WARNINGS AND CAUTIONS

It is important to note that this manual contains various Warnings, Cautions, and Notes that must be carefully observed in order to reduce the risk of personal injury during service or repair. Improper service or repair may damage the engine or render it unsafe or fail to make the engine emissions compliant. It is also important to warn of all hazardous consequences that might result from careless treatment of the engine. Failure to observe these items could influence terms of the warranty.

#### WARNING

**Failure to heed could result in death, injury, or property damage.**

#### WARNING

**Do not smoke, carry lighted tobacco, or use a lighted flame of any type when working on or near any fuel related component. Highly flammable air/fuel mixtures may be present and can be ignited causing personal injury.**

#### WARNING

**Do not allow propane to contact the skin. Propane is stored in the fuel tank as a liquid. When propane contacts the atmosphere, it immediately expands into a gas, resulting in refrigeration that can cause severe burns.**

#### WARNING

**Do not allow propane to accumulate in areas below ground level such as in a service pit or**

**underground ventilation systems. Propane is heavier than air and can displace oxygen, creating a dangerous condition.**

#### CAUTION

**Less severe than a WARNING, but has the potential to cause injury or damage to equipment. Also used to notify of situations that could lead to eventual failure, injury or damage.**

#### CAUTION

**Late model engines use a combination of standard and metric fasteners. The components affected are the starter motor, engine mounts, and flywheel housing mounting. Other components may also have a combination of fasteners. Always verify that the proper fasteners are used whenever removing or replacing any components.**

To reduce the chance of personal injury and/or property damage, the following instructions must be carefully observed.

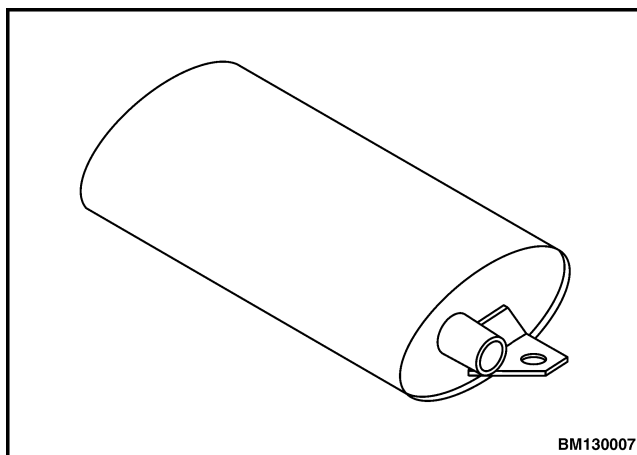
- Proper service and repair are important to the safety of the service technician and the safe reliable operation of all engines. The service procedures recommended and described in this service manual are effective methods of performing service and repair. Some of these procedures require the use of tools specially designed for the purpose.
- If part replacement is necessary, the replacement part must be of the same part number or equivalent part. Do not use a replacement part of lesser quality. In the case of replacement parts for the emission control system use only genuine HYSTER replacement parts.
- Before using a replacement part, service procedure, or a tool which is not recommended by the engine manufacturer, it must first be determined that neither personal safety nor the safe operation of the engine will be jeopardized by the replacement part, service procedure, or the tool selected.

ECM and has no external adjustments. When the ECM determines load adjustment or maximum engine speed has been achieved, the governor overrides the foot pedal and corrects the throttle blade position.

Also mounted on throttle body assembly is the FTV. The FTV is a 12-volt normally closed solenoid valve. During closed loop operation, the ECM may send a reference signal to the FTV to open or close to allow more or less fuel to be introduced below the throttle blade to correct the air fuel mixture for proper emission control.

### THREE-WAY CATALYTIC (TWC) MUFFLER

The emission certified engine has been designed and calibrated to meet the emission standards in effect for 2004. To help meet the emission requirements, the vehicle has been equipped with a TWC muffler. See Figure 7. The catalyst muffler is a three-way catalyst, sound damping, and spark arresting unit. Besides controlling the noise created from the combustion process and preventing sparks from escaping from the exhaust system, the most important function is treating the exhaust gases which are created from the combustion process. The TWC consists of a honeycomb coated with a mixture of platinum, palladium, and rhodium. The hot gases flow through the catalyst sections where an oxidation and reduction reactions take place. These chemical reactions reduce the amount of carbon monoxide (CO), hydrocarbon (HC), and nitrogen oxide (NO<sub>x</sub>) in the engines exhaust. The exhaust gas then flows through the outlet.



*Figure 7. Three-Way Catalytic Muffler*

### ELECTRONIC CONTROL MODULE (ECM)

To obtain maximum effect from the catalyst and accurate control of the air fuel ratio, the emission certified engine is equipped with an on-board computer or ECM. See Figure 8. The ECM is a 32-bit controller which receives input data from sensors fitted to the engine and fuel system and then outputs various signals to control engine operation.

One specific function of the controller is to maintain closed loop fuel control. Closed loop fuel control is accomplished when the heated exhaust gas oxygen (HEGO) sensor, mounted in the exhaust system, sends a voltage signal to the controller. The controller then calculates any correction that may need to be made to the air fuel ratio. The controller then outputs signals to the PTV or the FTV or both to change the amount of fuel being delivered from the regulator or mixer or to the engine. See Figure 9.

The controller also performs diagnostic functions on the fuel system and notifies the operator of malfunctions by turning on a malfunction indicator light (MIL) mounted in the dash. Malfunctions in the system are identified by a diagnostic code number. In addition to notifying the operator of the malfunction in the system, the controller also stores the information about the malfunction in its memory. A technician can then utilize a computerized diagnostic tool to retrieve the stored diagnostic code and by using the section **Electronic Control Module (ECM) Diagnostic Troubleshooting, GM 3.0L and 4.3L EPA Compliant Engines 2200 SRM 1090**, can determine the cause of the malfunction. In the event a technician does not have the computerized diagnostic tool, the MIL light can be used to identify the diagnostic code. By following specific steps, the technician can activate the blink feature and count the number of blinks to determine the diagnostic code number to locate the fault in the system.

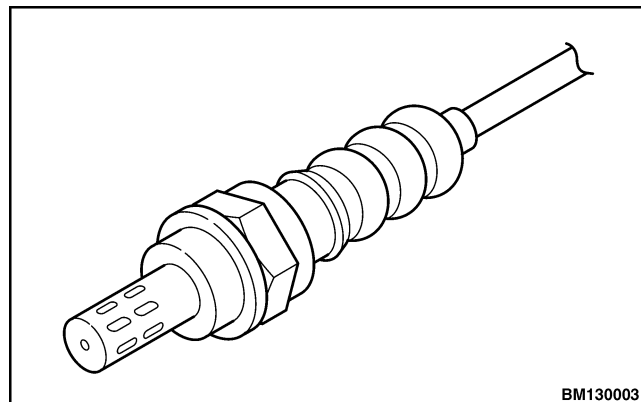
## HEATED EXHAUST GAS OXYGEN (HEGO) SENSOR

### CAUTION

The HEGO sensor is an emissions control component. If the HEGO sensor fails to operate, replace only with a HYSTER approved part. The HEGO sensor is sensitive to silicone and silicone-based products and can become contaminated. Avoid using silicone sealers or hoses treated with silicone lubricant in the air stream or fuel supply lines.

The HEGO sensor is mounted in the exhaust system downstream of the engine. See Figure 19. The HEGO sensor is used to measure the amount of oxygen present in the exhaust stream and communicates that to the ECM via an electrical signal. The amount of oxygen present in the exhaust stream indicates whether the fuel air ratio is too rich or too lean. If the HEGO sensor signal indicates that the exhaust stream is too rich, the ECM will decrease or lean the fuel mixture by reducing the signals to the injectors during engine operation. If the mixture is too

lean, the ECM will richen the mixture or increase the pulse to the injectors. The ECM continuously monitors the HEGO sensor output. If a rich or lean condition is present for an extended period of time and if the ECM cannot correct the condition, the ECM will set a diagnostic code and turn on the MIL light in the dash.



*Figure 19. Heated Exhaust Gas Oxygen Sensor*

## LPG Fuel System Repair

### PROPANE FUEL SYSTEM PRESSURE RELIEF

#### WARNING

The propane fuel system operates at pressures up to 21.5 bar (312 psi). To minimize the risk of fire and personal injury, relieve the propane fuel system pressure (where applicable) before servicing the propane fuel system components.

#### WARNING

Never use an open flame of any type when relieving fuel system pressure.

#### CAUTION

Residual vapor pressure will be present in the fuel system. Ensure the work area is well ventilated before disconnecting any fuel line.

To relieve propane fuel system pressure:

1. Close the manual shutoff valve (MSV) on the propane fuel tank.
2. Start and run the vehicle until the engine stalls.
3. Turn the ignition switch **OFF**.

### PROPANE FUEL SYSTEM LEAK TEST

#### WARNING

Never use an open flame of any type to check for propane fuel system leaks.

Always inspect the propane fuel system for leaks after performing service. Check for leaks at the fittings of the serviced or replaced component. Use a commercially available liquid leak detector or an electronic leak detector. When using both methods, use the electronic leak detector first to avoid contamination by the liquid leak detector.

## Install

### CAUTION

Balance line hoses are specifically designed. **DO NOT** use any hose material. Only use HYS-TER approved parts.

### CAUTION

**DO NOT** mix the hoses when installing.

### CAUTION

Install check valve in correct direction (arrow on check valve pointing away from mixer).

1. Install hose clamps and set back on each hose.
2. Install the LPR hose end to the LPR fitting and set clamp.
3. Install check valve with the arrow pointing away from mixer and set clamp.
4. Install the small hose section and set clamps.
5. Start engine and check for leaks.

## PTV HOSE REPLACEMENT

### Remove

1. Using hose clamp pliers, disconnect the clamps on the hose fitting at the mixer.
2. Using a small screwdriver, push the locking clip back on PTV connection.
3. Remove the hose and discard.

### Install

### CAUTION

PTV hoses are specifically designed. **DO NOT** use any hose material. Only use HYS-TER approved parts.

1. Install hose clamps and set back on the mixer hose end.
2. Install hose at the PTV and push lock in place.

3. Install hose at the mixer and set clamp.
4. Start engine and check for leaks.

## FTV HOSE REPLACEMENT

### Remove

1. Using a small screwdriver, push locking clips back on FTV connection at FTV and LPR.
2. Remove the hose and discard.

### Install

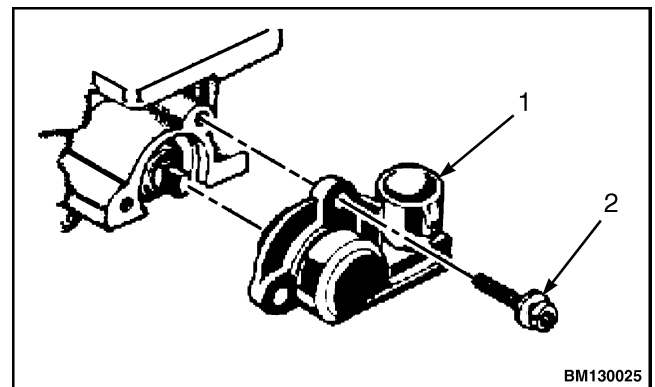
### CAUTION

FTV hoses are specifically designed. **DO NOT** use any hose material. Only use HYS-TER approved parts.

1. Install hose at the FTV and LPR and push locks in place.
2. Start engine and check for leaks.

## THROTTLE POSITION SENSOR (TPS) REPLACEMENT

Refer to Figure 24 and Table 1 for the replacement procedures of the TPS.



1. TPS

2. SCREW

*Figure 24. Throttle Position Sensor (TPS)*



**Table 4. FPP Replacement Procedure (Continued)**

<b>Step</b>	<b>Action</b>	<b>Value(s)</b>	<b>Yes</b>	<b>No</b>
4	<ul style="list-style-type: none"> <li>Replace the FPP sensor and install the two mounting screws so that they just touch the FPP sensor body.</li> </ul> <p>Is the new FPP sensor installed with the mounting screws still slightly loose?</p>		Go to step 5.	
5	<ul style="list-style-type: none"> <li>Reconnect the battery negative cable and the FPP wire harness connector. Leave the governor motor disconnected for now.</li> </ul> <p>Has the negative battery cable and FPP wire harness connector been reconnected?</p>		Go to step 6.	
6	<ul style="list-style-type: none"> <li>Connect the laptop computer and turn the ignition key to the <b>ON</b> position.</li> </ul> <p>Is the laptop computer connected with the key in the <b>ON</b> position?</p>		Go to step 7.	Go to Diagnostic Communication Error in the section <b>Electronic Control Module (ECM) Diagnostic Troubleshooting, GM 3.0L and 4.3L EPA Compliant Engines 2200 SRM 1090.</b>
7	<ul style="list-style-type: none"> <li>With the throttle in the idle position, move the FPP sensor body while monitoring the laptop computer raw volts screen for FPP 1 volts. Set the FPP voltage between 1.408 to 1.510 volts while tightening the two mounting screws evenly to a maximum 2.25 N•m (20 lbf in).</li> </ul> <p>Were you able to set the voltage between 1.408 to 1.510 volts with the mounting bolts torque set to 2.25 N•m (20 lbf in)?</p>	1.408 to 1.510 volts 2.25 N•m (20 lbf in)	Go to step 8.	Replace the throttle assembly.
8	<ul style="list-style-type: none"> <li>Manually actuate the throttle to the wide open position and check that the voltage is between 4.413 to 4.511 volts.</li> </ul> <p>Is the voltage between 4.413 to 4.511 volts?</p>	4.413 to 4.511 volts	Go to step 9.	Replace the throttle assembly.

**Table 6. Fuel Control Diagnosis (Continued)**

Step	Action	Value(s)	Yes	No
9	<ol style="list-style-type: none"> <li>1. Connect the negative lead of the DVOM to a know good engine ground.</li> <li>2. Using the positive lead of the DVOM back probe Pin B at the PTV connector.</li> </ol> Was the PTV voltage within the specified range?	12.6V to 15.1V	Go to Step 12	Go to Step 10
10	<ol style="list-style-type: none"> <li>1. Turn the engine <b>OFF</b>.</li> <li>2. Disconnect the ECM connector C001.</li> <li>3. Disconnect the PTV electrical connector.</li> <li>4. Check the PTV ground circuit terminal A for continuity to the ECM connector pin number 2.</li> <li>5. Check the PTV ground circuit in Terminal A for short to ignition power or ground.</li> </ol> Was a problem found?	--	Go to Step 16	Go to Step 11
11	Using the DVOM measure the resistance at the PTV terminals.  Was the resistance measured within specification?	16Ω to 24Ω	Go to Step 17	Go to Step 19
12	<ol style="list-style-type: none"> <li>1. Connect the negative lead of the DVOM to battery negative.</li> <li>2. Using the positive lead of the DVOM back probe pin A at the FTV connector.</li> </ol> Was the FTV voltage within the specified range?	12.6V to 15.1V	Go to Step 14	Go to Step 13
13	<ol style="list-style-type: none"> <li>1. Turn the engine <b>OFF</b>.</li> <li>2. Disconnect the ECM connector C001.</li> <li>3. Disconnect the FTV electrical connector.</li> <li>4. Check the FTV ground circuit terminal A for continuity to the ECM connector pin 2.</li> <li>5. Check the FTV ground circuit in Terminal A for short to ignition power or ground.</li> </ol> Was a problem found?	--	Go to Step 16	Go to Step 18
14	Using the DVOM measure the resistance at the FTV terminals.  Was the resistance measured within specification?	16Ω to 24Ω	Go to Step 18	Go to Step 20
15	Replace the ECM. Refer to Electronic Control Module (ECM) Replacement.  Is this action complete?	--	Go to Step 21	--
16	Repair the open or damaged circuit.  Is this action complete?	--	Go to Step 21	--

## LPG Symptom Diagnosis

This section will help the technician to diagnose fuel symptom problems on your lift truck. The symptoms to be checked are listed below in Table 9 through Table 19.

**Table 9. Preliminary Checks**

Checks	Action
Before Using This Section	<p>Before using this section, you should have performed an OBD check and determined that:</p> <ol style="list-style-type: none"> <li>1. The ECM and MIL are operating correctly.</li> <li>2. There are no DTCs stored, or a DTC exists but without a MIL.</li> </ol> <p>Several of the following symptom procedures call for a careful visual and physical check. The visual and physical checks are very important. The checks can lead to correcting a problem without further checks that may save valuable time.</p>
LPG Fuel System Check	<ol style="list-style-type: none"> <li>1. Verify the complaint.</li> <li>2. Locate the correct symptom table.</li> <li>3. Check the items indicated under that symptom.</li> <li>4. Operate the vehicle under the conditions the symptom occurs. Verify HEGO switching between lean and rich.</li> </ol> <p><b>NOTE:</b> Normal HEGO switching indicates the LPG fuel system is in closed loop and operating correctly at that time.</p> <ol style="list-style-type: none"> <li>5. If a laptop computer is available, take a snapshot under the condition that the symptom occurs. Verify normal sensor values and parameters.</li> </ol>
Visual and Physical Checks	<ul style="list-style-type: none"> <li>• Check all ECM system fuses and circuit breakers.</li> <li>• Check the ECM ground for being clean, tight, and in its proper location.</li> <li>• Check the vacuum hoses for splits, kinks, and proper connections.</li> <li>• Check thoroughly for any type of leak or restriction.</li> <li>• Check for air leaks at all the mounting areas of the intake manifold sealing surfaces.</li> <li>• Check for proper installation of the mixer module assembly.</li> <li>• Check for air leaks at the mixer assembly.</li> <li>• Check the ignition wires for the following conditions:             <ul style="list-style-type: none"> <li>- Cracking</li> <li>- Hardness</li> <li>- Proper routing</li> <li>- Carbon tracking</li> </ul> </li> <li>• Check the wiring for the following items:             <ul style="list-style-type: none"> <li>- Proper connections, pinches, or cuts.</li> </ul> </li> <li>• The following symptom tables contain groups of possible causes for each symptom. The order of these procedures is not important. If the laptop computer readings do not indicate the problems, then proceed in a logical order, easiest to check or most likely to cause first.</li> </ul>

**Table 17. Poor Fuel Economy (Continued)**

<b>Checks</b>	<b>Action</b>
Ignition System Checks	<ul style="list-style-type: none"> <li>• Verify that the spark plugs are correct. Refer to the <b>Parts Manual</b> for your lift truck.</li> <li>• Check the spark plugs. Remove the plugs and inspect them for the following conditions:               <ul style="list-style-type: none"> <li>- Wet plugs</li> <li>- Cracks</li> <li>- Wear</li> <li>- Improper gap</li> <li>- Burned electrodes</li> <li>- Heavy deposits</li> </ul> </li> <li>• Check the ignition wires for the following items:               <ul style="list-style-type: none"> <li>- Cracking</li> <li>- Hardness</li> <li>- Proper connections</li> </ul> </li> </ul>
Cooling System Checks	Check the engine thermostat for always being open or for the wrong heat range.
Additional Check	<ul style="list-style-type: none"> <li>• Check the transmission shift pattern.</li> <li>• Check for dragging brakes.</li> </ul>

**Table 18. Rough, Unstable, Incorrect Idle, or Stalling**

<b>Checks</b>	<b>Action</b>
<p>Definition: The engine runs unevenly at idle. If severe enough, the engine or vehicle may shake. The engine idle speed may vary in rpm. Either condition may be severe enough to stall the engine.</p>	
Preliminary Checks	Refer to Table 9.
Sensor Checks	<ul style="list-style-type: none"> <li>• Check for silicon contamination from fuel or improperly used sealant. The sensor will have a white powdery coating. The sensor will result in a high but false signal voltage (rich exhaust indication). The ECM will reduce the amount of fuel delivered to the engine causing a severe driveability problem.</li> <li>• Check the HEGO performance.</li> <li>• Check the TMAP sensor response and accuracy.</li> </ul>
Fuel System Checks	<ul style="list-style-type: none"> <li>• Check for rich or lean symptom that causes the condition. Drive the vehicle at the speed of the complaint. Monitoring the oxygen sensors will help identify the problem.</li> <li>• Check for a sticking mixer air valve.</li> <li>• Verify proper operation of the PTV and FTV.</li> <li>• Perform a cylinder compression test.</li> <li>• Check the LPR fuel pressure. Refer to LPG System Diagnosis.</li> <li>• Check mixer module assembly for proper installation and connection.</li> </ul>

**Table 27. Lack of Power, Sluggishness, or Sponginess**

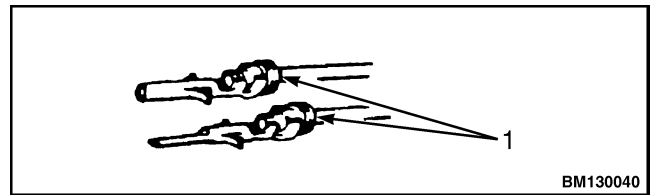
Checks	Action
Definition: The engine delivers less than expected power. There is little or no increase in speed when partially applying the accelerator pedal.	
Preliminary Checks	<ul style="list-style-type: none"> <li>• Refer to Table 20.</li> <li>• Refer to Gasoline System Diagnosis.</li> <li>• Compare the customer's vehicle with a similar unit. Make sure the customer has an actual problem.</li> <li>• Remove the air filter and check for dirt or restriction.</li> <li>• Check the vehicle transmission.</li> </ul>
Fuel System Checks	<ul style="list-style-type: none"> <li>• Check for a restricted fuel filter, contaminated fuel, or improper fuel pressure. Refer to Gasoline System Diagnosis.</li> <li>• Check for the proper ignition output voltage.</li> <li>• Check the fuel pump electrical circuit.</li> <li>• Verify proper fuel pump pressure.</li> <li>• Verify proper fuel rail pressure.</li> <li>• Refer to the Gasoline Fuel System Diagnosis.</li> <li>• Check electrical connections at the injectors.</li> </ul>
Sensor Checks	<ul style="list-style-type: none"> <li>• Check the HEGO sensor for contamination and performance.</li> <li>• Check for proper operation of the MAP sensor.</li> <li>• Check for proper operation of the TPS and FPP sensors.</li> </ul>
Exhaust System Checks	<ul style="list-style-type: none"> <li>• Check the exhaust system for a possible restriction: <ul style="list-style-type: none"> <li>– Inspect the exhaust system for damaged or collapsed pipes.</li> <li>– Inspect the muffler for signs of heat distress or for possible internal failure.</li> <li>– Check for possible plugged catalytic converter.</li> </ul> </li> </ul>
Engine Mechanical Check	<p>Check the engine for the following:</p> <ul style="list-style-type: none"> <li>• Engine compression</li> <li>• Valve timing</li> <li>• Improper or worn camshaft.</li> </ul>
Additional Check	<ul style="list-style-type: none"> <li>• Check the ECM grounds for being clean, tight, and in their proper locations.</li> <li>• Check the generator output voltage.</li> <li>• If all procedures have been completed and no malfunction has been found, review and inspect the following items: <ul style="list-style-type: none"> <li>– Visually and physically inspect all electrical connections within the suspected circuit and/or systems.</li> <li>– Check the laptop computer data.</li> </ul> </li> </ul>

**STEP 5.**

Push terminal and connector onto wire and engage locking tabs.

**STEP 6.**

Close secondary lock hinge.



1. SEAL

---

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### IGNITION SYSTEM TEST

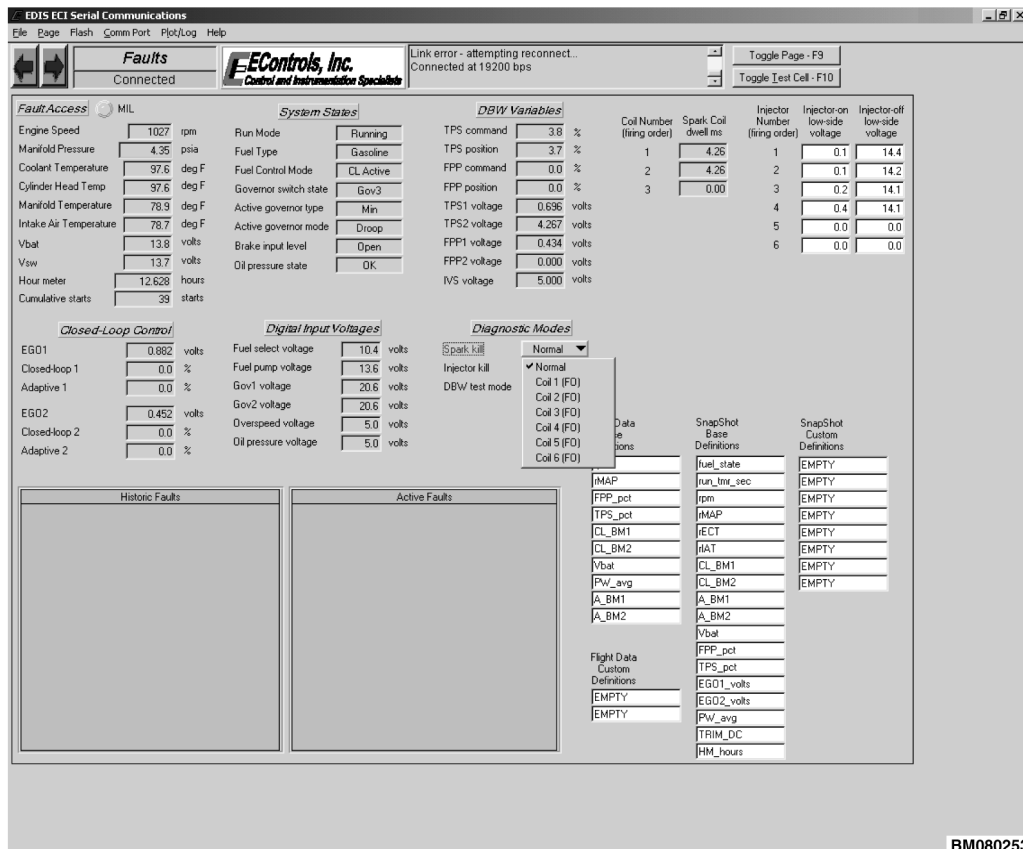
The Spark Kill diagnostic mode allows the technician to disable the ignition on individual cylinders. If the Spark Kill diagnostic mode is selected with the engine running below 1000 rpm, the minimum throttle command will lock into the position it was in when the test mode was entered. If the Spark System Test mode is selected with the engine running above 1000 rpm, the throttle will continue to operate normally. See Figure 4.

and select the desired coil. The spark output can be re-enabled by using the mouse to highlight the Spark Kill button and selecting Normal. If the engine is running below 1000 rpm, the spark output will stay disabled for 15 seconds and then reset. If the engine is running above 1000 rpm, the spark output will stay disabled for 5 seconds and then reset. This test mode has a timeout of 10 minutes. Record the rpm drop related to each spark output disabled.

### Disabling Ignition Outputs

To disable the ignition system for an individual cylinder, use the mouse to highlight the Spark Kill button

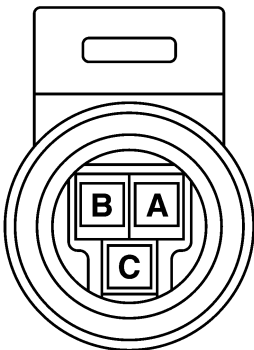
The spark outputs are arranged in the order which the engine fires, not by cylinder number.



BM080253

Figure 4. Ignition System Test Screen

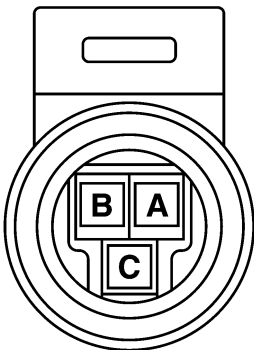
**Table 11. Throttle Position Sensor Connector C009**



BM080625

Pin	Wire Color	Function
A	Light Green/Red	5 Volt Reference
B	Black/Light Green	Analog Return
C	Purple/Light Blue	TPS 1

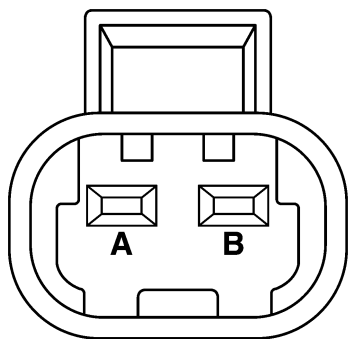
**Table 12. Foot Pedal Position Connector C010**



BM080625

Pin	Wire Color	Function
A	Light Green/Red	5 Volt Reference
B	Black/Light Green	Analog Return
C	Dark Blue	Foot Pedal Position

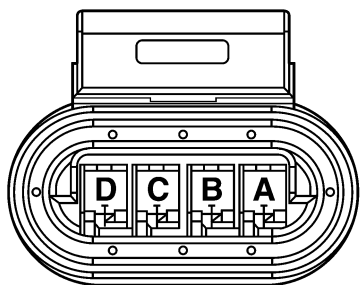
**Table 13. Governor Motor Connector C011**



BM080381

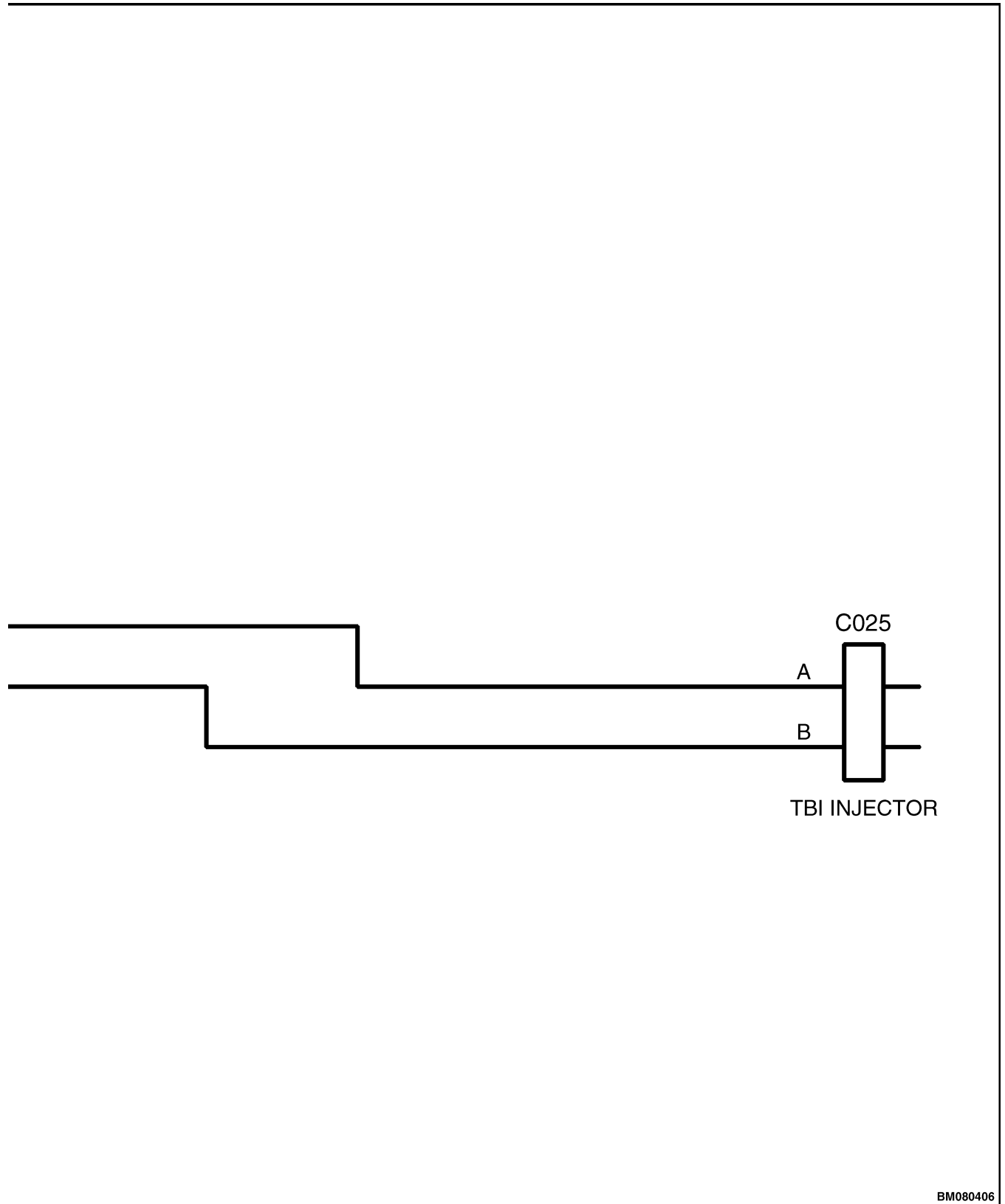
Pin	Wire Color	Function
A	Tan/Orange	DBW -
B	Pink/White	DBW +

**Table 14. TMAP Connector C012**



BM080626

Pin	Wire Color	Function
A	Black/Light Green	Analog Return
B	Tan	IAT
C	Light Green/Red	5 Volt Reference
D	Light Green	MAP



BM080406

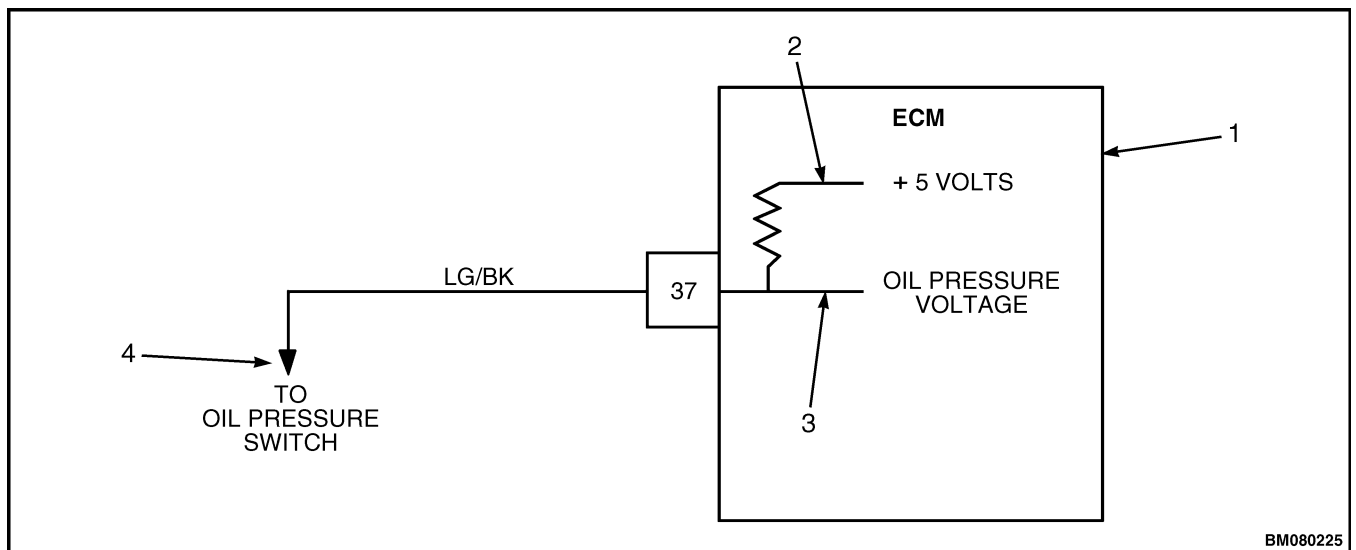
*Figure 10. 3.0L Gasoline Jump Harness*

**DTC 115 - OIL PRESSURE LOW****Circuit Description**

The oil pressure switch is used to communicate a low oil pressure condition to the ECM. Engine damage can occur if the engine is operated with low oil pressure. The ECM uses an analog voltage input with an internal 5-volt reference. If the oil pressure circuit is grounded, the input voltage will be near zero. If it is open, the input will be near 5 volts. The switch is normally open, and the fault will set if the switch remains open with the engine running. The engine will shut down in the event of this fault to help prevent possible damage. See Figure 16.

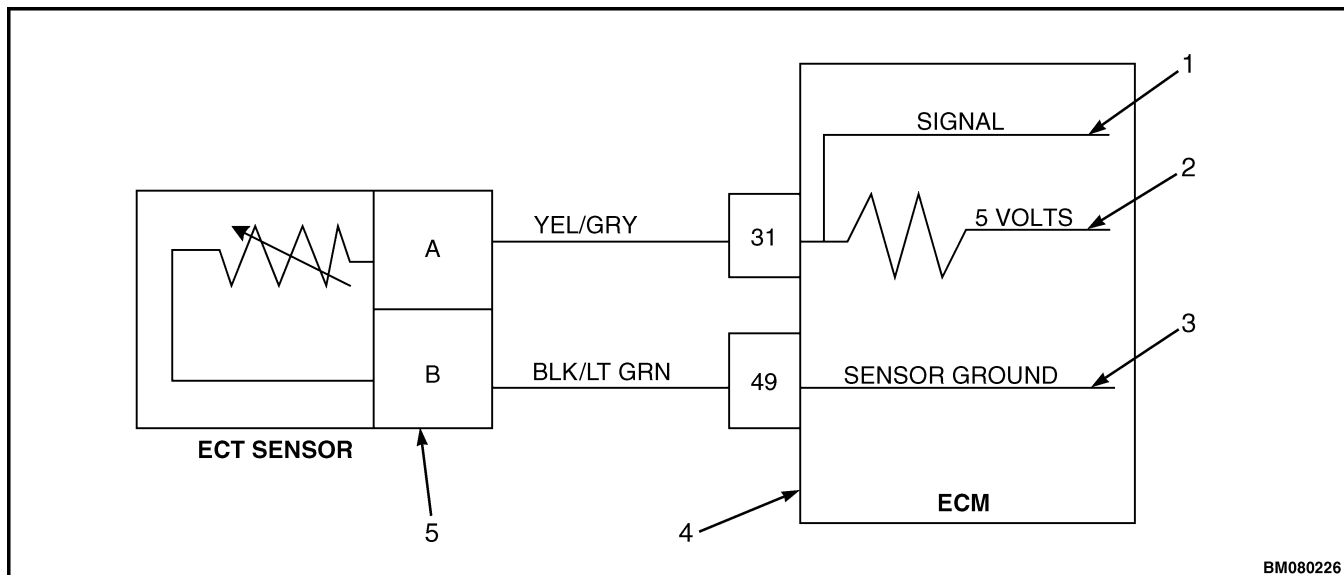
**Conditions for Setting the DTC**

- Engine oil pressure low.
- Check condition - engine running for 30 seconds and engine speed is greater than 600 rpm.
- Fault condition - open circuit/voltage high.
- MIL - on during active fault and for 3 seconds after active fault.
- Adaptive - enabled.
- Closed loop - enabled.
- Engine shut down.



1. ELECTRONIC CONTROL MODULE (ECM)
2. +5 VOLTS
3. OIL PRESSURE VOLTAGE
4. TO OIL PRESSURE SWITCH

**Figure 16. Oil Pressure Switch Circuit**



BM080226

- |   |  |
|---|--|
| <ol style="list-style-type: none"> <li>1. SIGNAL</li> <li>2. 5 VOLTS</li> <li>3. SENSOR GROUND</li> </ol> | <ol style="list-style-type: none"> <li>4. ELECTRONIC CONTROL MODULE (ECM)</li> <li>5. ENGINE COOLANT TEMPERATURE (ECT) SENSOR</li> </ol> |
|---|--|

**Figure 19. ECT Sensor Circuit**

**Table 35. DTC 123 - ECT Higher Than Expected 1**

Step	Action	Value(s)	Yes	No
1	Did you perform the On-board diagnostics (OBD) system check?		Go to step 2.	Go to On-Board Diagnostics System Check/Malfunction Indicator Lamp.
2	<ul style="list-style-type: none"> <li>• Key <b>ON</b>.</li> <li>• Laptop computer connected in system data mode.</li> <li>• Warm engine to normal operating temperature, then run the engine above 1000 rpm for 60 seconds.</li> </ul> <p>Does laptop computer display ECT temperature of 104°C (220°F) or greater, with the engine running over 500 rpm?</p>		Go to step 3.	Intermittent problem. Go to Preliminary and Intermittent Checks.
3	<ul style="list-style-type: none"> <li>• Verify with a temperature gauge that the engine coolant is over 107.2°C (225°F).</li> </ul> <p>Does the temperature gauge indicate 107.2°C (225°F) or greater?</p>		Repair the cooling system.	Go to step 4.
4	Verify ECT circuit function. Follow diagnostic test procedure for DTC 122 - ECT Voltage Low.			

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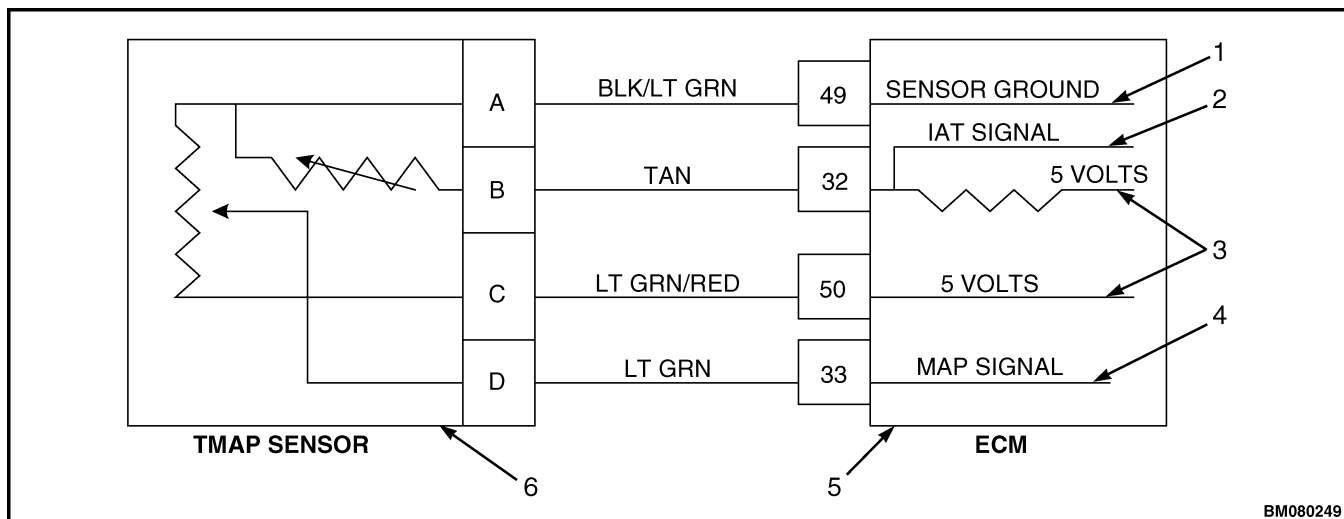
### DTC 134 - BP HIGH PRESSURE MOTOROLA® TMAP

#### Circuit Description

The barometric pressure (BP) is estimated from the TMAP sensor. The barometric pressure value is used for fuel and airflow calculations. This fault sets in the event the BP value is out of the normal range. See Figure 23.

#### Conditions for Setting the DTC

- Barometric pressure.
- Check condition - key ON.
- Fault condition - BP greater than 16 psia.
- MIL - on for active fault and for 2 seconds after active fault.
- Adaptive - disabled for remainder of key ON cycle.



- |  |   |
|--|---|
| 1. SENSOR GROUND                           | 5. ELECTRONIC CONTROL MODULE (ECM)                      |
| 2. INTAKE AIR TEMPERATURE (IAT) SIGNAL     | 6. TEMPERATURE MANIFOLD ABSOLUTE PRESSURE (TMAP) SENSOR |
| 3. 5 VOLTS                                 |   |
| 4. MANIFOLD ABSOLUTE PRESSURE (MAP) SIGNAL |   |

**Figure 23. TMAP Sensor Circuit (Motorola® TMAP)**

**Table 39. DTC 134 - BP High Pressure (Motorola® TMAP)**

Step	Action	Value(s)	Yes	No
1	Did you perform the On-board diagnostics (OBD) system check?		Go to step 2.	Go to On-Board Diagnostics System Check/Malfunction Indicator Lamp.
2	<ul style="list-style-type: none"> <li>• Key ON.</li> <li>• Laptop computer connected in system data mode.</li> </ul> Does laptop computer display MAP pressure of 16 psia or greater?		Go to step 3.	Intermittent problem. Go to Preliminary and Intermittent Checks.

*Table 42. DTC 143 - Never Crank Synced At Start (Continued)*

<b>Step</b>	<b>Action</b>	<b>Value(s)</b>	<b>Yes</b>	<b>No</b>
3	<ul style="list-style-type: none"> <li>• Key <b>OFF</b>.</li> <li>• Disconnect the crankshaft position sensor (CKP) connector.</li> <li>• Using a DVOM check for voltage at the CKP sensor connector while cranking the engine.</li> </ul> <p>Do you have voltage?</p>	Over 0.5 volts	Go to step 4.	Go to step 11.
4	<ul style="list-style-type: none"> <li>• Key <b>OFF</b>.</li> <li>• Disconnect ECM connector C001.</li> <li>• Using a DVOM check for continuity between CKP connector pin B and ECM connector pin 12.</li> </ul> <p>Do you have continuity between them?</p>		Go to step 5.	Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 16.
5	<ul style="list-style-type: none"> <li>• Using a DVOM check for continuity between CKP connector pin A and ECM connector pin 11.</li> </ul> <p>Do you have continuity between them?</p>		Go to step 6.	Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 16.
6	<ul style="list-style-type: none"> <li>• Inspect the CKP connector C007 pins for damage, corrosion or contamination.</li> </ul> <p>Did you find a problem?</p>		Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 16.	Go to step 7.
7	<ul style="list-style-type: none"> <li>• Inspect the ECM connector C001 pins 11 and 12 for damage, corrosion or contamination.</li> </ul> <p>Did you find a problem?</p>		Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 16.	Go to step 8.
8	<ul style="list-style-type: none"> <li>• Using a DVOM, check for continuity between ECM connector pins 11 and 12 to engine ground.</li> </ul> <p>Do you have continuity?</p>		Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 16.	Go to step 10.
9	<ul style="list-style-type: none"> <li>• Replace CKP sensor.</li> </ul> <p>Is the replacement complete?</p>		Go to step 16.	
10	<ul style="list-style-type: none"> <li>• Replace the ECM.</li> </ul> <p>Is the replacement complete?</p>		Go to step 16.	

**Table 45. DTC 211 - Closed Loop Multiplier High (LPG) (Continued)**

<b>Step</b>	<b>Action</b>	<b>Value(s)</b>	<b>Yes</b>	<b>No</b>
6	<ul style="list-style-type: none"> <li>• Replace HO<sub>2</sub>S sensor.</li> </ul> <p>Is the replacement complete?</p>		Go to step 7.	
7	<ul style="list-style-type: none"> <li>• Remove all test equipment except the laptop computer.</li> <li>• Connect any disconnected components, fuses, etc.</li> <li>• Using the laptop computer, clear DTC information from the ECM.</li> <li>• Turn the ignition OFF and wait 30 seconds.</li> <li>• Start the engine and operate the vehicle to full operating temperature.</li> <li>• Observe the MIL.</li> <li>• Observe engine performance and driveability.</li> <li>• After operating the engine within the test parameters of DTC 211, check for any stored codes.</li> </ul> <p>Does the engine operate normally with no stored codes?</p>		System OK.	Go to On-Board Diagnostics System Check/Malfunction Indicator Lamp.

**Table 49. DTC 224 - Closed Loop Multiplier Low (LPG)**

<b>Step</b>	<b>Action</b>	<b>Value(s)</b>	<b>Yes</b>	<b>No</b>
1	Did you perform the On-board diagnostics (OBD) system check?		Go to step 2.	Go to On-Board Diagnostics System Check/ Malfunction Indicator Lamp.
2	<ul style="list-style-type: none"> <li>• Key <b>ON</b> and engine running.</li> <li>• Laptop computer connected in system data mode.</li> <li>• Run engine to full operating temperature and then idle for a minimum of 2 minutes.</li> </ul> <p>Does laptop computer display HO<sub>2</sub>S voltage fixed above 0.7 volts after 2 minutes of idle run time?</p>		Go to step 3.	Intermittent problem. Go to Preliminary and Intermittent Checks.
3	<ul style="list-style-type: none"> <li>• Key <b>OFF</b>.</li> <li>• Disconnect HO<sub>2</sub>S wire harness connector.</li> <li>• Disconnect ECM wiring harness connector.</li> <li>• Key <b>ON</b>.</li> <li>• Using a high impedance DVOM, check for voltage between HO<sub>2</sub>S connector signal pin B and engine ground.</li> </ul> <p>Do you have voltage?</p>		Repair wire harness shorted signal to voltage. Refer to Wire Harness Repair.	Refer to Diagnostic Aids for DTC 224.

**DTC 244 - ADAPTIVE LEARN LOW (LPG)****Circuit Description**

The heated oxygen sensor (HO<sub>2</sub>S) is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the closed loop multiplier and adaptive multiplier.

This fault will set if the adaptive multiplier exceeds the limits of normal operation. See Figure 37.

**Conditions for Setting the DTC**

- Heated oxygen sensor.
- Check condition - engine running.

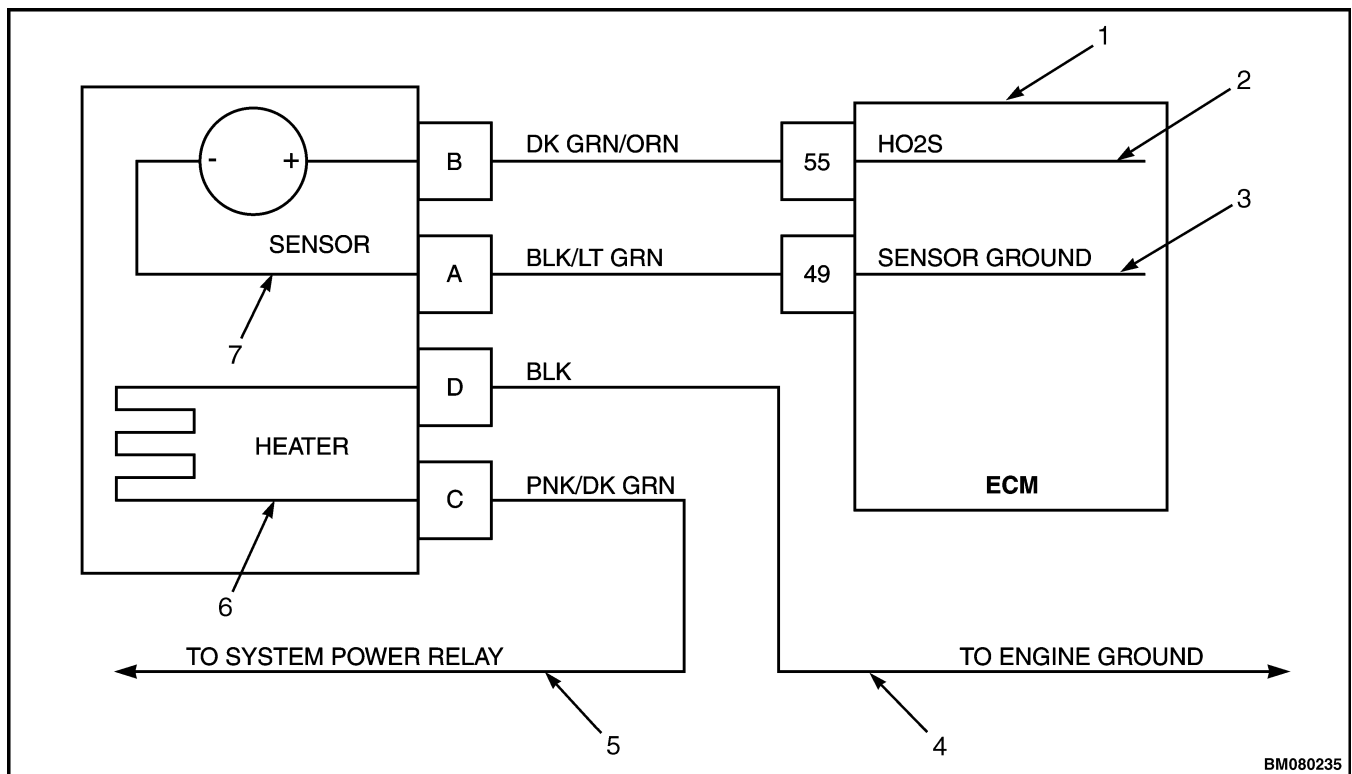
- Fault condition - adaptive multiplier out of range (at limit of -30 percent).
- MIL - on during active fault.

**Diagnostic Aids**

Always diagnose any other ECM codes that are present before beginning this diagnostic procedure.

**Fuel system** - high secondary fuel pressure will cause the system to run rich. A worn fuel mixer, faulty pressure trim valve (PTV) or fuel trim valve (FTV) can also cause the system to run rich.

**Fuel quality** - a drastic variation in fuel quality (very high butane content) may cause the system to run rich. Be sure that the specified HD- 5 or HD-10 motor fuel grade propane is used.



1. ELECTRONIC CONTROL MODULE (ECM)
2. HEATED OXYGEN SENSOR (HO<sub>2</sub>S)
3. SENSOR GROUND
4. TO ENGINE GROUND

5. TO SYSTEM POWER RELAY
6. HEATER
7. SENSOR

**Figure 37. Heated Oxygen Sensor Circuit**

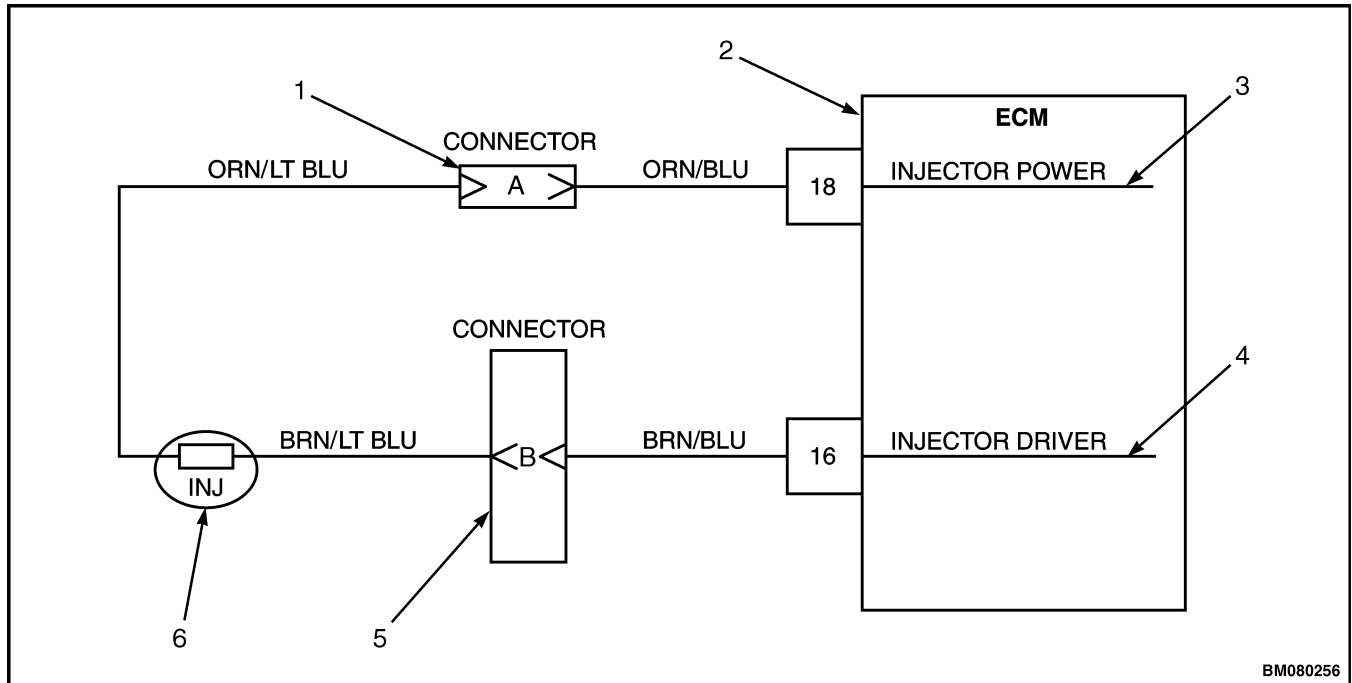
**DTC 412 - INJECTOR DRIVER 1 SHORTED****Circuit Description**

Injector driver No. 1 controls the single TBI injector. See Figure 41.

This fault will set if the ECM detects 10 injector firings with the internal driver sense voltage greater than 4 volts while the injector is in the on-state and battery voltage is less than 16 volts.

**Conditions for Setting the DTC**

- Injector coil shorted.
- Check condition - key **ON** and engine running.
- Fault condition - battery voltage at ECM less than 16 volts and injector low-side greater than 4 volts for 10 injector firings.
- MIL - on during active fault and for 5 seconds after active fault.
- Adaptive - disabled for remainder of key **ON** cycle.
- Closed loop - disabled during active fault.

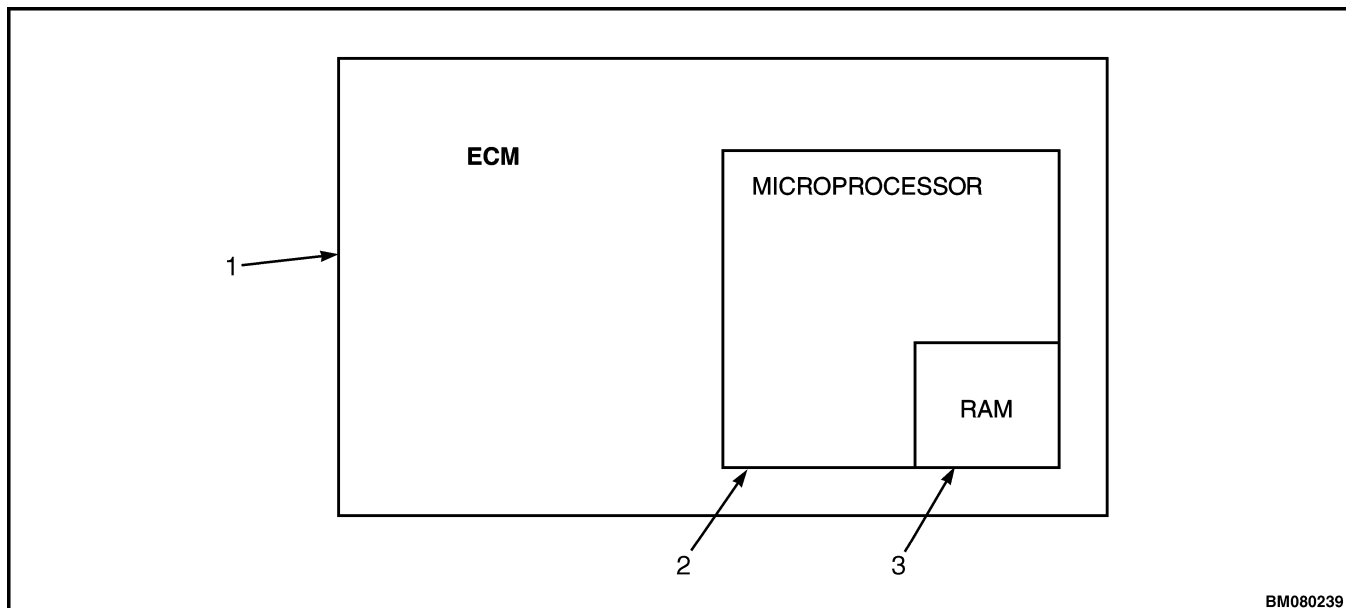


- |                                    |                    |
|------------------------------------|--------------------|
| 1. CONNECTOR                       | 4. INJECTOR DRIVER |
| 2. ELECTRONIC CONTROL MODULE (ECM) | 5. CONNECTOR       |
| 3. INJECTOR POWER                  | 6. INJECTOR        |

**Figure 41. Injector Circuit**

Table 61. DTC 514 - RTI 1 Loss

Step	Action	Value(s)	Yes	No
1	Did you perform the On-board diagnostics (OBD) system check?		Go to step 2.	Go to On-Board Diagnostics System Check/Malfunction Indicator Lamp.
2	<ul style="list-style-type: none"> <li>• Key <b>ON</b> and engine running.</li> <li>• Laptop computer connected in system data mode.</li> <li>• Clear system fault code.</li> </ul> Does DTC 514 reset with the engine idling?		Go to step 3.	Intermittent problem. Go to Preliminary and Intermittent Checks.
3	<ul style="list-style-type: none"> <li>• Check all ECM power and ground circuits. Refer to GM 3.0L Wiring Schematics and Connectors.</li> </ul> Are the power and ground circuits OK?		Go to step 4.	Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 5.
4	<ul style="list-style-type: none"> <li>• Replace the ECM.</li> </ul> Is the replacement complete?		Go to step 5.	
5	<ul style="list-style-type: none"> <li>• Remove all test equipment except the laptop computer.</li> <li>• Connect any disconnected components, fuses, etc.</li> <li>• Using the laptop computer, clear DTC information from the ECM.</li> <li>• Turn the ignition <b>OFF</b> and wait 30 seconds.</li> <li>• Start the engine and operate the vehicle to full operating temperature.</li> <li>• Observe the MIL.</li> <li>• Observe engine performance and driveability.</li> <li>• After operating the engine within the test parameters of DTC 514, check for any stored codes.</li> </ul> Does the engine operate normally with no stored codes?		System OK.	Go to On-Board Diagnostics System Check/Malfunction Indicator Lamp.



BM080239

1. ELECTRONIC CONTROL MODULE (ECM)
2. MICROPROCESSOR
3. RAM

**Figure 50. ECM Microprocessor**

**Table 66. DTC 555 - RTI 2 Loss**

Step	Action	Value(s)	Yes	No
1	Did you perform the On-board diagnostics (OBD) system check?		Go to step 2.	Go to On-Board Diagnostics System Check/ Malfunction Indicator Lamp.
2	<ul style="list-style-type: none"> <li>• Key <b>ON</b> and engine running.</li> <li>• Laptop computer connected in system data mode.</li> <li>• Clear system fault code</li> </ul> Does DTC 555 reset with the engine idling?		Go to step 3.	Intermittent problem. Go to Preliminary and Intermittent Checks.
3	<ul style="list-style-type: none"> <li>• Check all ECM power and ground circuits. Refer to GM 3.0L Wiring Schematics and Connectors.</li> </ul> Are the power and ground circuits OK?		Go to step 4.	Repair the circuit as necessary. Refer to Wire Harness Repair.

*Table 69. DTC 612 - FPP Low Voltage (Continued)*

Step	Action	Value(s)	Yes	No
15	<ul style="list-style-type: none"> <li>Using a DVOM, check for continuity between ECM connector FPP signal pin 38 and engine ground.</li> </ul> <p>Do you have continuity?</p>		Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 18.	Go to step 16.
16	<ul style="list-style-type: none"> <li>Using a DVOM check for continuity between ECM FPP signal pin 38 and ECM connector FPP sensor ground pin 49.</li> </ul> <p>Do you have continuity between them?</p>		Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 18.	Go to step 13.
17	<ul style="list-style-type: none"> <li>Replace the ECM.</li> </ul> <p>Is the replacement complete?</p>		Go to step 18.	
18	<ul style="list-style-type: none"> <li>Remove all test equipment except the laptop computer.</li> <li>Connect any disconnected components, fuses, etc.</li> <li>Using the laptop computer clear DTC information from the ECM.</li> <li>Turn the ignition <b>OFF</b> and wait 30 seconds.</li> <li>Start the engine and operate the vehicle to full operating temperature.</li> <li>Observe the MIL.</li> <li>Observe engine performance and driveability.</li> <li>After operating the engine within the test parameters of DTC 612, check for any stored codes.</li> </ul> <p>Does the engine operate normally with no stored codes?</p>		System OK.	Go to On-Board Diagnostics System Check/ Malfunction Indicator Lamp.

### DTC 651 - MAXIMUM GOVERN SPEED OVERRIDE

#### Circuit Description

This fault will set anytime the engine rpm exceeds:

- 3300 rpm for greater than 0.10 seconds for cushion model trucks.
- 3400 rpm for greater than 0.10 seconds for pneumatic model trucks.

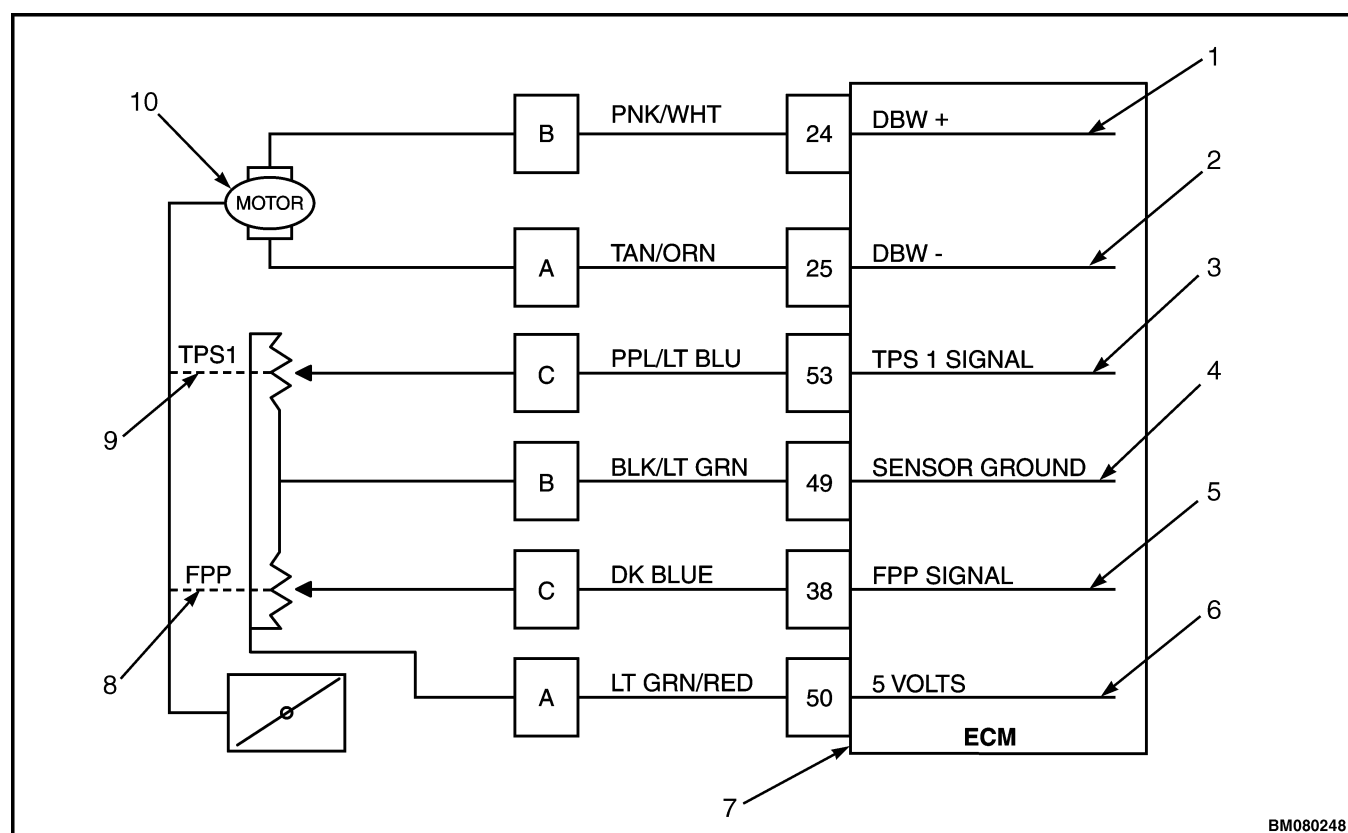
This is to help prevent engine or equipment damage in the event of a governor failure. The MIL will be on during this active fault. See Figure 57.

#### Conditions for Setting the DTC

- Maximum govern speed override.
- Check condition - engine running.
- Fault condition - engine rpm greater than specified for 0.10 seconds.
- MIL - on during active fault.

#### Diagnostic Aids

This fault is an indication of a problem in the speed governing control system. This DTC will most likely be accompanied by other DTC codes related to the speed governing control system. Always diagnose and repair starting with the lowest DTC code number in the event of multiple code sets.

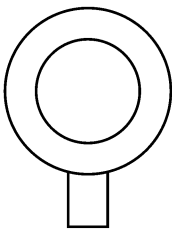


1. DRIVE BY WIRE (DBW) +
2. DRIVE BY WIRE (DBW) -
3. TPS1 SIGNAL
4. SENSOR GROUND
5. FPP SIGNAL

6. 5 VOLTS
7. ELECTRONIC CONTROL MODULE (ECM)
8. FOOT PEDAL POSITION (FPP)
9. THROTTLE POSITION SENSOR 1 (TPS1)
10. MOTOR

Figure 57. Throttle Circuit

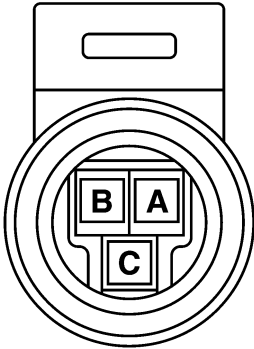
**Table 79. Oil Pressure Connector C005**



BM080374

Pin	Wire Color	Function
A	Light Green/Black	Oil Pressure

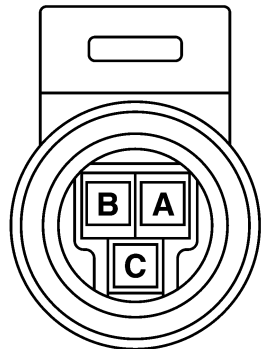
**Table 80. Throttle Position Sensor 1 Connector C006**



BM080625

Pin	Wire Color	Function
A	Light Green/Red	5 Volt Reference
B	Black/Light Green	Analog Return
C	Purple/Light Blue	Throttle Position Sensor 1

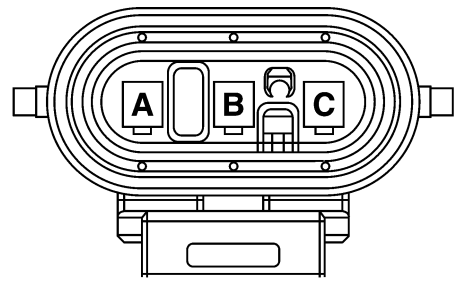
**Table 81. Foot Pedal Position Connector C006A**



BM080625

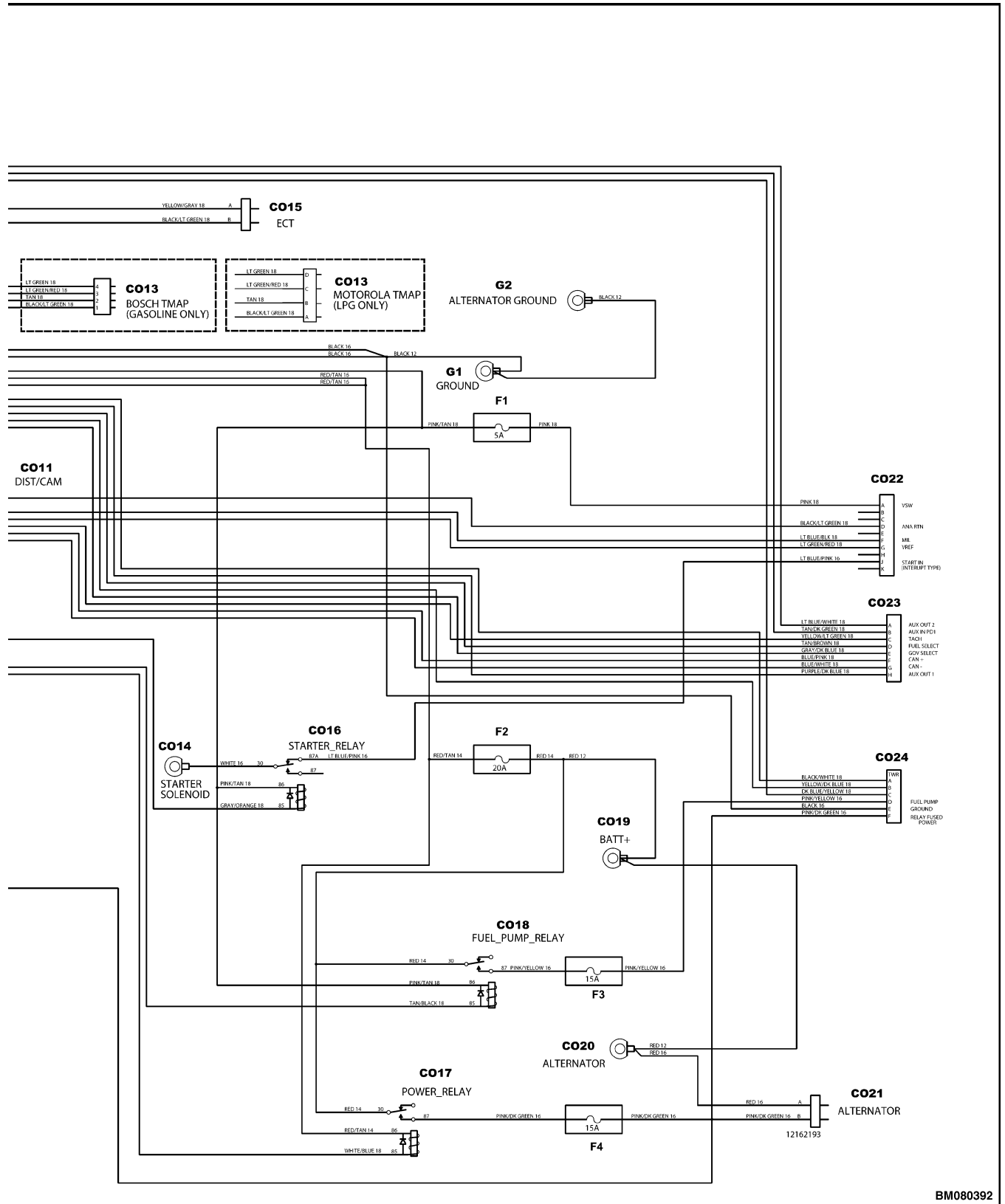
Pin	Wire Color	Function
A	Light Green/Red	5 Volt Reference
B	Black/Light Green	Analog Return
C	Dark Blue	Foot Pedal Position

**Table 82. Coil Connector C007**



BM080376

Pin	Wire Color	Function
A	Pink/Dark Green	EGO
B	Yellow/Black	Module
C	Not Used	Not Used



BM080392

Figure 60. 4.3L Main Harness

**Table 112. DTC 111 - IAT Voltage High (Motorola® TMAP)**

<b>Step</b>	<b>Action</b>	<b>Value(s)</b>	<b>Yes</b>	<b>No</b>
1	Did you perform the On-board diagnostics (OBD) system check?		Go to step 2.	Go to On-Board Diagnostics System Check/ Malfunction Indicator Lamp.
2	<ul style="list-style-type: none"> <li>• Key <b>ON</b>.</li> <li>• Laptop computer connected in system data mode.</li> </ul> Does laptop computer display IAT voltage of 4.95 or greater?		Go to step 3.	Intermittent problem. Go to Preliminary and Intermittent Checks.
3	<ul style="list-style-type: none"> <li>• Key <b>OFF</b>.</li> <li>• Disconnect the TMAP sensor connector from the wiring harness. Using a jumper, connect pins A and B together.</li> <li>• Turn the key to the <b>ON</b> position.</li> </ul> Does the laptop computer display IAT voltage of 0.1 volts or less?		Go to step 9.	Go to step 4.
4	<ul style="list-style-type: none"> <li>• Key <b>OFF</b>.</li> <li>• Using a jumper, connect TMAP sensor connector signal pin B to engine ground.</li> <li>• Turn the key to the <b>ON</b> position.</li> </ul> Does laptop computer display IAT voltage of 0.1 volts or less?		Go to step 7.	Go to step 6.
5	<ul style="list-style-type: none"> <li>• Replace TMAP sensor.</li> </ul> Is the replacement complete?		Go to step 11.	
6	<ul style="list-style-type: none"> <li>• Key <b>OFF</b>.</li> <li>• Disconnect the ECM wire harness connector.</li> <li>• Check for continuity between TMAP sensor connector signal pin B and ECM IAT signal pin 32.</li> </ul> Do you have continuity between them?		Go to step 10.	Repair the circuit as necessary. Refer to Wire Harness Repair.
7	<ul style="list-style-type: none"> <li>• Check for continuity between TMAP sensor connector ground circuit pin A and ECM sensor ground circuit pin 49.</li> </ul> Do you have continuity between them?		Go to step 10.	Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 11.
8	<ul style="list-style-type: none"> <li>• Replace the ECM.</li> </ul> Is the replacement complete?		Go to step 11.	

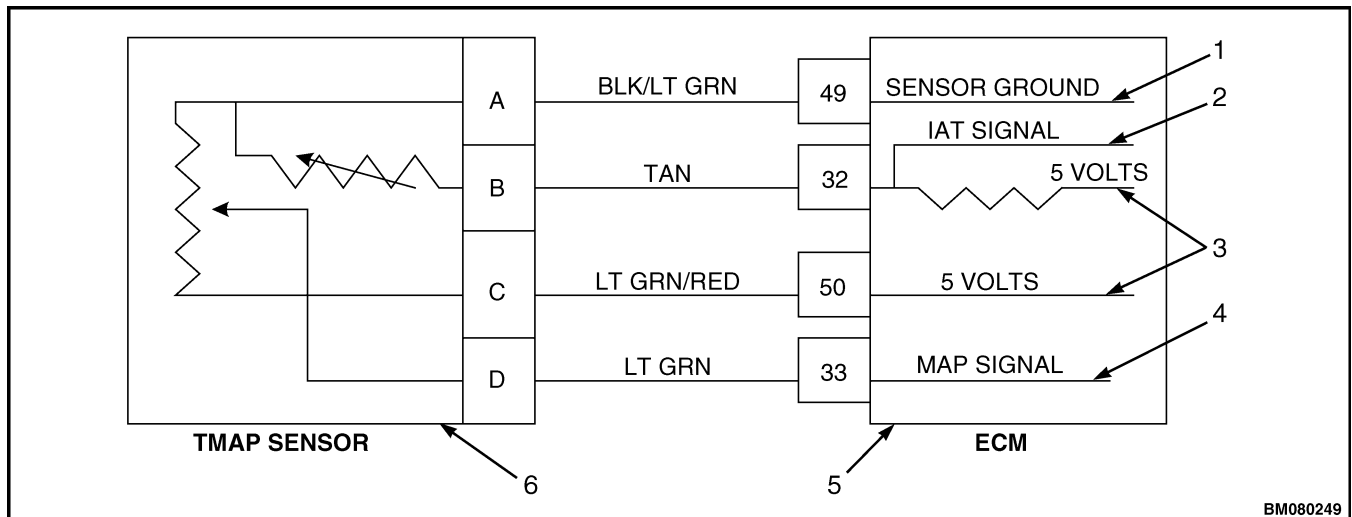
## DTC 114 - IAT HIGHER THAN EXPECTED 2 MOTOROLA® TMAP

### Circuit Description

The TMAP is a combined intake air temperature (IAT) and manifold absolute pressure (MAP) sensor. A temperature-sensitive resistor is used in the TMAP located in the intake manifold of the engine. It is used to monitor incoming air temperature; and the output, in conjunction with other sensors, is used to determine the airflow to the engine. The

ECM provides a voltage divider circuit so that when the air is cool, the signal reads higher voltage, and lower when warm. The IAT is a calculated value based mainly on the IAT sensor at high airflow, and influenced more by the engine coolant temperature (ECT) at low airflow. See Figure 71.

This fault will set if the intake air temperature is greater than 104.4°C (220°F) for 120 seconds and engine speed is greater than 1000 rpm. The MIL light will be on during this active fault and the engine will shut down.



1. SENSOR GROUND
2. INTAKE AIR TEMPERATURE (IAT) SIGNAL
3. 5 VOLTS
4. MANIFOLD ABSOLUTE PRESSURE (MAP) SIGNAL
5. ELECTRONIC CONTROL MODULE (ECM)
6. TEMPERATURE MANIFOLD ABSOLUTE PRESSURE (TMAP) SENSOR

**Figure 71. TMAP Sensor Circuit (Motorola® TMAP)**

### Conditions for Setting the DTC

- Intake air temperature.
- Check condition - engine running.
- Fault condition - intake air temperature greater than 104.4°C (220°F) for 120 seconds and engine speed is greater than 1000 rpm.
- MIL - on for active fault and for 15 seconds after active fault.
- Engine shut down.

### Diagnostic Aids

This fault will set when inlet air is much hotter than normal. The most common cause of high inlet air

temperature is a problem with the inlet air system. Ensure that the air inlet is not obstructed, modified, or damaged.

Inspect the air inlet system for cracks or breaks that may allow unwanted under hood air in to the air inlet system

If none of the above can be found, follow the diagnostic steps for DTC 112 - IAT Low Voltage Motorola® TMAP.

## DTC 123 - ECT HIGHER THAN EXPECTED 1

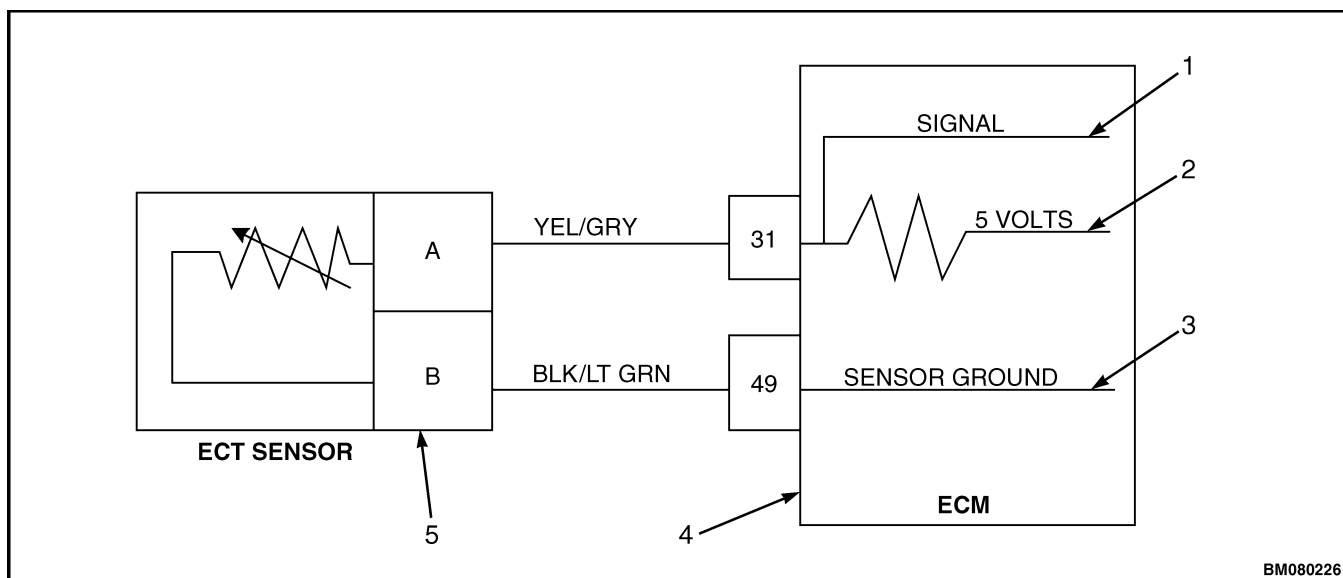
### Circuit Description

The engine coolant temperature (ECT) sensor is a temperature-sensitive resistor located in the engine coolant, near the thermostat. The ECT is used for engine airflow calculation, fuel enrichment, ignition timing control, to enable certain features, and for engine protection. The ECM provides a voltage divider circuit so when the sensor reading is cool the sensor reads higher voltage, and lower when warm. See Figure 75.

This fault will set when the coolant exceeds 104.4°C (220°F) for 60 seconds and engine speed exceeds 500 rpm.

### Conditions for Setting the DTC

- Engine coolant temperature.
- Check condition - engine running.
- Fault condition - engine coolant temperature reading or estimate greater than 144.4°C (220°F) for 60 seconds and engine speed is greater than 500 rpm.
- MIL - on.
- Adaptive - disabled during active fault.



1. SIGNAL
2. 5 VOLTS
3. SENSOR GROUND

4. ELECTRONIC CONTROL MODULE (ECM)
5. ENGINE COOLANT TEMPERATURE (ECT) SENSOR

*Figure 75. ECT Sensor Circuit*

## DTC 132 - MAP LOW VOLTAGE BOSCH® TMAP

### Circuit Description

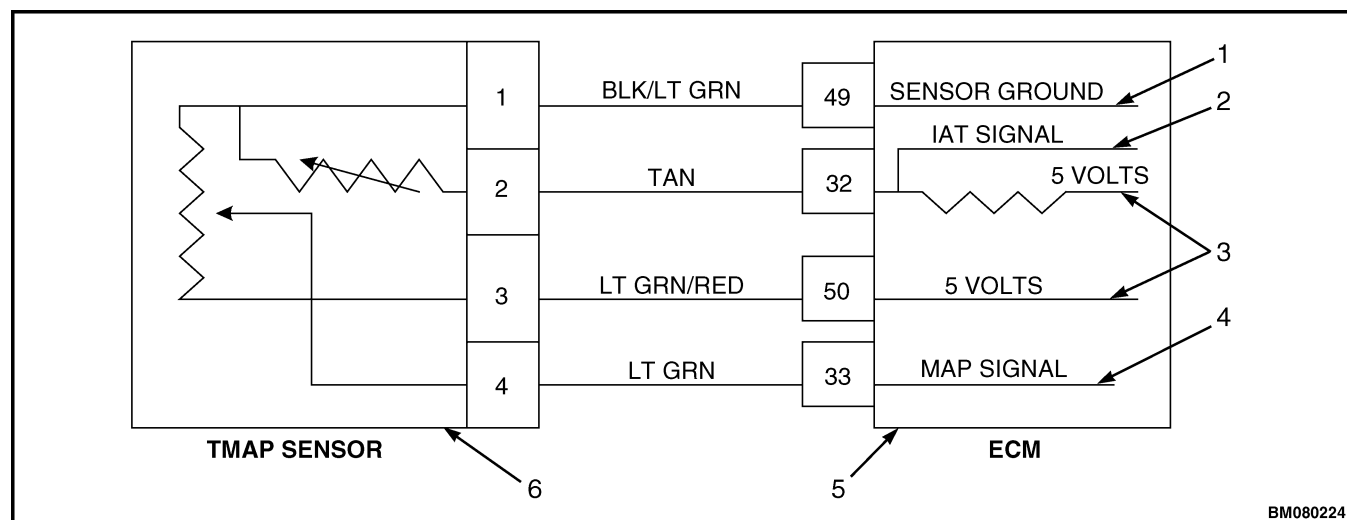
The manifold absolute pressure sensor is a pressure transducer connected to the intake manifold. It is used to measure the pressure of air in the manifold prior to induction into the engine. The pressure reading is used in conjunction with other inputs to determine the airflow rate to the engine, which determines the fuel flow rate. See Figure 79.

This fault will set when the MAP reading is lower than the sensor should normally produce. When this fault is set, the adaptive learn will be disabled for

the remainder of the key **ON** cycle and the MIL will be on. The fueling is then based on rpm and TPS limp-home condition.

### Conditions for Setting the DTC

- Manifold absolute pressure.
- Check condition - cranking or running.
- Fault condition - MAP voltage less than 0.05, throttle position greater than 2 percent, and engine speed is less than 7000 rpm.
- MIL - on for remainder of key **ON** cycle.
- Adaptive - disabled for remainder of key **ON** cycle.
- Miscellaneous - fueling is based on rpm and TPS limp-home condition during this fault.



1. SENSOR GROUND
2. INTAKE AIR TEMPERATURE (IAT) SIGNAL
3. 5 VOLTS
4. MANIFOLD ABSOLUTE PRESSURE (MAP) SIGNAL
5. ELECTRONIC CONTROL MODULE (ECM)
6. TEMPERATURE MANIFOLD ABSOLUTE PRESSURE (TMAP) SENSOR

**Figure 79. TMAP Sensor Circuit (Bosch® TMAP)**

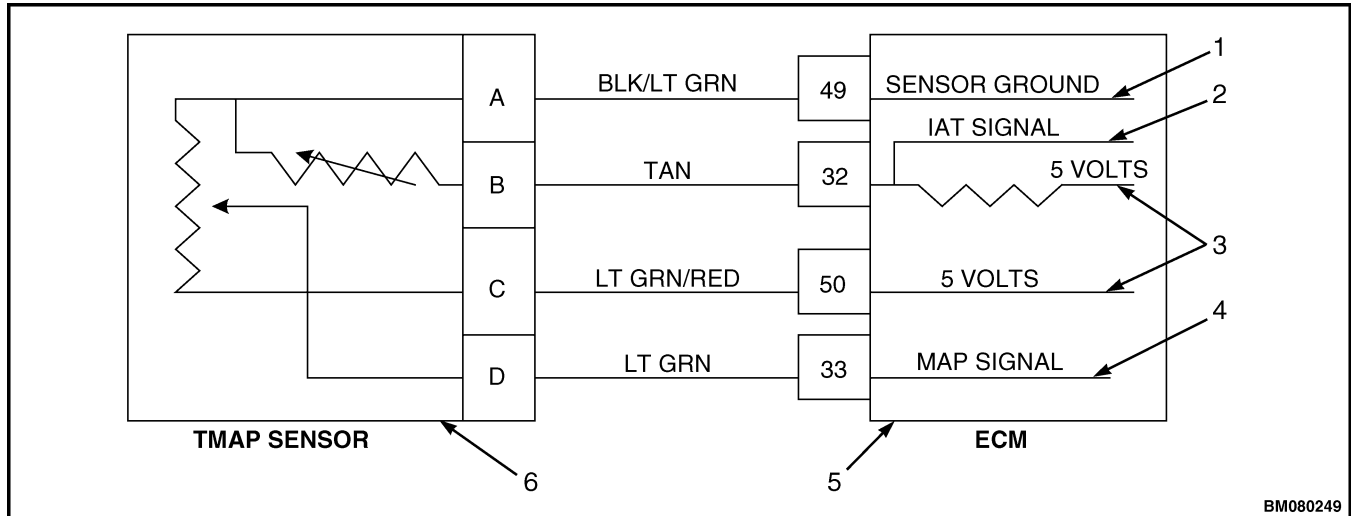
## DTC 134 - BP HIGH PRESSURE MOTOROLA® TMAP

### Circuit Description

The barometric pressure (BP) is estimated from the TMAP sensor. The barometric pressure value is used for fuel and airflow calculations. This fault will set if the BP pressure exceeds 16 psia for 1 second. MIL will be on and remain on for 2 seconds after the active fault. See Figure 82.

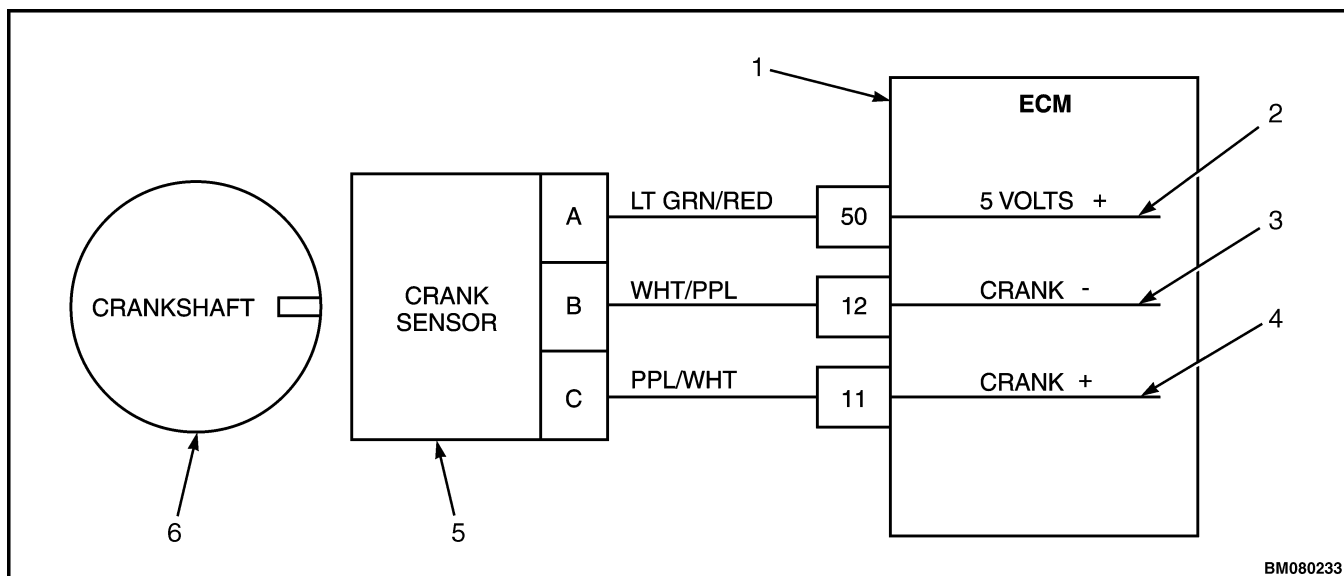
### Conditions for Setting the DTC

- Barometric pressure.
- Check condition - key ON.
- Fault condition - BP greater than 16 psia.
- MIL - on for active fault and for 2 seconds after active fault.
- Adaptive - disabled for remainder of key ON cycle.
- Closed loop - enabled.



- |  |   |
|--|---|
| 1. SENSOR GROUND                           | 5. ELECTRONIC CONTROL MODULE (ECM)                      |
| 2. INTAKE AIR TEMPERATURE (IAT) SIGNAL     | 6. TEMPERATURE MANIFOLD ABSOLUTE PRESSURE (TMAP) SENSOR |
| 3. 5 VOLTS                                 |   |
| 4. MANIFOLD ABSOLUTE PRESSURE (MAP) SIGNAL |   |

**Figure 82. TMAP Sensor Circuit (Motorola® TMAP)**



- 1. ELECTRONIC CONTROL MODULE (ECM)
- 2. 5 VOLTS +
- 3. CRANK -
- 4. CRANK +
- 5. CRANK SENSOR
- 6. CRANKSHAFT

**Figure 85. Crankshaft Position Sensor Circuit**

**Table 129. DTC 142 - Crank Sync Noise**

Step	Action	Value(s)	Yes	No
1	Did you perform the On-board diagnostics (OBD) system check?		Go to step 2.	Go to On-Board Diagnostics System Check/Malfunction Indicator Lamp.
2	<ul style="list-style-type: none"> <li>• Check that the ECM ground terminals G1 and G2 are clean and tight.</li> </ul> Are the ground terminals G1 and G2 clean and tight?		Go to step 3.	Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 11.
3	<ul style="list-style-type: none"> <li>• Key <b>ON</b> and engine <b>OFF</b>.</li> <li>• Disconnect the crankshaft position sensor (CKP) connector C009.</li> <li>• Using a DVOM check for voltage at the CKP sensor connector pin A and engine ground.</li> </ul> Do you have voltage?	5.0 volts	Go to step 4.	Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 11.
4	<ul style="list-style-type: none"> <li>• Key <b>OFF</b>.</li> <li>• Disconnect ECM connector C001.</li> <li>• Using a DVOM check for continuity between CKP connector pin B and ECM connector pin 12.</li> </ul> Do you have continuity between them?		Go to step 5.	Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 11.

Table 132. DTC 145 - Camshaft Sensor Noise (Continued)

Step	Action	Value(s)	Yes	No
3	<ul style="list-style-type: none"> <li>• Key <b>ON</b> and engine <b>OFF</b>.</li> <li>• Disconnect the CMP sensor connector C011.</li> <li>• Using a DVOM, check for voltage at the CMP sensor connector pin C and engine ground.</li> </ul> <p>Do you have voltage?</p>	5.0 volts	Go to step 4.	Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 11.
4	<ul style="list-style-type: none"> <li>• Key <b>OFF</b>.</li> <li>• Disconnect ECM connector C001.</li> <li>• Using a DVOM, check for continuity between CMP connector pin A and ECM connector pin 14.</li> </ul> <p>Do you have continuity between them?</p>		Go to step 5.	Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 11.
5	<ul style="list-style-type: none"> <li>• Using a DVOM, check for continuity between CMP connector pin B and ECM connector pin 13.</li> </ul> <p>Do you have continuity between them?</p>		Go to step 6.	Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 11.
6	<ul style="list-style-type: none"> <li>• Inspect the CMP connector C011 terminals for damage, corrosion or contamination.</li> </ul> <p>Did you find a problem?</p>		Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 11.	Go to step 7.
7	<ul style="list-style-type: none"> <li>• Inspect the ECM connector C001 terminals 13, 14, and 50 for damage, corrosion or contamination.</li> </ul> <p>Did you find a problem?</p>		Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 11.	Go to step 8.
8	<ul style="list-style-type: none"> <li>• Replace CMP sensor. Pay special attention to CMP sensor reluctor wheel inspection.</li> </ul> <p>Is the replacement complete?</p>		Go to step 10.	
9	<ul style="list-style-type: none"> <li>• Replace the ECM.</li> </ul> <p>Is the replacement complete?</p>		Go to step 11.	

*Table 135. DTC 221 - Closed Loop Multiplier High (Gasoline) (Continued)*

<b>Step</b>	<b>Action</b>	<b>Value(s)</b>	<b>Yes</b>	<b>No</b>
6	<ul style="list-style-type: none"> <li>• Replace HO<sub>2</sub>S sensor.</li> </ul> <p>Is the replacement complete?</p>		Go to step 7.	
7	<ul style="list-style-type: none"> <li>• Remove all test equipment except the laptop computer.</li> <li>• Connect any disconnected components, fuses, etc.</li> <li>• Using the laptop computer, clear DTC information from the ECM.</li> <li>• Turn the ignition <b>OFF</b> and wait 30 seconds.</li> <li>• Start the engine and operate the vehicle to full operating temperature.</li> <li>• Observe the MIL.</li> <li>• Observe engine performance and driveability.</li> <li>• After operating the engine within the test parameters of DTC 221, check for any stored codes.</li> </ul> <p>Does the engine operate normally with no stored codes?</p>		System OK.	Go to On-Board Diagnostics System Check/Malfunction Indicator Lamp.

Table 139. DTC 242 - Adaptive Rich Fault (Low Limit-Gasoline) (Continued)

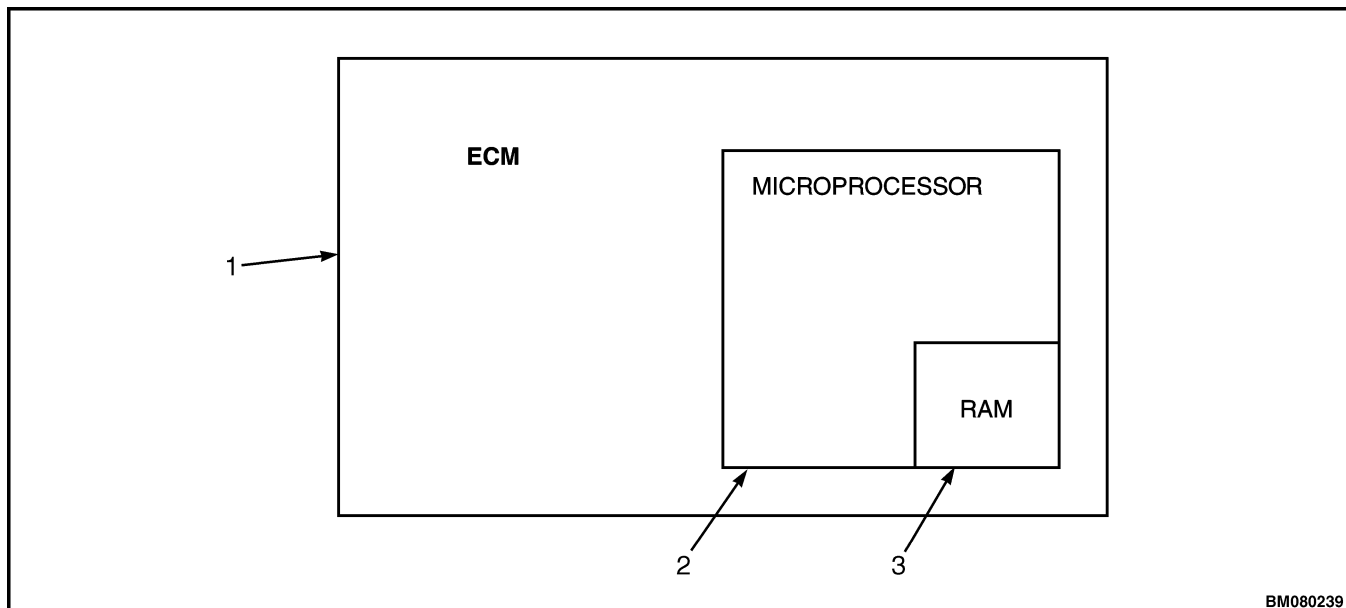
Step	Action	Value(s)	Yes	No
4	<ul style="list-style-type: none"> <li>• Key <b>OFF</b>.</li> <li>• Disconnect HO<sub>2</sub>S sensor wire harness connector.</li> <li>• Disconnect ECM wire harness connector.</li> <li>• Key <b>ON</b>.</li> <li>• Using a DVOM, check for voltage at HO<sub>2</sub>S connector signal pin B and engine ground.</li> </ul> <p>Do you have voltage?</p>		Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 6.	Go to step 5.
5	<ul style="list-style-type: none"> <li>• Replace HO<sub>2</sub>S sensor.</li> </ul> <p>Is the replacement complete?</p>		Go to step 6.	
6	<ul style="list-style-type: none"> <li>• Remove all test equipment except the laptop computer.</li> <li>• Connect any disconnected components, fuses, etc.</li> <li>• Using the laptop computer clear DTC information from the ECM.</li> <li>• Turn the ignition <b>OFF</b> and wait 30 seconds.</li> <li>• Start the engine and operate the vehicle to full operating temperature.</li> <li>• Observe the MIL.</li> <li>• Observe engine performance and driveability.</li> <li>• After operating the engine within the test parameters of DTC 242, check for any stored codes.</li> </ul> <p>Does the engine operate normally with no stored codes?</p>		System OK.	Go to On-Board Diagnostics System Check/Malfunction Indicator Lamp.

Table 143. DTC 262 - System Voltage Low (Continued)

Step	Action	Value(s)	Yes	No
2	<ul style="list-style-type: none"> <li>• Key <b>ON</b> and engine running.</li> <li>• Laptop computer connected in system data mode.</li> </ul> <p>Does laptop computer display system voltage greater than 9.0 volts?</p>		Intermittent problem. Go to Preliminary and Intermittent Checks.	Go to step 3.
3	<ul style="list-style-type: none"> <li>• Check battery condition.</li> </ul> <p>Is it OK?</p>		Go to step 4.	Replace battery. Go to step 8.
4	<ul style="list-style-type: none"> <li>• Check charging system.</li> </ul> <p>Is it OK?</p>		Go to step 5.	Repair charging system. Go to step 8.
5	<ul style="list-style-type: none"> <li>• Back probe ECM connector pins 22 and 23.</li> <li>• Measure voltage with DVOM between each pin and engine ground.</li> </ul> <p>Is the voltage greater than 9.0 volts?</p>		Repair ECM ground circuit. Refer to GM 4.3L Wiring Schematics and Connectors. Go to step 8.	Go to step 6.
6	<ul style="list-style-type: none"> <li>• Back probe ECM connector pins 19 and 20.</li> <li>• Measure voltage with DVOM between each pin and battery voltage.</li> </ul> <p>Is the voltage greater than 9.0 volts?</p>		Repair ECM power circuit. Refer to the GM 4.3L Wiring Schematics and Connectors. Go to step 8.	Go to step 7.
7	<ul style="list-style-type: none"> <li>• Replace ECM.</li> </ul> <p>Is the replacement complete?</p>		Go to step 8.	
8	<ul style="list-style-type: none"> <li>• Remove all test equipment except the laptop computer.</li> <li>• Connect any disconnected components, fuses, etc.</li> <li>• Using the laptop computer, clear DTC information from the ECM.</li> <li>• Turn the ignition <b>OFF</b> and wait 30 seconds.</li> <li>• Start the engine and operate the vehicle to full operating temperature.</li> <li>• Observe the MIL.</li> <li>• Observe engine performance and driveability.</li> <li>• After operating the engine within the test parameters of DTC 262, check for any stored codes.</li> </ul> <p>Does the engine operate normally with no stored codes?</p>		System OK.	Go to On-Board Diagnostics System Check/Malfunction Indicator Lamp.

**Table 148. DTC 515 - Flash Checksum Invalid**

<b>Step</b>	<b>Action</b>	<b>Value(s)</b>	<b>Yes</b>	<b>No</b>
1	Did you perform the On-board diagnostics (OBD) system check?		Go to step 2.	Go to On-Board Diagnostics System Check/Malfunction Indicator Lamp.
2	<ul style="list-style-type: none"> <li>• Key <b>ON</b> and engine running.</li> <li>• Laptop computer connected in system data mode.</li> <li>• Clear system fault code.</li> </ul> Does DTC 515 reset with the engine idling?		Go to step 3.	Intermittent problem. Go to Preliminary and Intermittent Checks.
3	<ul style="list-style-type: none"> <li>• Check all ECM power and ground circuits. Refer to GM 4.3L Wiring Schematics and Connectors.</li> </ul> Are the power and ground circuits OK?		Go to step 4.	Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 5.
4	<ul style="list-style-type: none"> <li>• Replace the ECM.</li> </ul> Is the replacement complete?		Go to step 5.	
5	<ul style="list-style-type: none"> <li>• Remove all test equipment except the laptop computer.</li> <li>• Connect any disconnected components, fuses, etc.</li> <li>• Using the laptop computer, clear DTC information from the ECM.</li> <li>• Turn the ignition <b>OFF</b> and wait 30 seconds.</li> <li>• Start the engine and operate the vehicle to full operating temperature.</li> <li>• Observe the MIL.</li> <li>• Observe engine performance and driveability.</li> <li>• After operating the engine within the test parameters of DTC 515, check for any stored codes.</li> </ul> Does the engine operate normally with no stored codes?		System OK.	Go to On-Board Diagnostics System Check/Malfunction Indicator Lamp.



BM080239

1. ELECTRONIC CONTROL MODULE (ECM)
2. MICROPROCESSOR
3. RAM

**Figure 109. ECM Microprocessor**

**Table 153. DTC 556 - RTI 3 Loss**

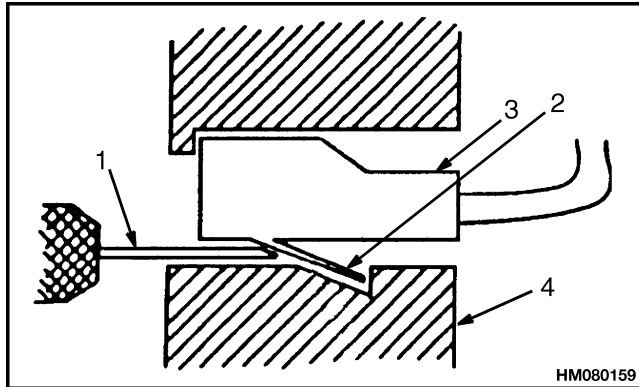
Step	Action	Value(s)	Yes	No
1	Did you perform the On-board diagnostics (OBD) system check?		Go to step 2.	Go to On-Board Diagnostics System Check/ Malfunction Indicator Lamp.
2	<ul style="list-style-type: none"> <li>• Key <b>ON</b> and engine running.</li> <li>• Laptop computer connected in system data mode.</li> <li>• Clear system fault code.</li> </ul> Does DTC 556 reset with the engine idling?		Go to step 3.	Intermittent problem. Go to Preliminary and Intermittent Checks.
3	<ul style="list-style-type: none"> <li>• Check all ECM power and ground circuits. Refer to GM 4.3L Wiring Schematics and Connectors.</li> </ul> Are the power and ground circuits OK?		Go to step 4.	Repair the circuit as necessary. Refer to Wire Harness Repair.

**Table 156. DTC 631 - TPS1 Signal Voltage High**

<b>Step</b>	<b>Action</b>	<b>Value(s)</b>	<b>Yes</b>	<b>No</b>
1	Did you perform the On-board diagnostics (OBD) system check?		Go to step 2.	Go to On-Board Diagnostics System Check/ Malfunction Indicator Lamp.
2	<ul style="list-style-type: none"> <li>• Key <b>ON</b> and engine <b>OFF</b>.</li> <li>• Laptop computer connected in system data mode.</li> </ul> <p>Does the laptop computer display TPS1 voltage of 4.8 volts or greater with the throttle closed.</p>		Go to step 4.	Go to step 3.
3	<ul style="list-style-type: none"> <li>• Slowly depress foot pedal while observing TPS1 voltage.</li> </ul> <p>Does TPS1 voltage ever exceed 4.8 volts?</p>		Go to step 4.	Intermittent problem. Go to Preliminary and Intermittent Checks.
4	<ul style="list-style-type: none"> <li>• Key <b>OFF</b>.</li> <li>• Disconnect TPS1 electrical connector.</li> <li>• Key <b>ON</b>.</li> </ul> <p>Does laptop computer display TPS1 voltage less than 0.2 volts?</p>		Go to step 7.	Go to step 5.
5	<ul style="list-style-type: none"> <li>• Key <b>OFF</b>.</li> <li>• Disconnect ECM wire harness connector.</li> <li>• Key <b>ON</b>.</li> <li>• Using a DVOM, check for voltage between TPS1 signal at the ECM connector pin 53 and engine ground.</li> </ul> <p>Do you have voltage?</p>		Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 11.	Go to step 6.
6	<ul style="list-style-type: none"> <li>• Replace the ECM.</li> </ul> <p>Is the replacement complete?</p>		Go to step 11.	
7	<ul style="list-style-type: none"> <li>• Back probe sensor ground circuit at the ECM side of the wire harness pin 49 with a test light connected to battery voltage.</li> </ul> <p>Does the test light come on?</p>		Go to step 8.	Go to step 10.
8	<ul style="list-style-type: none"> <li>• Inspect the TPS1 electrical connector terminals for damage, corrosion or contamination.</li> </ul> <p>Did you find a problem?</p>		Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 11.	Go to step 9.

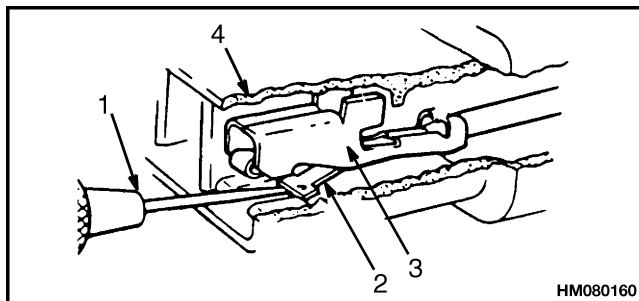
*Table 159. DTC 651 - Maximum Govern Speed Override (Continued)*

<b>Step</b>	<b>Action</b>	<b>Value(s)</b>	<b>Yes</b>	<b>No</b>
8	<ul style="list-style-type: none"> <li>• Check engine for large manifold vacuum leaks.</li> </ul> <p>Did you find and correct the vacuum leak?</p>		Go to step 9.	Go to On-Board Diagnostics System Check/Malfunction Indicator Lamp.
9	<ul style="list-style-type: none"> <li>• Remove all test equipment except the laptop computer.</li> <li>• Connect any disconnected components, fuses, etc.</li> <li>• Using the laptop computer, clear DTC information from the ECM.</li> <li>• Turn the ignition <b>OFF</b> and wait 30 seconds.</li> <li>• Start the engine and operate the vehicle to full operating temperature.</li> <li>• Observe the MIL.</li> <li>• Observe engine performance and driveability.</li> <li>• After operating the engine within the test parameters of DTC 651, check for any stored codes.</li> </ul> <p>Does the engine operate normally with no stored codes?</p>		System OK.	Go to On-Board Diagnostics System Check/Malfunction Indicator Lamp.



- 1. TOOL (PICK)
- 2. LOCK TAB
- 3. TERMINAL
- 4. CONNECTOR BODY

**Figure 121. Metri-Pack Push-to-Seat Connector**



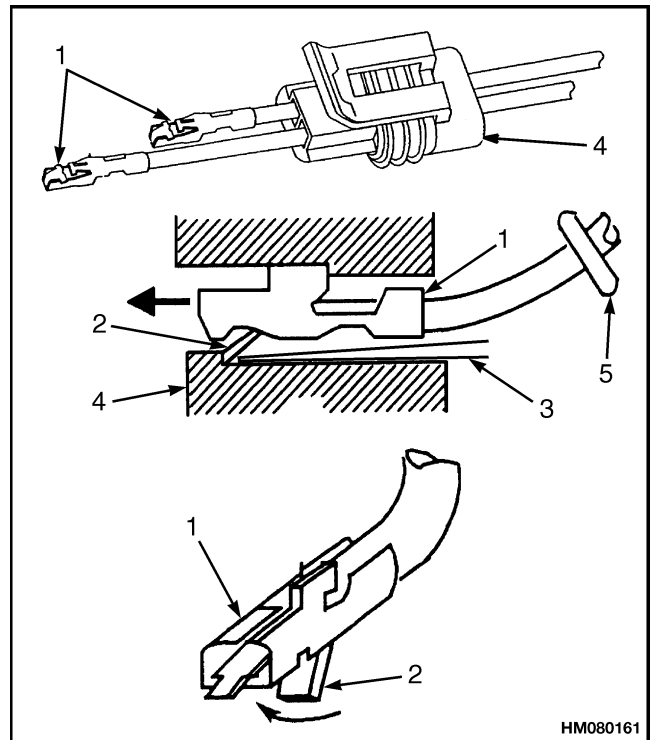
- 1. TOOL (PICK)
- 2. LOCK TAB
- 3. TERMINAL
- 4. CONNECTOR BODY

**Figure 122. Metri-Pack Pull-to-Seat Connector**

- 4. Use the removal tool to move the lock tab to release the terminal from its seat.

**Push-to-Seat** - Gently pull the wire to remove the terminal from the back of the connector.

**Pull-to-Seat** - Gently push the wire to remove the terminal through the front of the connector. See Figure 123.



- 1. TERMINAL
- 2. LOCK TAB
- 3. TOOL KIT
- 4. CONNECTOR BODY
- 5. SEAL

**Figure 123. Metri-Pack Pull-to-Seat Terminal Removal**

**CAUTION**

Work carefully and do not use enough force to damage the terminal or the connector.

- 5. Inspect the terminal and connector for damage. See Figure 124.

## Description

### DISTRIBUTOR IGNITION (DI) SYSTEM

The distributor ignition (DI) system is responsible for producing and controlling a high energy secondary spark. This spark is used to ignite the compressed air/fuel mixture at precisely the correct time. This provides optimal performance, fuel economy, and control of exhaust emissions. This ignition system consists of a single ignition coil and ignition control module (ICM). Spark energy is delivered via a distributor cap, rotor, and secondary spark plug wires. The driver module within the ICM is commanded to operate the coil by the electronic control module (ECM), that has complete control over spark timing. The DI system consists of a Crankshaft Position (CKP) Sensor, Camshaft Position (CMP) Sensor, Ignition Coil and Ignition Control Module (ICM), and Secondary Ignition Components.

### CRANKSHAFT POSITION (CKP) SENSOR

The CKP sensor is a three-wire sensor based on the magneto-resistive principle. A magneto-resistive sensor uses two magnetic pickups between a permanent magnet. As an element such as a reluctor wheel passes the magnets, the resulting change in the magnetic field is used by the sensor electronics to produce a digital output pulse. The ECM supplies a 5-volt, low reference and signal circuit to the CKP sensor. The sensor returns a digital ON/OFF pulse 3 times per crankshaft revolution. The CKP sensor

reads the crankshaft mounted reluctor wheel to identify pairs of cylinders at top dead center (TDC).

### CAMSHAFT POSITION (CMP) SENSOR

The CMP sensor is a hall-effect sensor located in the ignition distributor base, and uses the same type of circuits as the CKP sensor. The CMP sensor signal is a digital ON/OFF pulse, output once per revolution of the camshaft. The CMP sensor information is used by the ECM to determine the position of the valve train relative to the CKP.

### IGNITION COIL AND IGNITION CONTROL MODULE (ICM)

The ICM is connected to the ECM by an ignition control (IC) circuit. The ICM also has a ground circuit and shares an ignition 1 voltage supply with the ignition coil. The coil driver in the ICM controls current through the ignition coil based on signal pulses from the ECM. There is no backup or bypass function in the ICM.

### SECONDARY IGNITION COMPONENTS

The distributor is only used as a means to operate the CMP sensor and to distribute spark in the correct sequence. Since the distributor has no influence on base timing, the distributor is not adjustable. The spark is distributed through conventional carbon core wires to the spark plugs.

## Spark Plugs and Wires

### SPARK PLUG WIRE INSPECTION

Spark plug wire integrity is vital for proper engine operation. A thorough inspection will be necessary to accurately identify conditions that may affect engine operation. Inspect for the following conditions:

1. Correct routing of the spark plug wires. Incorrect routing may cause cross-firing.
2. Any signs of cracks or splits in the wires.
3. Inspect each boot for the following conditions:
  - Tearing
  - Piercing
  - Arcing
  - Carbon tracking
  - Corroded terminal

If corrosion, carbon tracking, or arcing are indicated on a spark plug wire boot or on a terminal, replace the wire and the component connected to the wire.

### SPARK PLUG WIRE REPLACEMENT

#### Remove

1. Disconnect the spark plug wire at each spark plug. See Figure 1.
  - a. Twist the boots 1/2 turn before removing the boots.
  - b. Pull only on the boot or use a tool designed for this purpose in order to remove the wire from each spark plug.

7. Once the distributor is completely seated, the rotor segment should be aligned with the mark on the distributor base.
  - If the rotor segment is not aligned with the mark, the driven gear teeth and the camshaft have meshed one or more teeth out of alignment.
  - In order to correct this condition, remove and reinstall the distributor.



### CAUTION

Late model engines use a combination of standard and metric fasteners. The components affected are the starter motor, engine mounts, and flywheel housing mounting. Other components may also have a combination of fasteners. Always verify that the proper fasteners are used whenever removing or replacing any components.

8. Install the distributor mounting clamp bolt. Tighten the bolt to 25 N•m (18 lbf ft). See Figure 20.
9. Install the distributor cap. See Figure 17.
10. Install the new distributor capscrews. Tighten the capscrews to 2.4 N•m (21 lbf in).
11. Install the electrical connector to the distributor.
12. Install the spark plug wires to the distributor cap.
13. Install the ignition coil wire. Note the correct orientation of the wire boot. See Figure 16.



### CAUTION

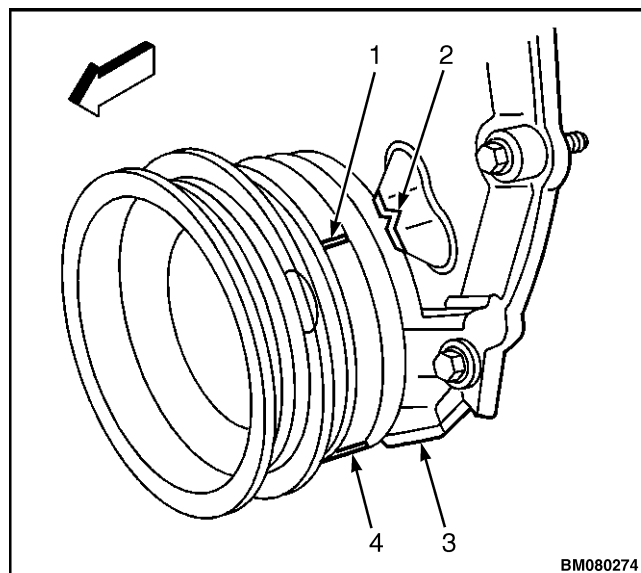
If the malfunction indicator lamp illuminates after installing the distributor and DTC P1345 is set, the distributor has been installed incorrectly.

14. Refer to Install Procedure 2 if the malfunction indicator lamp illuminates after installing the distributor.
15. Install the engine cover. Refer to the **Frame** section for your lift truck.

## Install Procedure 2

**NOTE:** Rotate the number 1 cylinder to top dead center (TDC) of the compression stroke. The engine front cover has 2 alignment tabs and the crankshaft balancer has 2 alignment marks spaced 90 degrees apart which are used for positioning the number 1 piston at TDC. See Figure 22. With the piston on the compression stroke and at TDC, the crankshaft balancer alignment mark (1) must align with the engine front cover tab (2) and the crankshaft balancer alignment mark (4) must align with the engine front cover tab (3).

1. Rotate the crankshaft balancer clockwise until the alignment marks on the crankshaft balancer are aligned with the tabs on the engine front cover and the number 1 piston is at TDC of the compression stroke. See Figure 22.



1. CRANKSHAFT BALANCER ALIGNMENT MARK
2. ENGINE FRONT COVER TAB
3. ENGINE FRONT COVER TAB
4. CRANKSHAFT BALANCER ALIGNMENT MARK

**Figure 22. Crankshaft Balancer and Engine Front Cover Alignment Marks**

2. Align the white paint mark on the bottom stem of the distributor and the pre-drilled indent hole in the bottom of the gear. See Figure 7.

They are also called pull-to-seat terminals because to install a terminal on a wire, the wire is first inserted through the seal and connector. The terminal is then crimped on the wire and the terminal pulled back into the connector to seat it in place.

**Remove**

1. Slide the seal back on the wire.
2. Hold the wire and use it to push the terminal to its forward position in the connector body. Hold the terminal in this position. See Figure 39.
3. Find the lock tab for the terminal in the connector channel. Push a removal tool (pick) of the correct size into the connector channel. See Figure 40 and Figure 41.

4. Use the removal tool to move the lock tab to release the terminal from its seat.

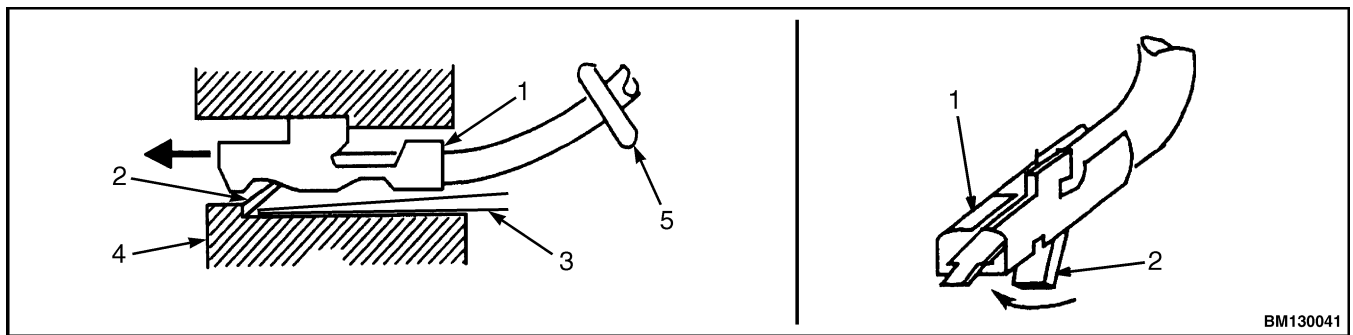
**Push-to-Seat** - Gently pull the wire to remove the terminal from the back of the connector.

**Pull-to-Seat** - Gently push the wire to remove the terminal through the front of the connector. See Figure 42.

**CAUTION**

**Work carefully and do not use enough force to damage the terminal or the connector.**

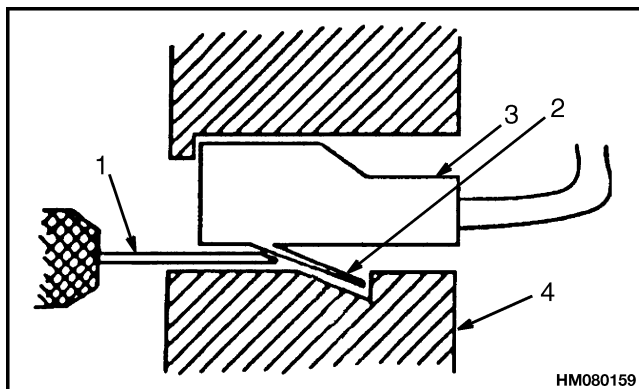
5. Inspect the terminal and connector for damage. See Figure 43.



1. FEMALE TERMINAL
2. LOCKING TAB
3. HYSTER TOOL KIT HYS1004

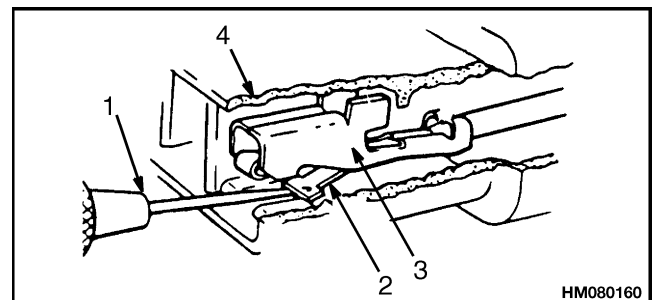
4. CONNECTOR BODY
5. SEAL

**Figure 39. Metri-Pack Terminal Removal**



1. TOOL (PICK)
2. LOCK TAB
3. TERMINAL
4. CONNECTOR BODY

**Figure 40. Metri-Pack Push-to-Seat Connector**



1. TOOL (PICK)
2. LOCK TAB
3. TERMINAL
4. CONNECTOR BODY

**Figure 41. Metri-Pack Pull-to-Seat Connector**

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